

# INDIRA GANDHI UNIVERSITY

Meerpur-Rewari, Haryana (122502)

(A State University Established under Haryana Act No. 29 of 2013)

(Recognized u/s 12(B) & 2(f) of UGC Act, 1956)

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## SCHEME OF EXAMINATION & SYLLABI

in accordance with National Education Policy-2020

Curriculum and Credit Framework for Undergraduate Programmes  
(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF)

for

**Undergraduate Programme**

**Subject: Physics**

Effective from Academic Session: 2026-27 (in phased manner)

**DEPARTMENT OF PHYSICS**

Indira Gandhi University  
Meerpur-Rewari (122502)  
Haryana, India



## DETAILS OF APPROVALS

| Council/Board    | Date       | Remark              |
|------------------|------------|---------------------|
| Staff Council    | 24/07/2026 |                     |
| Board of Studies | 29/07/2026 | Through Circulation |
| Faculty          |            |                     |
| Academic Council |            |                     |

  
**CHAIRPERSON**  
DEPARTMENT OF PHYSICS  
INDIRA GANDHI UNIVERSITY  
MIRJAPUR, BHOWALI-122502  


**Chairperson**

**(Signature with Stamp)**

# VISION AND MISSION OF THE UNIVERSITY

## VISION

To be a globally renowned university, recognized for excellence in teaching, innovative research and welfare of the society, imbibing the spirit of “*Vasudhaiv kutumbkam*”.

## MISSION

- To introduce and implement innovation in teaching and learning process matching up the global standards to strengthen academic delivery through curriculum design, teaching pedagogy and usage of ICT.
- To develop a mechanism that attracts talented, qualified and experienced faculty from across the globe for pursuing their academic and research careers at the University.
- To offer academic programmes at UG, PG, Doctoral, Post-Doctoral levels which are learner-centric, industry focused and adhere to outcome based international models.
- To create an ambiance that is conducive for undertaking sponsored research, innovation and consultancy services to a wide spectrum of societal and industrial requirements while encouraging interdisciplinary approach of learning, team work and research.
- To establish state of art centres of excellence in frontier areas of research and design innovation through industry collaboration to innovate and incubate the products and services.
- To establish smart campus and promote e-governance activities in the university for the digitally empowered society and knowledge economy.
- To provide a hygienic, modern, environment friendly and vivacious campus attuned to the urgent needs of Green Technology.
- To consider and implement norms, metrics, standards, procedures and benchmarks for assessing and improving the quality in every aspect of University system and achieve quality certifications by National and International bodies.
- To make society self-reliant by organizing various programmes including literacy, gender sensitization, health awareness and dissemination of information about livelihood generation.

## **VISION AND MISSION OF THE DEPARTMENT**

### **Vision**

To be a nationally and internationally recognized center of excellence in Physics education and research, fostering scientific curiosity, innovation, and critical thinking to address global challenges and contribute meaningfully to society and technology.

### **Mission**

1. To provide high-quality education in Physics through a balanced blend of theoretical foundation, experimental training, and computational skills.
2. To promote cutting-edge research in frontier areas such as condensed matter physics, photonics, quantum physics, nuclear and particle physics, and interdisciplinary fields.
3. To nurture scientific temper, analytical thinking, and problem-solving abilities among students through student-centric, inquiry-based, and experiential learning.
4. To establish state-of-the-art laboratories, computational facilities, and smart classrooms to support teaching and research excellence.
5. To foster industry-academia collaboration through internships, workshops, conferences, and industrial/research visits.
6. To encourage and support students to qualify in national-level competitive examinations such as JAM, CSIR-NET, GATE, and JEST, and to pursue careers in academia, research, and industry.
7. To create an inclusive and ethically responsible academic environment that prepares students to be self-reliant global citizens and contributors to scientific advancement.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

|             |                                                                                                                                                                                                                                                                                                                           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PEO1</b> | <b>Core Competence &amp; Practical Application</b> Graduates will actively contribute to scientific, industrial, or educational sectors by applying their foundational knowledge, technical data management skills, and practical lab techniques to support ongoing projects and resolve standard operational challenges. |
| <b>PEO2</b> | <b>Continued Education &amp; Professional Growth</b> Graduates will continue to build upon their undergraduate foundation by successfully pursuing higher education (such as Master's or professional degree programs), specialized certifications, or continuous workplace training.                                     |
| <b>PEO3</b> | <b>Teamwork &amp; Technical Communication</b> Graduates will function effectively as collaborative and dependable team members in diverse environments, assisting in the execution of technical projects and clearly communicating scientific results to peers and supervisors.                                           |
| <b>PEO4</b> | <b>Professional Ethics &amp; Social Awareness</b> Graduates will uphold ethical standards and professional integrity in their daily tasks, maintaining an awareness of how their scientific practices and technical contributions impact the environment and local communities.                                           |

## PROGRAMME LEARNING OBJECTIVES (PLOs)

|             |                                                                                                                                                                                                                                              |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PLO1</b> | <b>Disciplinary Knowledge:</b> Apply fundamental concepts, principles, and theories of the discipline to understand phenomena and their applications.                                                                                        |
| <b>PLO2</b> | <b>Effective Communication:</b> Communicate ideas, methods, and results effectively through oral, written, graphical, and digital formats.                                                                                                   |
| <b>PLO3</b> | <b>Teamwork &amp; Collaboration:</b> Function effectively as an individual, team member, or leader in multidisciplinary and collaborative environments.                                                                                      |
| <b>PLO4</b> | <b>Social Responsibility &amp; Ethical Awareness:</b> Apply methods and reasoning appropriate to the discipline to assess issues related to society and the consequent responsibilities relevant to professional practice.                   |
| <b>PLO5</b> | <b>Lifelong Learning:</b> Engage in self-directed learning and adapt to emerging knowledge, technologies, and professional demands throughout life.                                                                                          |
| <b>PLO6</b> | <b>Integrity &amp; Professional Ethics:</b> Demonstrate integrity, ethical conduct, and professional responsibility in academic, research/practice, and professional activities.                                                             |
| <b>PLO7</b> | <b>Scientific Inquiry and Research Skills:</b> Apply the scientific method to identify problems, conduct experiments or theoretical investigations, collect and analyze data, and interpret results using appropriate scientific approaches. |

|              |                                                                                                                                                                                   |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PLO8</b>  | <b>Problem Solving:</b> Identify, analyze, and solve scientific problems using logical reasoning, quantitative methods, and appropriate scientific tools and techniques.          |
| <b>PLO9</b>  | <b>Critical and Analytical Thinking:</b> Evaluate scientific information critically, interpret experimental data, and draw evidence-based conclusions using analytical reasoning. |
| <b>PLO10</b> | <b>Scientific Tools &amp; Techniques:</b> Use and learn scientific instruments, techniques, skills, and modern tools relevant to physical sciences practice.                      |
| <b>PLO11</b> | <b>Application &amp; Project Management:</b> Apply knowledge and understanding of the principles of physical sciences and undertake basic projects.                               |

# Indira Gandhi University, Meerpur, Rewari

## Scheme of Examination for the Physics Subject in Undergraduate Programmes

as per NEP 2020 Curriculum and Credit Framework for Undergraduate Programmes

(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF) with effect from the session 2026-27 (in a phased manner)

## Semester-1

\*L: Lecture, T: Tutorial, P: Practical, Th: Theory

| Semester                                         | Course Type | Applicable Scheme | Course Code                                                                                               | Nomenclature of the Course      | Theory (Th)/ Practical (P) | Credit | Contact hours per week (L+T+P=Total) | Internal Assessment Marks (Th+P=Total) | End Term Examination Marks (Th+P=Total) | Total Marks | Exam Hours Theory, Practical |
|--------------------------------------------------|-------------|-------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------|----------------------------|--------|--------------------------------------|----------------------------------------|-----------------------------------------|-------------|------------------------------|
| 1                                                | CC-1/MCC-1  | A, B & C          | 26L4.5-PHY-101                                                                                            | Mechanics                       | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th),<br>2 Hours (P) |
|                                                  | MCC-2       | C                 | 26L4.5-PHY-102                                                                                            | Mathematical Methods in Physics | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th),<br>2 Hours (P) |
|                                                  | *CC-M1      | A & B             | 26L4.5-PHY-103                                                                                            | Elementary Mechanics            | 1T / 1P                    | 2      | 1+0+2=3                              | 5+5=10                                 | 20+20=40                                | 50          | 2 Hours (Th),<br>2 Hours (P) |
|                                                  | CC-M1       | C                 | From Available CC-1/MCC-1 of 4 credits as per NEP                                                         |                                 |                            | 4      |                                      |                                        |                                         |             |                              |
|                                                  | MDC-1       | A, B & C          | From Available pool of Multidisciplinary Courses (MDC) from a subject of different discipline as per NEP. |                                 |                            | 3      |                                      |                                        |                                         |             |                              |
|                                                  | AEC-1       | A, B & C          | From Available pool of Ability Enhancement Courses (AEC) as per NEP                                       |                                 |                            | 2      |                                      |                                        |                                         |             |                              |
|                                                  | SEC-1       | A, B & C          | From Available pool of Skill Enhancement Courses (SEC) as per NEP                                         |                                 |                            | 3      |                                      |                                        |                                         |             |                              |
|                                                  | VAC-1       | A, B & C          | From Available pool of Value Added Courses (VAC) as per NEP                                               |                                 |                            | 2      |                                      |                                        |                                         |             |                              |
| *For students who opt Physics as a minor subject |             |                   |                                                                                                           |                                 |                            |        |                                      |                                        |                                         |             |                              |

## Semester-2

| Semester                                                                                | Course Type | Applicable Scheme | Course Code                                                                                              | Nomenclature of the Course                    | Theory (Th)/ Practical (P) | Credit | Contact hours per week (L+T+P=Total) | Internal Assessment Marks (Th+P=Total) | End Term Examination Marks (Th+P=Total) | Total Marks | Exam Hours Theory, Practical |
|-----------------------------------------------------------------------------------------|-------------|-------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------|----------------------------|--------|--------------------------------------|----------------------------------------|-----------------------------------------|-------------|------------------------------|
| 2                                                                                       | CC-2 /MCC-3 | A, B & C          | 26L4.5-PHY-201                                                                                           | Electricity, Magnetism & EM Theory            | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th),<br>2 Hours (P) |
|                                                                                         | *CC-M2      | A, B              | 26L4.5-PHY-202                                                                                           | Elementary Electricity, Magnetism & EM theory | 1T / 1P                    | 2      | 1+0+2=3                              | 5+5=10                                 | 20+20=40                                | 50          | 2 Hours (Th),<br>2 Hours (P) |
|                                                                                         | DSEC-1      | C                 | 26L4.5-PHY-203                                                                                           | Computational Physics                         | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th),<br>2 Hours (P) |
|                                                                                         | CC-M2       | C                 | From Available CC-2/MCC-3 of 4 credits as per NEP                                                        |                                               |                            | 4      |                                      |                                        |                                         |             |                              |
|                                                                                         | MDC-2       | A, B & C          | From Available pool of Multidisciplinary Courses (MDC) from a subject of different discipline as per NEP |                                               |                            | 3      |                                      |                                        |                                         |             |                              |
|                                                                                         | AEC-2       | A, B & C          | From Available pool of Ability Enhancement Courses (AEC) as per NEP                                      |                                               |                            | 2      |                                      |                                        |                                         |             |                              |
|                                                                                         | SEC-2       | A, B & C          | From Available pool of Skill Enhancement Courses (SEC) as per NEP                                        |                                               |                            | 3      |                                      |                                        |                                         |             |                              |
|                                                                                         | VAC-2       | A, B & C          | From Available pool of Value Added Courses (VAC) as per NEP                                              |                                               |                            | 2      |                                      |                                        |                                         |             |                              |
|                                                                                         | Internship  | A, B & C          | Internship of 4 Credits of 4-6 weeks duration after 2 <sup>nd</sup> Semester (Mandatory in case of exit) |                                               |                            | 4      |                                      |                                        |                                         |             | 100                          |
| Note: Exit provisions shall be applicable as per <a href="#">University ordinance</a> . |             |                   |                                                                                                          |                                               |                            |        |                                      |                                        |                                         |             |                              |

## Semester-3

| Semester | Course Type | Applicable Scheme | Course Code                                                                                              | Nomenclature of the Course      | Theory (Th)/ Practical (P) | Credit | Contact hours per week (L+T+P=Total) | Internal Assessment Marks (Th+P=Total) | End Term Examination Marks (Th+P=Total) | Total Marks | Exam Hours Theory, Practical |
|----------|-------------|-------------------|----------------------------------------------------------------------------------------------------------|---------------------------------|----------------------------|--------|--------------------------------------|----------------------------------------|-----------------------------------------|-------------|------------------------------|
| 3        | CC-3/ MCC-4 | A, B & C          | 26L5.0-PHY-301                                                                                           | Thermal Physics                 | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th), 2 Hours (P)    |
|          | MCC-5       | B & C             | 26L5.0-PHY-303                                                                                           | Classical Mechanics             | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th), 2 Hours (P)    |
|          | MCC-2       | B                 | 26L4.5-PHY-102                                                                                           | Mathematical Methods in Physics | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th), 2 Hours (P)    |
|          | CC-M3       | A & C             | From Available CC-3/MCC-4 of 4 credits as per NEP                                                        |                                 |                            | 4      |                                      |                                        |                                         |             |                              |
|          | CC-M3(V)    | B                 | From Available pool of Minor (Vocational) Courses VOC-1                                                  |                                 |                            | 4      |                                      |                                        |                                         |             |                              |
|          | MDC-3       | A, B & C          | From Available pool of Multidisciplinary Courses (MDC) from a subject of different discipline as per NEP |                                 |                            | 3      |                                      |                                        |                                         |             |                              |
|          | AEC-3       | A, B & C          | From Available pool of Ability Enhancement Courses (AEC) as per NEP                                      |                                 |                            | 2      |                                      |                                        |                                         |             |                              |
|          | SEC-3       | A, B & C          | From Available pool of Skill Enhancement Courses (SEC) as per NEP                                        |                                 |                            | 3      |                                      |                                        |                                         |             |                              |
|          | VAC-3       | A, B & C          | From Available pool of Value Added Courses (VAC) as per NEP                                              |                                 |                            | 2      |                                      |                                        |                                         |             |                              |

## Semester-4

| Semester   | Course Type           | Applicable Scheme                                                                                                                       | Course Code                                                         | Nomenclature of the Course     | Theory (Th)/ Practical (P) | Credit | Contact hours per week (L+T+P=Total) | Internal Assessment Marks (Th+P=Total) | End Term Examination Marks (Th+P=Total) | Total Marks | Exam Hours Theory, Practical |
|------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------|----------------------------|--------|--------------------------------------|----------------------------------------|-----------------------------------------|-------------|------------------------------|
| 4          | CC-4/<br>MCC-6        | A, B & C                                                                                                                                | 26L5.0-PHY-401                                                      | Waves and Optics               | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th),<br>2 Hours (P) |
|            | MCC-7                 | B & C                                                                                                                                   | 26L5.0-PHY-402                                                      | Introductory Quantum Mechanics | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th),<br>2 Hours (P) |
|            | MCC-8                 | B & C                                                                                                                                   | 26L5.0-PHY-403                                                      | Atomic Spectroscopy            | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th),<br>2 Hours (P) |
|            | DSE-1<br>(Choose one) | B & C                                                                                                                                   | 26L5.0-PHY-404                                                      | Laser Physics and Fiber Optics | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th),<br>2 Hours (P) |
|            |                       |                                                                                                                                         | 26L5.0-PHY-405                                                      | Physics of Nano Materials      |                            |        |                                      |                                        |                                         |             |                              |
|            | CC-M4(V)              | A & C                                                                                                                                   | From Available pool of Minor (Vocational) Courses VOC-1             |                                |                            |        | 4                                    |                                        |                                         |             |                              |
|            | CC-M4(V)              | B                                                                                                                                       | From Available pool of Minor (Vocational) Courses VOC-2             |                                |                            |        | 4                                    |                                        |                                         |             |                              |
|            | AEC-4                 | A, B & C                                                                                                                                | From Available pool of Ability Enhancement Courses (AEC) as per NEP |                                |                            |        | 2                                    |                                        |                                         |             |                              |
|            | VAC-3                 | A, B                                                                                                                                    | From Available pool of Value Added Courses (VAC) as per NEP         |                                |                            |        | 2                                    |                                        |                                         |             |                              |
|            | VAC-4                 | C                                                                                                                                       | From Available pool of Value Added Courses (VAC) as per NEP         |                                |                            |        | 2                                    |                                        |                                         |             |                              |
| Internship | A, B & C              | Internship of 4 Credits of 4-6 weeks duration after 4th Semester (Mandatory in case of exit if not done after 2 <sup>nd</sup> Semester) |                                                                     |                                |                            | 4      |                                      |                                        |                                         | 100         |                              |

**Note:** Exit provisions shall be applicable as per [University ordinance](#).

## Semester-5

| Semester                                                                                                                                                              | Course Type           | Applicable Scheme | Course Code                                                                    | Nomenclature of the Course             | Theory (Th)/ Practical (P) | Credit | Contact hours per week (L+T+P=Total) | Internal Assessment Marks (Th+P=Total) | End Term Examination Marks (Th+P=Total) | Total Marks | Exam Hours Theory, Practical |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------|--------------------------------------------------------------------------------|----------------------------------------|----------------------------|--------|--------------------------------------|----------------------------------------|-----------------------------------------|-------------|------------------------------|--|
| 5                                                                                                                                                                     | CC-5/MCC-9            | A, B & C          | 26L5.5-PHY-501                                                                 | Modern Physics                         | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th), 2 Hours (P)    |  |
|                                                                                                                                                                       | MCC-10                | B & C             | 26L5.5-PHY-502                                                                 | Nuclear Physics                        | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th), 2 Hours (P)    |  |
|                                                                                                                                                                       | DSE-2<br>(Choose one) | B & C             | 26L5.5-PHY-503                                                                 | Environmental Physics                  | 4T / 0P                    | 4      | 4+0+0=4                              | 30+0=30                                | 70+0=70                                 | 100         | 3 Hours (Th)                 |  |
|                                                                                                                                                                       |                       | B & C             | 26L5.5-PHY-504                                                                 | Non-Linear Dynamics                    |                            |        |                                      |                                        |                                         |             |                              |  |
|                                                                                                                                                                       | DSE-3<br>(Choose one) | B & C             | 26L5.5-PHY-505                                                                 | Instrumentation and Analytical Methods | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th), 2 Hours (P)    |  |
|                                                                                                                                                                       |                       | B & C             | 26L5.5-PHY-506                                                                 | Renewable Energy and Energy Harvesting |                            |        |                                      |                                        |                                         |             |                              |  |
|                                                                                                                                                                       | CC-M5(V)              | A & C             | From Available pool of Minor (Vocational) Courses VOC-2                        |                                        |                            |        | 4                                    |                                        |                                         |             |                              |  |
|                                                                                                                                                                       | Internship            | A, B & C          | Internship of 4 Credits of 4-6 weeks duration (After 4 <sup>th</sup> Semester) |                                        |                            |        | 4                                    |                                        |                                         |             | 100                          |  |
| 4 credits of summer internship (earned post-semester 2 or 4) will be taken into account in the 5th semester for 3rd-year UG students who did not take an exit option. |                       |                   |                                                                                |                                        |                            |        |                                      |                                        |                                         |             |                              |  |

## Semester-6

| Semester | Course Type           | Applicable Scheme | Course Code                                                 | Nomenclature of the Course         | Theory (Th)/ Practical (P) | Credit | Contact hours per week (L+T+P=Total) | Internal Assessment Marks (Th+P=Total) | End Term Examination Marks (Th+P=Total) | Total Marks | Exam Hours Theory, Practical |
|----------|-----------------------|-------------------|-------------------------------------------------------------|------------------------------------|----------------------------|--------|--------------------------------------|----------------------------------------|-----------------------------------------|-------------|------------------------------|
| 6        | MCC-11                | A, B & C          | 26L5.5-PHY-601                                              | Electronics                        | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th), 2 Hours(P)     |
|          | MCC-12                | B & C             | 26L5.5-PHY-602                                              | Solid State Physics-I              | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th), 2 Hours(P)     |
|          | DSE-4<br>(Choose one) | B & C             | 26L5.5-PHY-603                                              | Radiation Physics                  | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th), 2 Hours(P)     |
|          |                       | B & C             | 26L5.5-PHY-604                                              | Material Science                   |                            |        |                                      |                                        |                                         |             |                              |
|          | DSE-5<br>(Choose one) | B & C             | 26L5.5-PHY-605                                              | Nuclear and Particle Physics       | 3T / 1P                    | 4      | 3+0+2=5                              | 25+5=30                                | 50+20=70                                | 100         | 3 Hours (Th), 2 Hours(P)     |
|          |                       | B & C             | 26L5.5-PHY-606                                              | Modern Characterization Techniques |                            |        |                                      |                                        |                                         |             |                              |
|          | CC-M6                 | A                 | From Available CC-6/MCC-11 of 4 credits as per NEP          |                                    |                            |        | 4                                    |                                        |                                         |             |                              |
|          | CC-M5(V)              | B                 | From Available pool of Minor (Vocational) Courses VOC-3     |                                    |                            |        | 4                                    |                                        |                                         |             |                              |
|          | CC-M6(V)              | C                 |                                                             |                                    |                            |        |                                      |                                        |                                         |             |                              |
|          | CC-M7(V)              | A                 |                                                             |                                    |                            |        |                                      |                                        |                                         |             |                              |
|          | SEC-4                 | C                 | From Available pool of Skill Enhancement Courses as per NEP |                                    |                            |        | 2                                    |                                        |                                         |             |                              |

**Note:** Exit provisions shall be applicable as per [University ordinance](#).

## Semester-7

| Semester | Course Type           | Applicable Scheme | Course Code                                                          | Nomenclature of the Course         | Theory (Th)/ Practical (P) | Credit | Contact hours per week (L+T+P=Total) | Internal Assessment Marks (Th+P=Total) | End Term Examination Marks (Th+P=Total) | Total Marks | Exam Hours Theory, Practical |
|----------|-----------------------|-------------------|----------------------------------------------------------------------|------------------------------------|----------------------------|--------|--------------------------------------|----------------------------------------|-----------------------------------------|-------------|------------------------------|
| 7        | CC-H1                 | B & C             | 26L6.0-PHY - 701                                                     | Mathematical Physics               | 4T / 0P                    | 4      | 4+0+0=4                              | 30+0=30                                | 70+0=70                                 | 100         | 3 Hours (Th)                 |
|          | CC-H2                 | B & C             | 26L6.0-PHY - 702                                                     | Classical Mechanics and Relativity | 4T / 0P                    | 4      | 4+0+0=4                              | 30+0=30                                | 70+0=70                                 | 100         | 3 Hours (Th)                 |
|          | CC-H3                 | B & C             | 26L6.0-PHY - 703                                                     | Quantum Mechanics-I                | 4T / 0P                    | 4      | 4+0+0=4                              | 30+0=30                                | 70+0=70                                 | 100         | 3 Hours (Th)                 |
|          | DSE-6<br>(Choose one) | B & C             | 26L6.0-PHY - 704                                                     | Solid State Electronics            | 4T / 0P                    | 4      | 4+0+0=4                              | 30+0=30                                | 70+0=70                                 | 100         | 3 Hours (Th)                 |
|          |                       | B & C             | 26L6.0-PHY - 705                                                     | Molecular Physics                  |                            |        |                                      |                                        |                                         |             |                              |
|          | PC-H1                 | B & C             | 26L6.0-PHY - 706                                                     | Practical General                  | 0T / 4P                    | 4      | 0+0+8=8                              | 0+30=30                                | 0+70=70                                 | 100         | 3 Hours (P)                  |
|          | CC-HM1                | B & C             | From Available Core Courses in Minor Subject of 4 credits as per NEP |                                    |                            | 4      |                                      |                                        |                                         |             |                              |

## Semester-8 (Honors)

| Semester | Course Type           | Applicable Scheme | Course Code                                                          | Nomenclature of the Course             | Theory (Th)/ Practical (P) | Credit | Contact hours per week (L+T+P=Total) | Internal Assessment Marks (Th+P=Total) | End Term Examination Marks (Th+P=Total) | Total Marks | Exam Hours Theory, Practical |
|----------|-----------------------|-------------------|----------------------------------------------------------------------|----------------------------------------|----------------------------|--------|--------------------------------------|----------------------------------------|-----------------------------------------|-------------|------------------------------|
| 8        | CC-H4                 | B & C             | 26L6.0-PHY-801                                                       | Atomic and Molecular Physics           | 4T / 0P                    | 4      | 4+0+0=4                              | 30+0=30                                | 70+0=70                                 | 100         | 3 Hours (Th)                 |
|          | CC-H5                 | B & C             | 26L6.0-PHY-802                                                       | Thermodynamics & Statistical Mechanics | 4T / 0P                    | 4      | 4+0+0=4                              | 30+0=30                                | 70+0=70                                 | 100         | 3 Hours (Th)                 |
|          | CC-H6                 | B & C             | 26L6.0-PHY-803                                                       | Quantum Mechanics -II                  | 4T / 0P                    | 4      | 4+0+0=4                              | 30+0=30                                | 70+0=70                                 | 100         | 3 Hours (Th)                 |
|          | DSE-7<br>(Choose one) | B & C             | 26L6.0-PHY-804                                                       | Solid State Physics-II                 | 4T / 0P                    | 4      | 4+0+0=4                              | 30+0=30                                | 70+0=70                                 | 100         | 3 Hours (Th)                 |
|          |                       | B & C             | 26L6.0-PHY-805                                                       | Electrodynamics and Plasma Physics     |                            |        |                                      |                                        |                                         |             |                              |
|          | PC-H2                 | B & C             | 26L6.0-PHY-806                                                       | Practical general                      | 0T / 4P                    | 4      | 0+0+8=8                              | 0+30=30                                | 0+70=70                                 | 100         | 3 Hours (P)                  |
|          | CC-HM2                | B & C             | From Available Core Courses in Minor Subject of 4 credits as per NEP |                                        |                            |        | 4                                    |                                        |                                         |             |                              |
| OR       |                       |                   |                                                                      |                                        |                            |        |                                      |                                        |                                         |             |                              |

## Semester-8 (Honours with Research)

| Semester                                                                                                                                                               | Course Type | Applicable Scheme | Course Code                                                          | Nomenclature of the Course             | Theory (Th)/ Practical (P) | Credit | Contact hours per week (L+T+P=Total) | Internal Assessment Marks (Th+P=Total) | End Term Examination Marks (Th+P=Total) | Total Marks | Exam Hours Theory, Practical |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|----------------------------------------------------------------------|----------------------------------------|----------------------------|--------|--------------------------------------|----------------------------------------|-----------------------------------------|-------------|------------------------------|
| 8                                                                                                                                                                      | CC-H4       | B & C             | 26L6.0-PHY-801                                                       | Atomic and Molecular Physics           | 4T / 0P                    | 4      | 4+0+0=4                              | 30+0=30                                | 70+0=70                                 | 100         | 3 Hours (Th)                 |
|                                                                                                                                                                        | CC-H5       | B & C             | 26L6.0-PHY-802                                                       | Thermodynamics & Statistical Mechanics | 4T / 0P                    | 4      | 4+0+0=4                              | 30+0=30                                | 70+0=70                                 | 100         | 3 Hours (Th)                 |
|                                                                                                                                                                        | Research    | B & C             | 26L6.0-PHY-R- 807                                                    | Dissertation                           |                            | 12     |                                      | 90                                     | 210                                     | 300         |                              |
|                                                                                                                                                                        | CC-HM2      | B & C             | From Available Core Courses in Minor Subject of 4 credits as per NEP |                                        |                            | 4      |                                      |                                        |                                         |             |                              |
| Bachelor of Science (Hons.) / (Hons. with Research) in Major Physics of 184 Credits will be Awarded (after 8th Semester) as per <a href="#">University ordinance</a> . |             |                   |                                                                      |                                        |                            |        |                                      |                                        |                                         |             |                              |

## Courses offered by the department as Core Courses in Multi-disciplinary UG Program (Scheme A)

| Semester | Course Type | Course Code    | Nomenclature of the Course         | Theory (Th)/<br>Practical (P) | Credit | Contact hours per week<br>(L+T+P=Total) | Internal Assessment Marks<br>(Th+P=Total) | End Term Examination Marks<br>(Th+P=Total) | Total Marks | Exam Hours<br>Theory, Practical |
|----------|-------------|----------------|------------------------------------|-------------------------------|--------|-----------------------------------------|-------------------------------------------|--------------------------------------------|-------------|---------------------------------|
| 1        | CC-1/MCC-1  | 26L4.5-PHY-101 | Mechanics                          | 3T / 1P                       | 4      | 3+0+2=5                                 | 25+05=30                                  | 50+20=70                                   | 100         | 3 Hours (Th), 2 Hours (P)       |
| 2        | CC-2/MCC-3  | 26L4.5-PHY-201 | Electricity, Magnetism & EM Theory | 3T / 1P                       | 4      | 3+0+2=5                                 | 25+05=30                                  | 50+20=70                                   | 100         | 3 Hours (Th), 2 Hours (P)       |
| 3        | CC-3/MCC-4  | 26L5.0-PHY-301 | Thermal Physics                    | 3T / 1P                       | 4      | 3+0+2=5                                 | 25+05=30                                  | 50+20=70                                   | 100         | 3 Hours (Th), 2 Hours (P)       |
| 4        | CC-4/MCC-6  | 26L5.0-PHY-401 | Waves and Optics                   | 3T / 1P                       | 4      | 3+0+2=5                                 | 25+05=30                                  | 50+20=70                                   | 100         | 3 Hours (Th), 2 Hours (P)       |
| 5        | CC-5/MCC-9  | 26L5.5-PHY-501 | Modern Physics                     | 3T / 1P                       | 4      | 3+0+2=5                                 | 25+05=30                                  | 50+20=70                                   | 100         | 3 Hours (Th), 2 Hours (P)       |
| 6        | CC-6/MCC-11 | 26L5.5-PHY-601 | Electronics                        | 3T / 1P                       | 4      | 3+0+2=5                                 | 25+05=30                                  | 50+20=70                                   | 100         | 3 Hours (Th), 2 Hours (P)       |

*\*L: Lecture, T: Tutorial, P: Practical*

## Courses offered by the department as Skill Enhancement Courses (SEC) in the University pool for UG Programme

| Semester | Course Type | Course Code         | Nomenclature of the Course           | Theory Th)/<br>Practical (P) | Credit | Contact<br>hours per<br>week | Internal<br>Marks | End Term<br>Marks | Total<br>Marks | Exam Hours<br>Theory,<br>Practical |
|----------|-------------|---------------------|--------------------------------------|------------------------------|--------|------------------------------|-------------------|-------------------|----------------|------------------------------------|
| 2        | SEC-2       | 26L4.5- SEC-PHY-201 | Physics Laboratory Skill Enhancement | 2T / 1P                      | 3      | 2+0+2=4                      | 15+5=20           | 35+20=55          | 75             | 2 Hours (Th),<br>2 Hours (P)       |
| 3        | SEC-2       | 26L5.0- SEC-PHY-301 | Basic Instrumentation Skills         | 2T / 1P                      | 3      | 2+0+2=4                      | 15+5=20           | 35+20=55          | 75             | 2 Hours (Th),<br>2 Hours (P)       |

## Courses offered by the department as Value Added Courses (VAC) in the University pool for UG Programme

| Semester | Course Type | Course Code         | Nomenclature of the Course                         | Theory (Th)/<br>Practical (P) | Credit | Contact<br>hours per<br>week | Internal<br>Marks | End Term<br>Marks | Total<br>Marks | Exam<br>Hours<br><br>Theory,<br>Practical |
|----------|-------------|---------------------|----------------------------------------------------|-------------------------------|--------|------------------------------|-------------------|-------------------|----------------|-------------------------------------------|
| 3        | VAC-3       | 26L5.0-VAC-PHY -301 | Exploring the journey of<br>Indian Space Satellite | 2T / 0P                       | 2      | 2+0+0=2                      | 15+0=15           | 35+0=35           | 50             | 2 Hours (Th)                              |
|          |             | 26L5.0-VAC-PHY-302  | Basics of Indian Astronomy                         | 2T / 0P                       | 2      | 2+0+0=2                      | 15+0=15           | 35+0=35           | 50             | 2 Hours (Th)                              |
| 4        | VAC-3/VAC-4 | 26L5.0-VAC-PHY-401  | Physics in Everyday Life                           | 2T / 0P                       | 2      | 2+0+0=2                      | 15+0=15           | 35+0=35           | 50             | 2 Hours (Th)                              |

## Courses offered by the department as Multi-Disciplinary Courses (MDC) in the University pool for UG Programme

*\*Offered for the Other Departments*

| Semester | Course Type | Course Code    | Nomenclature of the Course | Theory (Th)/ Practical (P) | Credit | Contact hours per week | Internal Marks | End Term Marks | Total Marks | Exam Hours<br>Theory,<br>Practical |
|----------|-------------|----------------|----------------------------|----------------------------|--------|------------------------|----------------|----------------|-------------|------------------------------------|
| 1        | MDC-1       | 26L4.5-PHY-104 | Physics Fundamentals-I     | 2T / 1P                    | 3      | 2+0+2=4                | 15+5=20        | 35+20=55       | 75          | 2 Hours (Th),<br>2 Hours (P)       |
| 2        | MDC-2       | 26L4.5-PHY-204 | Physics Fundamentals-II    | 2T / 1P                    | 3      | 2+0+2=4                | 15+5=20        | 35+20=55       | 75          | 2 Hours (Th),<br>2 Hours (P)       |
| 3        | MDC-3       | 26L5.0-PHY-304 | Physics Fundamentals-III   | 2T / 1P                    | 3      | 2+0+2=4                | 15+5=20        | 35+20=55       | 75          | 2 Hours (Th),<br>2 Hours (P)       |

## Courses offered by the department as Minor/ Minor (Vocational) in the University pool for UG Programme

| Course Code                | Nomenclature of the Course                    | Semester | Theory (Th)/ Practical (P) | Credit | Contact hours per week | Internal Marks | End Term Marks | Total Marks | Exam Hours Theory, Practical  |
|----------------------------|-----------------------------------------------|----------|----------------------------|--------|------------------------|----------------|----------------|-------------|-------------------------------|
| <b>26L4.5-PHY-202</b>      | Elementary Electricity, Magnetism & EM theory | 2nd      | 1T / 1P                    | 2      | 1+0+2=3                | 05+05=10       | 20+20=40       | 50          | 2 Hours (Th),<br>2 Hours (P), |
| <b>26L4.5-PHY-103</b>      | Elementary Mechanics                          | 1st      | 1T / 1P                    | 2      | 1+0+2=3                | 05+05=10       | 20+20=40       | 50          | 2 Hours (Th),<br>2 Hours (P), |
| <b>26L5.0-VOC-PHY-401</b>  | Maintenance of Laboratory Instruments         | 4th      | 2T / 2P                    | 4      | 2+0+4=6                | 15+15=30       | 35+35=70       | 100         | 2 Hours (Th),<br>2 Hours (P)  |
| <b>26L5.5-VOC-PHY- 501</b> | Refrigeration and Air Conditioning            | 5th      | 2T / 2P                    | 4      | 2+0+4=6                | 15+15=30       | 35+35=70       | 100         | 2 Hours (Th),<br>2 Hours (P)  |
| <b>26L5.5-VOC-PHY-601</b>  | Installation and Maintenance of Solar Panels  | 6th      | 2T / 2P                    | 4      | 2+0+4=6                | 15+15=30       | 35+35=70       | 100         | 2 Hours (Th),<br>2 Hours (P)  |
| <b>26L5.0-VOC-PHY-301</b>  | Refrigeration and Air Conditioning            | 3rd      | 2T / 2P                    | 4      | 2+0+4=6                | 15+15=30       | 35+35=70       | 100         | 2 Hours (Th),<br>2 Hours (P)  |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Subject                                                                                       | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                      |                  |
| Semester                                                                                      | Semester 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                      |                  |
| Nomenclature of the Course                                                                    | Mechanics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                      |                  |
| Course Code                                                                                   | 26L4.5-PHY-101                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Course Type                                                                                   | CC-1/MCC-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Course Level                                                                                  | 100-199                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of mathematics and Newtonian Mechanics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L4.5-PHY-101.1:</b> Explain and apply the principles of Newtonian mechanics and rotational dynamics to analyze the motion of particles and rigid bodies.</p> <p><b>26L4.5-PHY-101.2:</b> Analyze the mechanical properties of solids and fluids, and apply the principles of gravitation to solve physical problems.</p> <p><b>26L4.5-PHY-101.3:</b> Explain and analyze oscillatory motion and the fundamental concepts of special relativity.</p> <p><b>26L4.5-PHY-101.4:</b> Perform mechanics experiments, analyze experimental data, estimate uncertainties, and interpret results using appropriate scientific methods and instruments.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0                   | 1                    | 4                |
| <b>Teaching hours per week</b>                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0                   | 2                    | 5                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     | 05                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     | 20                   | 70               |
| <b>Max. Marks</b>                                                                             | 75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     | 25                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 3 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     | 2 Hours              | 3 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |        |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Newtonian Mechanics and Rotational Dynamics: Frames of reference, Newton's laws of motion, motion of systems of particles, centre of mass, conservation of linear momentum, work and energy, conservative and non-conservative forces, conservation of energy, collisions, variable mass systems and rocket propulsion. Rigid body motion, moment of inertia of regular bodies (Thin rod, Rectangular plate, Solid and hollow Sphere, Spherical Shell and Solid and hollow cylinder), radius of gyration, parallel and perpendicular axis theorems, torque, rotational kinetic energy, angular momentum and its conservation, rolling motion and condition for pure rolling. | 1      | 15            |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Elasticity, Fluid Dynamics and Gravitation: Stress and strain, Hooke's law, elastic constants, Poisson's ratio, torsion of a cylinder, bending of beams and cantilevers. Fluid pressure, viscosity, surface tension, streamline and turbulent flow, equation of continuity, Bernoulli's theorem and its applications, Poiseuille's equation, Stoke's law and Reynolds number. Law of gravitation, gravitational potential and field, motion under central force, Kepler's laws, orbital and escape velocities.                                                                                                                                                               | 2      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |    |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-3                | Simple harmonic motion, damped and forced oscillations, resonance, coupled oscillations and normal modes, Michelson–Morley experiment, postulates of special relativity, Lorentz transformations, simultaneity, time dilation, length contraction, relativistic addition of velocities, mass-energy equivalence and relativistic Doppler effect.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3 | 15 |
| Practical Component s | 1. Measurement of length (or diameter) using Vernier Caliper, screw gauge and travelling microscope.<br>2. To study the random error in observations.<br>3. To determine the area of a window using a sextant.<br>4. Moment of Inertia of a Flywheel.<br>5. Moment of Inertia of an irregular body using a Torsion Pendulum.<br>6. Young's Modulus by Bending of a beam.<br>7. Modulus of rigidity of the material of a wire by Maxwell's Needle.<br>8. Elastic constants by Searle's method.<br>9. To determine the value of 'g' by using Bar pendulum.<br>10. To find the Poisson ratio of rubber by Rubber tube method.<br>11. To compare Moment of Inertia of a solid Sphere, Hollow Sphere and solid Disc of same mass with the help of Torsion Pendulum.<br>12. To determine the bending moment of a cantilever beam with uniformly distributed load, uniformly varying load and point load.<br><b>Note:</b> The student will perform at least six experiments. | 4 | 30 |

| Suggested Evaluation Methods                          |       |       |                                         |       |       |
|-------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                               | TH-25 | PR-05 | End Term Examination: 70                | TH-50 | PR-20 |
| Class Participation                                   | 5     | NA    | Written Examination                     | 50    | NA    |
| Seminar/presentation/assignment/quiz/cla ss test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.      | NA    | 05    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                      | 15    | NA    | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L4.5-PHY-101.1                                        | 3                | 1                | 1                | 1                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |
| 26L4.5-PHY-101.2                                        | 3                | 1                | 1                | 1                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |
| 26L4.5-PHY-101.3                                        | 3                | 1                | 1                | 1                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |
| 26L4.5-PHY-101.4                                        | 3                | 2                | 3                | 1                | 2                | 2                | 2                | 3                | 3                | 3                 | 2                 |

### Learning Resources

- Halliday, D., Resnick, R., & Walker, J. (2022). Fundamentals of Physics (12th ed.). Wiley.
- Kleppner, D., & Kolenkow, R. J. (2014). An Introduction to Mechanics (2nd ed.). Cambridge University Press. Taylor, J. R. (2005). Classical Mechanics. University Science Books
- Feynman, R. P., Leighton, R. B., & Sands, M. (2011). The Feynman Lectures on Physics, Vol. I: Mainly Mechanics, Radiation and Heat. Basic Books.
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- Rana, N. C., & Joag, P. S. (1991). Classical Mechanics. Tata McGraw-Hill.
- Ghoshal, S. N. (2017). Classical Mechanics (Revised ed.). S. Chand Publishing.
- Landau, L. D., & Lifshitz, E. M. (1976). Mechanics (3rd ed.). Butterworth-Heinemann.
- Kittel, C., Knight, W. D., & Ruderman, M. A. (1971). Berkeley physics course: Vol. 1. Mechanics. Tata McGraw-Hill.
- Mathur, D. S. (2000). Elements of properties of matter. S. Chand & Company Ltd.
- Gupta, S. L., & Kumar, V. (2017). Practical physics. Pragati Prakashan.
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- Nelkon, M., & Ogborn, J. (1998). Advanced level practical physics (5th ed.). Heinemann Educational Books.
- Resnick, R. (1968). Introduction to Special Relativity. Wiley.
- Goldstein, H., Poole, C. P., & Safko, J. L. (2002). Classical Mechanics (3rd ed.). Addison-Wesley.

### Content Mapping with NEP thrust areas

| Field                     | Hours Devoted |
|---------------------------|---------------|
| Skill Enhancement         | 30            |
| Communication Development | 30            |

### Important Notes:

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |               |                  |
|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------|------------------|
| Subject                                                                                       | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |               |                  |
| Semester                                                                                      | Semester 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |               |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |               |                  |
| Nomenclature of the Course                                                                    | Mathematical Methods in Physics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |               |                  |
| Course Code                                                                                   | 26L4.5-PHY-102                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |               |                  |
| Course Type                                                                                   | MCC-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |               |                  |
| Course Level                                                                                  | 100-199                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |               |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of calculus and elementary Mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |               |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L4.5-PHY-102.1:</b> Apply the concepts of linear algebra and error analysis to solve physical and mathematical problems.</p> <p><b>26L4.5-PHY-102.2:</b> Solve ordinary and partial differential equations using analytical methods relevant to physical systems.</p> <p><b>26L4.5-PHY-102.3:</b> Apply Fourier series, Fourier transforms, and Legendre polynomials to analyze mathematical models in physics.</p> <p><b>26L4.5-PHY-102.4:</b> Develop and implement computer programs to solve mathematical and computational problems in physics.</p> |              |               |                  |
|                                                                                               | Theory (Th)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |              | Practical (P) | Total            |
|                                                                                               | Lecture (L)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Tutorial (T) |               |                  |
| Credits                                                                                       | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0            | 1             | 4                |
| Teaching hours per week                                                                       | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0            | 2             | 5                |
| Internal Assessment Marks (Th+P=Total)                                                        | 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              | 05            | 30               |
| End Term Exam Marks                                                                           | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              | 20            | 70               |
| Max. Marks                                                                                    | 75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              | 25            | 100              |
| Examination Duration (in Hours)                                                               | 3 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              | 2 Hours       | 3 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |        |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <b>Instructions for Examiner:</b><br><b>Theory:</b><br>The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |        |               |
| <b>Practical:</b><br>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p><b>Linear Algebra:</b> Normal, orthogonal, Hermitian, unitary, symmetric, anti-symmetric, conjugate, and anti-Hermitian matrices; rank and trace of a matrix, eigenvalues and eigenvectors of matrices, and diagonalization of matrices. Vector space, basis vectors. Vectors and operators as matrices.</p> <p><b>Theory of errors:</b> Systematic and random errors, propagation of errors, normal law of errors, standard and probable error, least square fit, error on slope and intercept of a fitted line.</p> | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |    |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <p>Taylor's expansion, power series. Ordinary and partial differential equations, first-order differential equations, method of separation of variables, singular points, and Method of Frobenius. One-dimensional heat flow, heat conduction equation in 3D rectangular configuration, vibrations of rectangular and circular membranes, diffusion equation, and Laplace's equation in problems of rectangular, cylindrical, and spherical symmetry. Inhomogeneous PDE and introduction to Green's function method.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2 | 15 |
| Unit-3                | <p>Evaluation of coefficients of Fourier series, cosine and sine series, Dirichlet's theorem, representation of even and odd functions, extension of interval, and complex form of Fourier series. Convergence, integration, differentiation, Parseval's theorem, and physical applications of Fourier series analysis to square wave, rectifiers, saw-tooth wave, and triangular wave. Fourier integrals, and deduction of expressions for the Fourier Transform and its inverse.</p> <p>Legendre's differential equation, Legendre's polynomials, generating function, orthogonality, Rodrigue's formula, and basic recursion relations.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3 | 15 |
| Practical Component s | <p><b>Review of Programming fundamentals:</b> Data types, arithmetic operations, built-in functions, input/output statements, conditional and iterative control structures, arrays/lists, user-defined functions, and basic mathematical operations.</p> <p>The following tasks need to be performed using programming:</p> <ol style="list-style-type: none"> <li>1. Compute the product of two matrices of different dimensions using a DO loop.</li> <li>2. Numerical integration by Simpson's 1/3 rule.</li> <li>3. Fitting of a straight line using Least-Square method.</li> <li>4. Using an array, find out the average and standard deviation.</li> <li>5. Write a program to evaluate a given trigonometric functions for a given range of x.</li> <li>6. To find the maximum, minimum and range of a given set of numbers.</li> <li>7. To evaluate the sum of a finite series.</li> <li>8. Find the roots of a quadratic equation.</li> <li>9. To find the integration of a definite integral by trapezoidal rule.</li> <li>10. To find the area of a triangle, sphere and cylinder.</li> <li>11. Given values for a, b, c and d and a set of values for the variable x evaluate the function defined by.</li> </ol> $f(x) = ax^2 + bx + c, \text{ if } x < d$ $f(x) = 0, \text{ if } x = d$ $f(x) = ax^2 + bx - c, \text{ if } x > d$ <p>For each value of x and print the value of x and f(x). Write a program for an arbitrary number of x values.</p> <p><b>Note:</b> The student will perform at least six experiments.</p> | 4 | 30 |

| Suggested Evaluation Methods                         |       |       |                                         |       |       |
|------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                              | TH-25 | PR-05 | End Term Examination: 70                | TH-50 | PR-20 |
| Class Participation                                  | 5     | NA    | Written Examination                     | 50    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 05    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                     | 15    | NA    | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L4.5-PHY-102.1                                        | 3                | 1                | 1                | 1                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |
| 26L4.5-PHY-102.2                                        | 3                | 1                | 1                | 1                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |
| 26L4.5-PHY-102.3                                        | 3                | 1                | 1                | 1                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |
| 26L4.5-PHY-102.4                                        | 2                | 2                | 3                | 1                | 2                | 2                | 2                | 3                | 3                | 3                 | 2                 |

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <ul style="list-style-type: none"> <li>Boas, M. L. (2006). Mathematical Methods in the Physical Sciences (3rd ed.). Wiley.</li> <li>Riley, K. F., Hobson, M. P., &amp; Bence, S. J. (2006). Mathematical Methods for Physics and Engineering (3rd ed.). Cambridge University Press.</li> <li>Arfken, G. B., Weber, H. J., &amp; Harris, F. E. (2013). Mathematical Methods for Physicists: A Comprehensive Guide (7th ed.). Academic Press.</li> <li>Gupta, B. D. (2015). Mathematical Physics (4th ed.). Vikas Publishing House.</li> <li>Chapra, S. C., &amp; Canale, R. P. (2020). Numerical Methods for Engineers (8th ed.). McGraw-Hill.</li> <li>Kreyszig, E. (2011). Advanced Engineering Mathematics (10th ed.). Wiley.</li> <li>Jain, M. K., Iyengar, S. R. K., &amp; Jain, R. K. (2012). Numerical Methods for Scientific and Engineering Computation (6th ed.). New Age International.</li> <li>Spiegel, M. R., Lipschutz, S., Liu, J., &amp; Spellman, D. (2018). Schaum's Outline of Mathematical Handbook of Formulas and Tables (5th ed.). McGraw-Hill Education.</li> <li>Sastry, S. S. (2012). Introductory methods of numerical analysis (5th ed.). PHI Learning.</li> <li>Dass, H. K., &amp; Verma, R. (2011). Mathematical physics. S. Chand Publishing.</li> <li>Atkinson, K. E. (2007). An introduction to numerical analysis (3rd ed.). Wiley India.</li> <li>Ascher, U. M., &amp; Greif, C. (2012). A first course in numerical methods. PHI Learning.</li> <li>Python documentation: <a href="http://www.python.org">www.python.org</a></li> <li>Numpy documentation: <a href="http://www.numpy.org">www.numpy.org</a></li> </ul> |  |

| Content Mapping with NEP thrust areas                         |               |
|---------------------------------------------------------------|---------------|
| Field                                                         | Hours Devoted |
| Employability                                                 | 30            |
| Skill Enhancement                                             | 30            |
| Important Notes:                                              |               |
| Use of scientific calculator is permitted in the examination. |               |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |               |                  |
|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------|------------------|
| Subject                                                                                       | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |               |                  |
| Semester                                                                                      | Semester 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |               |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |               |                  |
| Nomenclature of the Course                                                                    | Electricity, Magnetism & EM Theory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |               |                  |
| Course Code                                                                                   | 26L4.5-PHY-201                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |               |                  |
| Course Type                                                                                   | CC-2/MCC-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |               |                  |
| Course Level                                                                                  | 100-199                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |               |                  |
| Pre-requisites for the course (if any)                                                        | Basic knowledge of Electricity, Magnetism, and Vectors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |               |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L4.5-PHY-201.1:</b> Explain and differentiate the vector and scalar formalisms of electrostatics and magnetostatics. Also be able to apply Gauss's Divergence &amp; Stokes theorem to solve various problems in electrostatics and magnetostatics.</p> <p><b>26L4.5-PHY-201.2:</b> 2. Describe the electric and magnetic properties of materials, Maxwell equations and their physical significance and familiar about the propagation of electromagnetic waves i.e. boundary conditions at the interface between different media</p> <p><b>26L4.5-PHY-201.3:</b> Understand D.C. and A.C. circuits, able to apply and analyse using networks. Analyze DC/AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor</p> <p><b>26L4.5-PHY-201.4:</b> Perform electrical and electromagnetic experiments using standard laboratory instruments, verify the fundamental laws and network theorems of electricity and magnetism, analyze experimental data, and interpret the characteristics of electrical circuits, magnetic materials, and electromagnetic phenomena.</p> |              |               |                  |
|                                                                                               | Theory (Th)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              | Practical (P) | Total            |
|                                                                                               | Lecture (L)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Tutorial (T) |               |                  |
| Credits                                                                                       | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0            | 1             | 4                |
| Teaching hours per week                                                                       | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0            | 2             | 5                |
| Internal Assessment Marks (Th+P=Total)                                                        | 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              | 05            | 30               |
| End Term Exam Marks                                                                           | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              | 20            | 70               |
| Max. Marks                                                                                    | 75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              | 25            | 100              |
| Examination Duration (in Hours)                                                               | 3 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              | 2 Hours       | 3 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |        |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.</p> |        |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Topics | CLO(s) | Contact Hours |

|        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |    |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-1 | <b>Vector Background and Fields:</b> Gradient of a scalar and its physical significance, Line, Surface and Volume integrals of a vector and their physical significance, Flux of a vector field, Divergence and curl of a vector and their physical significance, Gauss's divergence theorem, Stokes' theorem. Conservative nature of Electrostatic Field. Derivation of Laplace and Poisson equations. Electric flux, Gauss's Law, Differential form of Gauss's Law, and applications of Gauss's Law. Biot-Savart law, Current Loop as a Magnetic Dipole and its Dipole Moment, Ampere's Circuital Law and its applications (1) Solenoid and (2) Toroid, properties of B: curl and divergence, Energy stored in an electric field, and Magnetic field                                                                                                                                                                                                                                                                                                    | 1 | 14 |
| Unit-2 | <b>Electric and Magnetic Properties of Matter &amp; Electromagnetism:</b> Dielectrics, electric polarization, torque on dipole in E, and in B (both uniform and non-uniform). bound charge, volume charge density and surface charge density, electric displacement, susceptibility, permittivity, dielectric constant, relation between D, E, and P. Electric currents in Atoms, Electron spin and Magnetic moment, types of magnetic materials, Magnetization vector (M), Magnetic Intensity (H), Magnetic Susceptibility and permeability, Relation between B, H and M, Cycle of Magnetization- B-H curve and hysteresis loop: Energy dissipation, Hysteresis loss and importance of Hysteresis Curve. Electromagnetic induction, Faraday's laws of induction and Lenz's Law, Self-inductance, Mutual inductance, Derivation of Maxwell's equations, Maxwell's equations in differential and integral form and their physical significance. Transverse nature of electromagnetic wave, energy transported by electromagnetic waves, Poynting's theorem | 2 | 18 |
| Unit-3 | <b>Electricity: DC current Circuits:</b> Electric current and current density, Electrical conductivity and Ohm's law (Review), Kirchhoff's laws for D.C. networks, Network theorems: Thevenin's theorem, Norton theorem, Superposition theorem. <b>Alternating Current Circuits:</b> A resonance circuit, Phasor, Complex Reactance and Impedance, Analysis for RL, RC and LC Circuits, Series LCR Circuit: (1) Resonance, (2) Power Dissipation (3) Quality Factor and (4) Band Width, Parallel LCR Circuit.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3 | 13 |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |    |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Practical Component s | <p><b>Practicum</b></p> <ol style="list-style-type: none"> <li>1. Use of Multimeter for measuring Resistance, A.C. and D.C. Voltage and Current, checking of electrical fuses.</li> <li>2. Low resistance by Carey Foster's bridge with calibration.</li> <li>3. Determination of Impedance of an A.C. circuit and its verification.</li> <li>4. Frequency of A.C. mains using an electromagnet.</li> <li>5. Frequency of A.C. mains Electrical vibrator.</li> <li>6. High resistance by substitution method.</li> <li>7. To compare capacitances using De'Sauty bridge.</li> <li>8. To study the Characteristics of a Series RC Circuit.</li> <li>9. To study a series LCR circuit and determine its (a) Resonant frequency, (b) Quality factor.</li> <li>10. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor.</li> <li>11. To verify the Thevenin and Norton theorems.</li> <li>12. To verify the Superposition and Maximum Power Transfer Theorems.</li> <li>13. Self-inductance by Anderson's bridge.</li> <li>14. Verification of laws of electromagnetic induction.</li> <li>15. Study of B-H curves of various materials using C.R.O, and determination of various parameters.</li> <li>16. To demonstrate the production, propagation, and detection of electromagnetic (EM) waves using a Hertzian spark-gap apparatus.</li> </ol> <p><b>Note:</b> The student will perform at least six experiments.</p> | 4 | 30 |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|

| Suggested Evaluation Methods                         |       |       |                                         |       |       |
|------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                              | TH-25 | PR-05 | End Term Examination: 70                | TH-50 | PR-20 |
| Class Participation                                  | 5     | NA    | Written Examination                     | 50    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 05    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                     | 15    | NA    | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLOs                                                    | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L4.5-PHY-201.1                                        | 3                | 2                |                  | 1                | 2                |                  | 2                | 3                | 3                | 2                 | 1                 |
| 26L4.5-PHY-201.2                                        | 3                | 2                |                  | 2                | 3                | 1                | 3                | 3                | 3                | 3                 | 2                 |
| 26L4.5-PHY-201.3                                        | 3                | 2                |                  | 1                | 2                | 1                | 3                | 3                | 3                | 3                 | 2                 |
| 26L4.5-PHY-201.4                                        | 2                | 3                | 2                | 2                | 2                | 3                | 3                | 3                | 3                | 3                 | 3                 |

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Purcell, E. M. (1985). Electricity and magnetism: Berkeley physics course (2nd ed., Vol. 2). McGraw-Hill.</li> <li>Mahajan, A. S., &amp; Rangwala, A. A. (1988). Electricity and magnetism. Tata McGraw-Hill.</li> <li>Mahajan, S., &amp; Choudhury, S. R. (2012). Electricity, magnetism and electromagnetic theory. McGraw Hill Education.</li> <li>Griffiths, D. J. (1999). Introduction to electrodynamics (3rd ed.). Prentice Hall</li> <li>Feynman, R. P., Leighton, B. B., &amp; Sands, M. (2008). The Feynman Lectures on Physics: Vol. 2. Mainly electromagnetism and matter. Pearson</li> <li>Sadiku, M. N. O. (2010). Elements of electromagnetics (5th ed.). Oxford University Press</li> <li>Fewkes, J. H., &amp; Yarwood, J. (1991). Electricity and magnetism (Vol. 1). Oxford University Press</li> <li>Cheng, D. K. (1989). Field and wave electromagnetics (2nd ed.). Addison-Wesley.</li> <li>Flint, B. L., &amp; Worsnop, H. T. (1971). Advanced practical physics for students. Asia Publishing House.</li> <li>Singla, R. K. (2014). Modern approach to practical physics. Modern Publishers</li> <li>Arora, C. L. (2010). B.Sc. practical physics. S. Chand Publishing</li> <li>Nelkon, M., &amp; Ogborn, J. (1970). Advanced level practical physics (3rd rev. ed.). Heinemann Educational Books</li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 4             |
| Entrepreneurship                      | 2             |
| Skill Enhancement                     | 10            |
| Communication Development             | 2             |
| Environmental Awareness               | 3             |

| Important Notes:                                                                                                                |
|---------------------------------------------------------------------------------------------------------------------------------|
| Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination. |

| Introduction                                                                                  |                                                                                                                                                                    |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Subject                                                                                       | Physics - UG                                                                                                                                                       |                     |                      |                  |
| Semester                                                                                      | Semester 2                                                                                                                                                         |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                 |                     |                      |                  |
| Nomenclature of the Course                                                                    | Computational Physics                                                                                                                                              |                     |                      |                  |
| Course Code                                                                                   | 26L4.5-PHY-203                                                                                                                                                     |                     |                      |                  |
| Course Type                                                                                   | DSEC-1                                                                                                                                                             |                     |                      |                  |
| Course Level                                                                                  | 100-199                                                                                                                                                            |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Mathematics and Programming                                                                                                                 |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <b>26L4.5-PHY-203.1:</b> Develop Python programs using appropriate programming constructs, NumPy, and Matplotlib to solve basic computational problems in physics. |                     |                      |                  |
|                                                                                               | <b>26L4.5-PHY-203.2:</b> Apply numerical methods for interpolation, differentiation, and solving nonlinear equations to analyze physical problems.                 |                     |                      |                  |
|                                                                                               | <b>26L4.5-PHY-203.3:</b> Apply numerical integration techniques and numerical methods for solving differential equations relevant to physical systems.             |                     |                      |                  |
|                                                                                               | <b>26L4.5-PHY-203.4:</b> Implement and validate numerical algorithms using Python to solve computational problems and interpret the obtained results.              |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                 |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                 | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 3                                                                                                                                                                  | 0                   | 1                    | 4                |
| <b>Teaching hours per week</b>                                                                | 3                                                                                                                                                                  | 0                   | 2                    | 5                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 25                                                                                                                                                                 |                     | 05                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 50                                                                                                                                                                 |                     | 20                   | 70               |
| <b>Max. Marks</b>                                                                             | 75                                                                                                                                                                 |                     | 25                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 3 Hours                                                                                                                                                            |                     | 2 Hours              | 3 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <b>Instructions for Examiner:</b><br><b>Theory:</b><br>The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |               |
| <b>Practical:</b><br>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Structure of a Python Program, interpreter shell, indentation, input/output statements, identifiers, keywords, literals, numbers, strings, expressions, and basic operators (arithmetic, relational, logical or boolean, assignment, bitwise). Control structures including conditional statements, loop control statements (break, continue, pass), exit function, and default arguments. Defining functions, mutable and immutable objects, standard libraries in Python, testing and debugging a program, and the basic notion of class, object, and method.<br><br>Introduction to NumPy arrays, array operations, mathematical functions, random number generation, and basic data visualization using Matplotlib. | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |    |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <p><b>Numerical Differentiation and Interpolation:</b> Taylor series method, Finite difference operators, Newton's forward and backward interpolation formulae, Central difference formulae, Stirling's interpolation formula, Numerical differentiation using finite differences, Estimation of errors in numerical differentiation.</p> <p><b>Numerical Solution of Equations:</b> Bisection method, Newton–Raphson method and simple applications to physical problems.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2 | 15 |
| Unit-3                | <p><b>Numerical Integration and Applications:</b> Trapezoidal rule, Simpson's 1/3 and 3/8 rules, Gaussian Quadrature, Legendre–Gauss Quadrature, Numerical double integration, Error estimation in numerical integration.</p> <p><b>Numerical Solution of Differential Equations:</b> Taylor series method, Euler method, Modified Euler method and Runge–Kutta method for first-order differential equations, Applications to simple physical systems such as harmonic oscillator and radioactive decay.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 3 | 15 |
| Practical Component s | <ol style="list-style-type: none"> <li>1. Write a Python program to illustrate the various functions of the Math, numpy and Scipy modules.</li> <li>2. Write a function that takes the lengths of three sides: side1, side2 and side3 of the triangle as the input from the user using the input function and returns the area of the triangle as the output. Also, assert that the sum of the length of any two sides is greater than the third side.</li> <li>3. Write a Python function that takes a number as input from the user and computes its factorial.</li> <li>4. Write a function that takes a number with two or more digits as an input, finds its reverse and computes the sum of its digits.</li> <li>5. Write a function that takes two numbers as input parameters and returns their least common multiple and highest common factor.</li> <li>6. Write a Python function to calculate the sum and product of two compatible matrices.</li> <li>7. Write a function that takes n as an input and creates a list of n lists such that ith list contains first five multiples of i.</li> <li>8. Numerical differentiation of a given function.</li> <li>9. Numerical integration using (a) trapezoidal and (b) Simpson1/3 rule.</li> <li>10. Gauss quadrature methods for one and two-dimensional integrals.</li> <li>11. Interpolation of given data and plotting.</li> <li>12. Solving given differential equation using Euler and RK methods.</li> </ol> <p><b>Note:</b> The student will perform at least six experiments.</p> | 4 | 30 |

| Suggested Evaluation Methods                         |       |       |                                         |       |       |
|------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                              | TH-25 | PR-05 | End Term Examination: 70                | TH-50 | PR-20 |
| Class Participation                                  | 5     | NA    | Written Examination                     | 50    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 05    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                     | 15    | NA    | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L4.5<br>-PHY-<br>203.1                                | 3                | 1                | 1                | 1                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |
| 26L4.5<br>-PHY-<br>203.2                                | 3                | 1                | 1                | 1                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |
| 26L4.5<br>-PHY-<br>203.3                                | 3                | 1                | 1                | 1                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |
| 26L4.5<br>-PHY-<br>203.4                                | 3                | 2                | 3                | 1                | 2                | 2                | 2                | 3                | 3                | 3                 | 2                 |

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Chapra, S. C., &amp; Canale, R. P. (2020). Numerical Methods for Engineers (8th ed.). McGraw-Hill Education.</li> <li>W. H., Teukolsky, S. A., Vetterling, W. T., &amp; Flannery, B. P. (2007). Numerical Recipes: The Art of Scientific Computing (3rd ed.). Cambridge University Press.</li> <li>Pang, T. (2006). An Introduction to Computational Physics (2nd ed.). Cambridge University Press.</li> <li>Johansson, R. (2019). Numerical Python: Scientific Computing and Data Science Applications with NumPy, SciPy and Matplotlib (2nd ed.). Apress.</li> <li>Garcia, A. L. (2000). Numerical Methods for Physics (2nd ed.). Prentice Hall.</li> <li>Beu, T. (2014). Introduction to Numerical Programming: A Practical Guide for Scientists and Engineers Using Python and C/C++. CRC Press.</li> <li>Landau, R. H., Páez, M. J., &amp; Bordeianu, C. C. (2022). Computational Physics: Problem Solving with Python (3rd ed.). Wiley.</li> <li>Taneja, S., &amp; Kumar, N. (2019). Python programming: A modular approach. Pearson India.</li> <li>Balagurusamy, E. (2018). Introduction to computing and problem solving using Python (2nd ed.). McGraw Hill Education.</li> <li>Rajaraman, V. (2007). Computer-oriented numerical methods. Prentice Hall of India.</li> <li>DeJong, M. L. (1988). Introduction to computational physics. Addison-Wesley Publishing Company.</li> <li>Atkinson, K. E. (1989). An introduction to numerical analysis (2nd ed.). John Wiley &amp; Sons.</li> <li>Sastry, S. S. (2012). Introductory methods of numerical analysis (5th ed.). PHI Learning.</li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 45            |
| Skill Enhancement                     | 45            |

| Important Notes:                                              |
|---------------------------------------------------------------|
| Use of scientific calculator is permitted during examination. |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Subject                                                                                       | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                      |                  |
| Semester                                                                                      | Semester 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |                  |
| Nomenclature of the Course                                                                    | Thermal Physics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |                  |
| Course Code                                                                                   | 26L5.0-PHY-301                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                      |                  |
| Course Type                                                                                   | CC-3/MCC-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Heat, Mechanics, and Calculus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.0-PHY-301.1:</b> Explain the laws of thermodynamics, entropy, thermodynamic processes, and low-temperature phenomena.</p> <p><b>26L5.0-PHY-301.2:</b> Apply thermodynamic potentials and Maxwell relations to analyze phase transitions, heat transfer, and thermal radiation.</p> <p><b>26L5.0-PHY-301.3:</b> Explain the principles of statistical mechanics and quantum statistics and apply them to ideal gases and radiation.</p> <p><b>26L5.0-PHY-301.4:</b> Perform experiments related to thermodynamics, heat transfer, and statistical physics, analyze experimental data, and interpret the results using appropriate scientific methods.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0                   | 1                    | 4                |
| <b>Teaching hours per week</b>                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0                   | 2                    | 5                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | 05                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | 20                   | 70               |
| <b>Max. Marks</b>                                                                             | 75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | 25                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 3 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     | 2 Hours              | 3 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Thermodynamic systems, thermodynamic variables and equation of state, thermal equilibrium and Zeroth law of thermodynamics, concept of heat and work, sign convention and path dependence of work, First law of thermodynamics, internal energy as a state function, isothermal, adiabatic, isobaric, isochoric and cyclic processes, reversible and irreversible processes, applications of the First law, Second law of thermodynamics, Carnot cycle and Carnot theorem, thermodynamic temperature scale, absolute zero, entropy and its physical significance, entropy change in reversible and irreversible processes, T-S diagrams, entropy of an ideal gas, Nernst heat theorem and Third law of thermodynamics. | 1      | 15            |

|        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |    |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2 | Joule's free expansion, Joule-Thomson effect and porous plug experiment, analytical treatment of Joule-Thomson effect, liquefaction of gases, Linde and Claude processes, liquefaction of oxygen, air, hydrogen and helium, adiabatic demagnetization and low-temperature physics. Thermodynamic potentials: internal energy, enthalpy, Helmholtz free energy and Gibbs free energy; Maxwell thermodynamic relations and their derivation, Clausius-Clapeyron equation and Clausius latent heat equation, phase transitions, phase diagrams and triple point, specific heat of saturated vapours, relation between specific heats, variation of internal energy with volume for ideal and van der Waals gases, adiabatic expansion and compression of gases, Stefan's law and thermodynamic radiation.                                                                         | 2 | 15 |
| Unit-3 | Microstates and macrostates, thermodynamic probability, accessible states and constraints, statistical fluctuations, entropy and probability, phase space, cells in phase space and postulates of statistical mechanics, ensembles and ensemble averages, microcanonical, canonical and grand canonical ensembles, partition function and its thermodynamic significance, Maxwell-Boltzmann statistics and its application to an ideal gas, Maxwell distribution of molecular speeds and velocities, most probable, average and rms speeds, mean energy of a Maxwellian gas.<br><br>Elementary introduction to quantum statistics, limitations of classical statistics, qualitative concepts of Bose-Einstein and Fermi-Dirac statistics (without derivation), Planck's radiation law, Bose-Einstein condensation, Fermi energy, Fermi temperature and electron gas in metals. | 3 | 15 |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |    |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Practical Component s | <ol style="list-style-type: none"> <li>To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.</li> <li>Measurement of Planck's constant using black body radiation.</li> <li>To determine Stefan's Constant.</li> <li>To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.</li> <li>To determine the coefficient of thermal conductivity of cube by Angstrom's Method.</li> <li>To determine the temperature coefficient of resistance by platinum resistance thermometer.</li> <li>To study the variation of thermo emf across two junction sofa thermocouple with temperature.</li> <li>To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system.</li> <li>To calibrate resistance temperature device(RTD) using null Method/Off-Balance Bridge.</li> <li>To prove the law of probability by using one coin, two coins, and 10 or more coins.</li> <li>To determine the coefficient of increase of volume of air at constant pressure.</li> <li>To determine the coefficient of increase of pressure of air at constant volume.</li> <li>Computer simulation of Maxwell-Boltzmann distribution, Fermi- Dirac &amp; Bose-Einstein.</li> <li>Study of statistical distribution from the given data and to find the most probable, average, and r.m.s value.</li> <li>Mechanical Equivalent of heat (J) by Joule's calorimeter.</li> <li>Heating efficiency of electrical kettle with varying voltage.</li> </ol> <p><b>Note:</b> The student will perform at least six experiments.</p> | 4 | 30 |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|

| Suggested Evaluation Methods                          |       |       |                                         |       |       |
|-------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                               | TH-25 | PR-05 | End Term Examination: 70                | TH-50 | PR-20 |
| Class Participation                                   | 5     | NA    | Written Examination                     | 50    | NA    |
| Seminar/presentation/assignment/quiz/cla ss test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.      | NA    | 05    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                      | 15    | NA    | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0 -PHY-301.1                                       | 3                | 1                | 1                | 1                | 2                | 1                | 3                | 3                | 2                | 2                 | 2                 |
| 26L5.0 -PHY-301.2                                       | 3                | 1                | 1                | 1                | 2                | 1                | 3                | 3                | 2                | 2                 | 2                 |

|                                   |   |   |   |   |   |   |   |   |   |   |   |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|
| <b>26L5.0<br/>-PHY-<br/>301.3</b> | 3 | 1 | 1 | 1 | 2 | 1 | 3 | 3 | 2 | 2 | 2 |
| <b>26L5.0<br/>-PHY-<br/>301.4</b> | 3 | 2 | 3 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 2 |

#### Learning Resources

- Zemansky, M. W., & Dittman, R. H. (1997). Heat and Thermodynamics (7th ed.). McGraw-Hill.
- Reif, F. (2009). Fundamentals of Statistical and Thermal Physics. Waveland Press.
- Pathria, R. K., & Beale, P. D. (2011). Statistical Mechanics (3rd ed.). Academic Press.
- Schroeder, D. V. (2000). An Introduction to Thermal Physics. Addison-Wesley.
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- Saha, M. N., & Srivastava, B. N. (2016). A Treatise on Heat. Indian Press.
- Sears, F. W., & Salinger, G. L. (1975). Thermodynamics, Kinetic Theory, and Statistical Thermodynamics (3rd ed.). Addison-Wesley.
- Garg, S. K., Bansal, C. K., & Ghosh, S. (2019). Thermal Physics. McGraw Hill Education.
- Roy, S. K. (2002). Thermal physics and statistical mechanics. New Age International Publishers.
- Stowe, K. (2007). Introduction to thermodynamics and its applications. Universities Press (India).
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- Sharma, J. K., & Sarkar, K. K. (2001). Thermodynamics and statistical physics. Himalaya Publishing House.
- Flint, B. L., & Worsnop, H. T. (1971). Advanced practical physics for students. Asia Publishing House.
- Nelkon, M., & Ogborn, J. M. (1985). Advanced level practical physics (4th ed.). Heinemann Educational Publishers.
- Khandelwal, D. P. (1985). A laboratory manual of physics for undergraduate classes. Vani Publications.

#### Content Mapping with NEP thrust areas

| Field             | Hours Devoted |
|-------------------|---------------|
| Skill Enhancement | 30            |

#### Important Notes:

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Subject                                                                                       | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                      |                  |
| Semester                                                                                      | Semester 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |                  |
| Nomenclature of the Course                                                                    | Classical Mechanics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                      |                  |
| Course Code                                                                                   | 26L5.0-PHY-303                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                      |                  |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |                  |
| Course Type                                                                                   | MCC-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Mechanics and Calculus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.0-PHY-303.1:</b> Explain the dynamics of rigid bodies in inertial and non-inertial frames using the concepts of inertia tensor, Euler's equations, precession, and the principle of equivalence.</p> <p><b>26L5.0-PHY-303.2:</b> Apply Lagrangian mechanics, normal mode analysis, and central force theory to analyze the motion of mechanical systems.</p> <p><b>26L5.0-PHY-303.3:</b> Explain the principles of continuum mechanics, fluid dynamics, and special relativity, and apply them to solve physical problems.</p> <p><b>26L5.0-PHY-303.4:</b> Perform experiments related to mechanics, elasticity, oscillations, and fluid flow, analyze experimental data, and interpret the results using appropriate scientific methods.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0                   | 1                    | 4                |
| <b>Teaching hours per week</b>                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0                   | 2                    | 5                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     | 05                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     | 20                   | 70               |
| <b>Max. Marks</b>                                                                             | 75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     | 25                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 3 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | 2 Hours              | 3 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                   |        |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.</p> |                                                                                                                                                                                                                                                                                                                                                   |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Topics                                                                                                                                                                                                                                                                                                                                            | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <p>Inertia tensor, principal axes and principal moments of inertia, Euler angles, angular velocity and angular momentum of a rigid body, Euler's equations of motion, precession, torque-free precession.</p> <p>Non-inertial systems, uniformly accelerating systems, physics in a rotating coordinate system, the principle of equivalence.</p> | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |    |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <p>Constraints and classifications, D'Alembert's principle, Lagrangian and Lagrangian Mechanics.</p> <p>Small oscillations, normal coordinates, normal modes and coupled oscillators.</p> <p>Central Force Motion: Central force and effective potential, orbital equation, stability of circular orbits, Kepler problem, planetary motion, Rutherford scattering, scattering cross-section, Virial theorem.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2 | 15 |
| Unit-3                | <p>Continuum Mechanics and Fluid Flow: Equation of continuity, Euler's equation of fluid motion, Bernoulli's equation, vorticity and circulation, laminar and turbulent flow, Navier-Stokes equation (introductory treatment), propagation of sound waves in fluids, surface waves and selected physical applications.</p> <p>Space-time interval, four-vectors, relativistic momentum and energy, energy-momentum relation, relativistic collisions and transformation of energy and momentum.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3 | 15 |
| Practical Component s | <ol style="list-style-type: none"> <li>1. To study the Motion of spring and calculate spring constant &amp; value of Acceleration due to Gravity.</li> <li>2. To determine the value of 'g' by using Kater's pendulum.</li> <li>3. To study (i) the law of conservation of linear momentum (ii) the law of conservation of kinetic energy and (iii) to calculate the restitution using one dimensional collision apparatus of two hanging spheres.</li> <li>4. To investigate the motion of coupled oscillators.</li> <li>5. Surface tension by Quinke's method.</li> <li>6. Young's modulus by Koenig's method.</li> <li>7. To determine "Y" by optical lever.</li> <li>8. Viscosity of liquid using Stokes method.</li> <li>9. To determine the surface tension of a liquid by jaeger's method.</li> <li>10. To determine the coefficient of Viscosity by Poiseuille's method.</li> <li>11. Verification of parallel &amp; perpendicular axis theorem– using Moment of Inertia.</li> <li>12. Determination of Log decrement &amp; viscosity.</li> <li>13. Verification of vibrating string Melde's experiment.</li> </ol> <p><b>Note:</b> The student will perform at least six experiments.</p> | 4 | 30 |

| Suggested Evaluation Methods                         |       |       |                                         |       |       |
|------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                              | TH-25 | PR-05 | End Term Examination: 70                | TH-50 | PR-20 |
| Class Participation                                  | 5     | NA    | Written Examination                     | 50    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 05    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                     | 15    | NA    | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0<br>-PHY-<br>303.1                                | 3                | 1                |                  | 3                |                  | 2                |                  |                  |                  |                   |                   |
| 26L5.0<br>-PHY-<br>303.2                                | 3                | 2                |                  | 3                |                  | 3                | 1                |                  |                  |                   |                   |
| 26L5.0<br>-PHY-<br>303.3                                | 3                | 2                |                  | 3                |                  | 2                | 1                |                  |                  |                   |                   |
| 26L5.0<br>-PHY-<br>303.4                                | 2                | 3                | 2                | 3                | 2                | 3                | 3                | 1                |                  |                   | 2                 |

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Goldstein, H., Poole, C. P., &amp; Safko, J. L. (2002). <i>Classical Mechanics</i> (3rd ed.). Addison-Wesley.</li> <li>Kleppner, D., &amp; Kolenkow, R. J. (2014). <i>An Introduction to Mechanics</i> (2nd ed.). Cambridge University Press.</li> <li>Rana, N. C., &amp; Joag, P. S. (1991). <i>Classical Mechanics</i>. Tata McGraw-Hill.</li> <li>Ghoshal, S. N. (2017). <i>Classical Mechanics</i> (Revised ed.). S. Chand Publishing.</li> <li>Taylor, J. R. (2005). <i>Classical Mechanics</i>. University Science Books.</li> <li>Marion, J. B., &amp; Thornton, S. T. (2004). <i>Classical Dynamics of Particles and Systems</i> (5th ed.). Brooks/Cole.</li> <li>Landau, L. D., &amp; Lifshitz, E. M. (1976). <i>Mechanics</i> (3rd ed.). Butterworth-Heinemann.</li> <li>Morin, D. (2008). <i>Introduction to Classical Mechanics: With Problems and Solutions</i>. Cambridge University Press.</li> <li>Feynman, R. P., Leighton, R. B., &amp; Sands, M. (2011). <i>The Feynman Lectures on Physics, Vol. I: Mainly Mechanics, Radiation and Heat</i>. Basic Books.</li> <li>Resnick, R. (1968). <i>Introduction to Special Relativity</i>. Wiley.</li> <li>Spiegel, M. R. (2009). <i>Schaum's Outline of Theoretical Mechanics</i>. McGraw-Hill Education.</li> <li>Arora, C. L. (2015). <i>B.Sc. practical physics</i>. S. Chand Publishing.</li> <li>Nelkon, M., &amp; Ogborn, J. M. (1998). <i>Advanced level practical physics</i> (5th ed.). Heinemann Educational Books.</li> <li>Gupta, S. L., &amp; Kumar, V. (2017). <i>Practical physics</i>. Pragati Prakashan.</li> <li>Upadhyaya, J. C. (2019). <i>Classical mechanics</i>. Himalaya Publishing House.</li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Skill Enhancement                     | 30            |

| Important Notes:                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------|
| Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination. |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Subject                                                                                       | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Semester                                                                                      | Semester 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
| Nomenclature of the Course                                                                    | Waves and Optics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Course Code                                                                                   | 26L5.0-PHY-401                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                      |                  |
| Course Type                                                                                   | CC-4/MCC-6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |                  |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Wave motion and Optics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.0-PHY-401.1:</b> Explain and analyze interference and Fresnel diffraction phenomena and apply them to solve problems related to optical systems</p> <p><b>26L5.0-PHY-401.2:</b> Analyze Fraunhofer diffraction, polarization, optical activity, and related optical devices used in scientific and engineering applications</p> <p><b>26L5.0-PHY-401.3:</b> Explain the working principles of lasers and optical fibres and evaluate their applications in communication, sensing, and modern engineering technologies</p> <p><b>26L5.0-PHY-401.4:</b> Perform experiments to determine the optical properties of materials and optical systems, analyze interference, diffraction, polarization, spectroscopy, and optical fibre characteristics using standard optical instruments, and interpret the experimental results with appropriate error analysis</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0                   | 1                    | 4                |
| <b>Teaching hours per week</b>                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0                   | 2                    | 5                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | 05                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | 20                   | 70               |
| <b>Max. Marks</b>                                                                             | 75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | 25                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 3 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     | 2 Hours              | 3 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <p><b>Interference by Division of Wave front:</b> Young's double slit experiment, Coherence, Conditions of interference, Fresnel's biprism and its applications (thickness of sheet &amp; wavelength of light), phase change on reflection.</p> <p><b>Interference by Division of Amplitude:</b> Plane parallel thin film, production of colors in thin films, classification of fringes in films, Interference due to transmitted light and reflected light, wedge-shaped film, Newton's rings</p> <p>Fresnel's diffraction: Huygens-Fresnel's theory, Fresnel's assumptions, diffraction at a straight edge, rectangular slit and diffraction at a circular aperture, diffraction due to a narrow wire.</p> | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |    |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <p><b>Fraunhofer diffraction &amp; Polarization</b>:- Single slit diffraction, double slit diffraction, plane transmission grating spectrum, dispersive power of grating, limit of resolution, Rayleigh's criterion, resolving power of grating.</p> <p>Polarization: Polarization by reflection, refraction and scattering, Malus Law, Phenomenon of double refraction, Huygens's wave theory of double refraction (Normal and oblique incidence), Analysis of polarized Light. Nicole prism, Quarter wave plate and half wave plate, production and detection of (i) Plane polarized light (ii) Circularly polarized light and (iii) Elliptically polarized light. Optical activity, Fresnel's theory of optical rotation, Specific rotation, Polarimeters (half shade and Biquartz).</p>                                                                                                                                                                                                                                                                                                                                                              | 2 | 15 |
| Unit-3                | <p><b>Lasers</b>: Basic concept of absorption and emission of radiations, amplification and population inversion; Main components of lasers; Metastable state, Excitation mechanism and Types of Lasers (He-Ne Laser &amp; Ruby Laser), Applications of Lasers.</p> <p>Optical fibres and their properties, Principal of light propagation through a optical fibre, Acceptance angle and numerical aperture, Types of optical fibres: Single mode and multimode fibres, Advantages and Disadvantages of optical fibres, Applications of optical fibres, Fibre optic sensors: Fibre Bragg Grating.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3 | 15 |
| Practical Component s | <p><b>Practicum</b></p> <ol style="list-style-type: none"> <li>To determine the refractive index of the material of a prism using a sodium source.</li> <li>Determination of the wavelength of sodium light using Newton's Rings.</li> <li>To determine the dispersive power and Cauchy constants of the material of a prism using a mercury discharge source.</li> <li>To determine the thickness of the paper sheet using Fresnel biprism.</li> <li>Determination of wavelength of sodium light by using a diffraction grating.</li> <li>To study the diffraction pattern using a narrow wire/circular aperture/straight edge.</li> <li>Resolving power of a grating.</li> <li>Comparison of Illuminating Powers by a Photometer.</li> <li>Measurement of (a) Specific rotation (b) Concentration of sugar solution using a polarimeter.</li> <li>Ordinary and extraordinary refractive indices for calcite or quartz.</li> <li>To study the characteristics of LASER.</li> <li>To determine the acceptance angle and numerical aperture of the given optical fibre.</li> </ol> <p><b>Note:</b> The student will perform at least six experiments.</p> | 4 | 30 |

| Suggested Evaluation Methods                         |       |       |                                         |       |       |
|------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                              | TH-25 | PR-05 | End Term Examination: 70                | TH-50 | PR-20 |
| Class Participation                                  | 5     | NA    | Written Examination                     | 50    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 05    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                     | 15    | NA    | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0-PHY-401.1                                        | 3                | 2                |                  |                  | 2                |                  | 2                | 3                | 3                | 2                 | 1                 |
| 26L5.0-PHY-401.2                                        | 3                | 2                |                  | 1                | 2                | 1                | 3                | 3                | 3                | 3                 | 2                 |
| 26L5.0-PHY-401.3                                        | 3                | 2                |                  | 2                | 3                | 1                | 2                | 2                | 2                | 3                 | 2                 |
| 26L5.0-PHY-401.4                                        | 2                | 3                | 2                | 2                | 2                | 3                | 3                | 3                | 3                | 3                 | 3                 |

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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| <ul style="list-style-type: none"> <li>• Born, M., &amp; Wolf, E. (1959). <i>Principles of optics: Electromagnetic theory of propagation, interference and diffraction of light</i>. Pergamon Press</li> <li>• Ghatak, A. K. (2010). Optics/Ajoy Ghatak.</li> <li>• Jenkins, F. A., &amp; White, H. E. (2017). <i>Fundamentals of optics</i> (4th ed.). McGraw Hill Education India</li> <li>• Möller, K.D. (1988). <i>Optics</i>. University Science Books</li> <li>• Tolansky, S. (1973). <i>An introduction to interferometry</i> (2nd ed.). John Wiley &amp; Sons</li> <li>• Shurcliff, W. A. (1962). <i>Polarized light: Production and use</i>. Harvard University Press</li> <li>• Laud, B. B. (2011). <i>Lasers and non-linear optics</i> (3rd ed.). New Age International</li> <li>• Thyagarajan, K., &amp; Ghatak, A. K. (1984). <i>Laser: Theory and applications</i>. Macmillan</li> <li>• Arora, C. L. (2010). <i>B.Sc. practical physics</i>. S. Chand Publishing</li> <li>• Nelkon, M., &amp; Ogborn, J. (1970). <i>Advanced level practical physics</i> (3rd rev. ed.). Heinemann Educational Books</li> <li>• Srivastava, S. S., &amp; Gupta, M. K. (1987). <i>Practical physics</i>. Atma Ram &amp; Son</li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 4             |
| Entrepreneurship                      | 2             |
| Skill Enhancement                     | 10            |
| Communication Development             | 2             |
| Environmental Awareness               | 2             |
| Current Issues and Social Awareness   | 3             |

| Important Notes:                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.</b> |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Subject                                                                                       | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |                  |
| Semester                                                                                      | Semester 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Nomenclature of the Course                                                                    | Introductory Quantum Mechanics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Course Code                                                                                   | 26L5.0-PHY-402                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Course Type                                                                                   | MCC-7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |                  |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Modern Physics and Calculus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.0-PHY-402.1:</b> Explain the fundamental concepts leading to quantum mechanics and analyze quantum phenomena such as blackbody radiation, photoelectric effect, Compton effect, matter waves, and uncertainty principle</p> <p><b>26L5.0-PHY-402.2:</b> Apply the postulates of quantum mechanics and Schrödinger wave equation to analyze wave functions, operators, probability, and expectation values of quantum systems</p> <p><b>26L5.0-PHY-402.3:</b> Solve one-dimensional quantum mechanical problems involving particle confinement, tunneling, and harmonic oscillator, and relate them to modern electronic and nanotechnology applications</p> <p><b>26L5.0-PHY-402.4:</b> Perform experiments and simulations to investigate fundamental quantum phenomena, determine key quantum parameters, analyze the behavior of quantum systems, and interpret the experimental and computational results in accordance with quantum mechanical principles</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0                   | 1                    | 4                |
| <b>Teaching hours per week</b>                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0                   | 2                    | 5                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     | 05                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     | 20                   | 70               |
| <b>Max. Marks</b>                                                                             | 75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     | 25                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 3 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     | 2 Hours              | 3 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |        |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <b>Instructions for Examiner:</b><br><b>Theory:</b><br>The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |        |               |
| <b>Practical:</b><br>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>THE ORIGIN OF QUANTUM PHYSICS</b><br><br>Inadequacies in Classical Physics, boundary between classical and quantum phenomena, Blackbody Radiation, Rayleigh Jeans law, Planck's radiation law, Photons, Photoelectric effect, Compton effect (theory and result), Frank-Hertz experiment, single photon interference pattern, dual nature of light and matter, de-Broglie hypothesis, Philosophical Precursors to Wave-Particle Duality, Davisson and Germer experiment, wave packet, phase velocity, group velocity and their relation, Heisenberg's uncertainty principle, Time energy and angular momentum, position uncertainty, Gaussian wave packet | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |    |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <b>THE SCHRODINGER WAVE EQUATION</b><br><br>Postulates of quantum mechanics, time-dependent and time-independent Schrodinger equation, properties of the wave function, Interpretation of the wave function, Condition for physical acceptability of Wave Functions. Eigenvalues and eigenfunctions, Mathematical consideration of Schrodinger equation: Normalization, Orthogonality, Observables, Stationary states, Position, Linear momentum & Energy operators; commutator of position and linear momentum operator, Probability current density, Expectation values of position and linear momentum, Ehrenfest's theorem, Kronecker delta and Dirac delta functions                                                                                            | 2 | 15 |
| Unit-3                | <b>One-Dimensional Problems</b><br><br>Free particle problem, Eigen Functions and Eigen values for a Particle in a One-Dimensional Box, Potential step: reflectance and transmittance, Penetration of a barrier: reflectance, transmittance and tunnel effect, Application of barrier penetration, Tunnel diode and alpha decay (Qualitative description), One Dimensional Simple Harmonic Oscillator: Energy Levels and Wave Functions. Zero Point Energy (qualitative description).                                                                                                                                                                                                                                                                                | 3 | 15 |
| Practical Component s | <b><u>Practicum</u></b><br><br>1. To determine the value of Planck's Constant by using four different LEDs.<br>2. Verification of Planck's Radiation Law using an Incandescent Lamp.<br>3. Determination of Particle Size/Wavelength using de-Broglie Analogies.<br>4. Study of the Dual Nature of Light via Double-Slit Laser Interference.<br>5. To study the quantum tunneling effect with solid state device, e.g. V-I Characteristics of a Tunnel Diode.<br>6. Determination of work function using the photoelectric effect.<br>7. Simulation of Energy Eigenvalues for a Particle in a One-Dimensional Box.<br>8. Phase Velocity and Group Velocity Simulation in a Dispersive Medium.<br><br><b>Note:</b> The student will perform at least six experiments. | 4 | 30 |

| Suggested Evaluation Methods                         |       |       |                                         |       |       |
|------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                              | TH-25 | PR-05 | End Term Examination: 70                | TH-50 | PR-20 |
| Class Participation                                  | 5     | NA    | Written Examination                     | 50    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 05    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                     | 15    | NA    | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0-PHY-402.1                                        | 3                | 2                |                  | 1                | 2                |                  | 2                | 3                | 3                | 2                 | 1                 |
| 26L5.0-PHY-402.2                                        | 3                | 2                |                  |                  | 2                | 1                | 3                | 3                | 3                | 2                 | 2                 |

|                                   |   |   |   |   |   |   |   |   |   |   |   |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|
| <b>26L5.0<br/>-PHY-<br/>402.3</b> | 3 | 2 |   | 1 | 2 | 1 | 3 | 3 | 3 | 3 | 2 |
| <b>26L5.0<br/>-PHY-<br/>402.4</b> | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

#### Learning Resources

- Leonard I. Schiff,(2010), Quantum Mechanics.
- P.M. Mathews and K. Venkatesan, (2010), A Text book of Quantum Mechanics.
- A.Ghatak & S.Lokanathan. (2004), Quantum Mechanics: Theory and Applications.
- David J.Griffith,(2005), Introductory Quantum Mechanics.
- G.Aruldas. (2002). Quantum Mechanics.
- Zettili, N. (2009). Quantum mechanics: concepts and applications.
- Nelkon, M. Ogborn, Advanced Level Practical Physics.
- S. S. Srivastava and M. K. Gupta, Practical Physics, Atma Ram & Sons, Delhi
- Arora, C. L. (2001). B. Sc. practical physics. S. Chand Publishing.

#### Content Mapping with NEP thrust areas

| Field                     | Hours Devoted |
|---------------------------|---------------|
| Employability             | 4             |
| Entrepreneurship          | 2             |
| Skill Enhancement         | 10            |
| Communication Development | 2             |
| Indian Knowledge System   | 1             |
| Environmental Awareness   | 1             |

#### Important Notes:

**Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Subject                                                                                       | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                      |                  |
| Semester                                                                                      | Semester 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                      |                  |
| Nomenclature of the Course                                                                    | Atomic Spectroscopy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Course Code                                                                                   | 26L5.0-PHY-403                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                      |                  |
| Course Type                                                                                   | MCC-8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Atomic Physics and Quantum Mechanics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.0-PHY-403.1:</b> Explain the historical development of atomic spectroscopy and analyze hydrogen spectra using Bohr's atomic model and its limitations.</p> <p><b>26L5.0-PHY-403.2:</b> Apply the vector atom model to explain electron spin, angular momentum coupling, spectroscopic terms, magnetic moments, and fine structure of alkali spectra</p> <p><b>26L5.0-PHY-403.3:</b> Analyze the interaction of atoms with external electric and magnetic fields through Zeeman, Paschen–Back, and Stark effects and interpret their spectroscopic applications</p> <p><b>26L5.0-PHY-403.4:</b> Analyze, quantify, and experimentally validate the fundamental principles of quantum mechanics—including energy quantization, atomic transitions, fine structure splitting, and magneto-optical perturbations—by conducting advanced spectroscopic measurements and evaluating atomic parameters</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0                   | 1                    | 4                |
| <b>Teaching hours per week</b>                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0                   | 2                    | 5                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     | 05                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     | 20                   | 70               |
| <b>Max. Marks</b>                                                                             | 70                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     | 30                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 3 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     | 2 Hours              | 3 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <p><b>Historical background of atomic spectroscopy:</b> Introduction of early observations, emission and absorption spectra, atomic spectra, wave number, Bohr atomic model (Bohr's postulates), spectra of Hydrogen atom, explanation of spectral series in Hydrogen atom, un-quantized states and continuous spectra, spectral series in absorption spectra, effect to nuclear motion on a line spectra (correction of finite nuclear mass), variation in Rydberg constant due to finite mass, short comings of Bohr's theory, Penetrating and Non-penetrating orbits, Penetrating orbits on the classical model.</p> | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |    |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <p><b>Vector atom model (single valence electron):</b> space quantization, electron spin, coupling of orbital and spin angular momentum, spectroscopic terms and their notation, quantum numbers associated with vector atom model, Orbital magnetic dipole moment (Bohr magneton), behavior of magnetic dipole in external magnetic field; Larmor's precession and Larmor's theorem. spin-orbit interaction energy of the single valence electron.</p> <p>Absorption spectra of Alkali atoms observed doublet fine structure in the spectra of alkali metals and their interpretation, Intensity rules for doublets</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2 | 15 |
| Unit-3                | <p><b>Atom in external field:</b> Zeeman Effect (normal and Anomalous), Experimental set-up for studying Zeeman effect, Explanation of normal Zeeman effect (classical and quantum mechanical), Explanation of anomalous Zeeman effect (Lande g-factor), Zeeman pattern of D1 and D2 lines of Na-atom, Paschen-Back effect of a single valence electron system. Weak-field Stark effect of Hydrogen atom.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3 | 15 |
| Practical Component s | <p><b>Practicum</b></p> <ol style="list-style-type: none"> <li>To demonstrate the concept of quantization of the energy levels according to Bohr's model of an atom.</li> <li>Study of the excitation potential of an atom using the Franck-Hertz experiment setup.</li> <li>To determine the wavelengths of the hydrogen spectrum and hence to determine the value of Rydberg's Constant (<math>R_H</math>).</li> <li>To determine the Wavelength of the H-alpha Emission Line of the hydrogen atom.</li> <li>To estimate the temperature of Sodium flame by studying the reversal of spectral lines (D lines).</li> <li>Study of Zeeman effect: with external magnetic field; Hyperfine splitting.</li> <li>To determine the ionization potential of mercury/lithium/sodium vapor.</li> <li>Study of Arc emission spectrum of given samples (Fe and Cu).</li> <li>Measurement of Larmor Precession via Electron Spin Resonance (ESR).</li> <li>Analysis of the Deuterium Spectrum to Calculate Electron-to-Proton Mass Ratio.</li> </ol> <p><b>Note:</b> The student will perform at least six experiments.</p> | 4 | 30 |

| Suggested Evaluation Methods                         |       |       |                                         |       |       |
|------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                              | TH-25 | PR-05 | End Term Examination: 70                | TH-50 | PR-20 |
| Class Participation                                  | 5     | NA    | Written Examination                     | 50    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 05    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                     | 15    | NA    | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0-PHY-403.1                                        | 3                | 2                |                  |                  | 2                |                  | 2                | 3                | 3                | 2                 | 1                 |

|                          |   |   |   |   |   |   |   |   |   |   |   |
|--------------------------|---|---|---|---|---|---|---|---|---|---|---|
| 26L5.0<br>-PHY-<br>403.2 | 3 | 2 |   |   | 2 | 1 | 3 | 3 | 3 | 2 | 2 |
| 26L5.0<br>-PHY-<br>403.3 | 3 | 2 |   | 1 | 2 | 1 | 3 | 3 | 3 | 3 | 2 |
| 26L5.0<br>-PHY-<br>403.4 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

#### Learning Resources

- Concept of Modern Physics (1987), A. Beiser, McGraw-Hill Co Ltd., New Delhi Atomic
- Physics (2007), J.B. Rajab, S Chand & Co, New Delhi
- Fundamentals of Molecular Spectroscopy, Colin N. Banwell and Elaine M. McCash, McGraw-Hill Co Ltd. New Delhi
- Raj Kumar, Atomic & Molecular Spectra, Kedar Nath Ram Nath Publication.
- Physics of Atoms and Molecules 2<sup>nd</sup> Ed (2009), B. H. Bransden and C.J. Joachain, Pearson Education, New Delhi
- Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi
- B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.
- D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.

#### Content Mapping with NEP thrust areas

| Field                               | Hours Devoted |
|-------------------------------------|---------------|
| Employability                       | 4             |
| Entrepreneurship                    | 2             |
| Skill Enhancement                   | 8             |
| Communication Development           | 2             |
| Environmental Awareness             | 2             |
| Current Issues and Social Awareness | 3             |

#### Important Notes:

**Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Subject                                                                                       | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                      |                  |
| Semester                                                                                      | Semester 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |                  |
| Nomenclature of the Course                                                                    | Laser Physics and Fiber Optics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                      |                  |
| Course Code                                                                                   | 26L5.0-PHY-404                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                      |                  |
| Course Type                                                                                   | DSE-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |                  |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Optics and Modern Physics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.0-PHY-404.1:</b> Understand the basic principle of laser, Einstein's coefficients and their physical significance. Line broadening and its reasons.</p> <p><b>26L5.0-PHY-404.2:</b> Qualitative understanding of different lasing mechanism, variation of output laser power around threshold and basic idea of oscillating of modes in laser cavity and their roles in propagation.</p> <p><b>26L5.0-PHY-404.3:</b> Understand about optical fibres and its classification, basic principle involved in propagation of light through optical fibre and its application in communication.</p> <p><b>26L5.0-PHY-404.4:</b> Have the idea of Fibre materials, Fibre Cables and Fabrication Techniques.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0                   | 1                    | 4                |
| <b>Teaching hours per week</b>                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0                   | 2                    | 5                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | 05                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | 20                   | 70               |
| <b>Max. Marks</b>                                                                             | 75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | 25                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 3 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     | 2 Hours              | 3 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <b>Instructions for Examiner:</b><br><b>Theory:</b><br>The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |               |
| <b>Practical:</b><br>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Fundamentals of Lasers and Line Broadening</b><br><br>Introduction to Lasers: Einstein coefficients, absorption and emission cross-sections, light amplification by an atomic system, threshold condition. Origin of line shape functions: Lorentzian and Gaussian line shapes. Line broadening mechanisms: homogeneous broadening: natural broadening and collision broadening and inhomogeneous broadening: Doppler broadening.<br><br>Laser Rate Equations: Two-level, three-level and four-level laser systems, threshold population, threshold pump rate, laser power output with suitable examples. variation of laser power around threshold, optimum output coupling. | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |    |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <p><b>Laser Cavities and Optical Fibres</b></p> <p>Cavity Modes: Number of modes in 1D, 2D and 3D cavities, mode locking, Q-switched lasers and methods of Q-switching.</p> <p>Optical Fibres: Introduction to optical fibres, step-index fibre, graded-index fibre and material dispersion, numerical aperture, pulse dispersion in step-index fibres, comparison of step-index and graded-index fibres. Propagation of light in optical fibres: basic structure and optical path of optical fibres, modes of propagation, meridional and skew rays, number of modes and cut-off parameters of fibres, single-mode propagation.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2 | 15 |
| Unit-3                | <p><b>Fibre Materials, Losses and Fabrication Techniques</b></p> <p>Fibre Materials and Losses: Glass fibres and plastic fibres, bending losses, intrinsic fibre losses, scattering losses and absorption losses.</p> <p>Fibre Cables: Fibre cable construction, cable tensile loading, minimum bend radius, losses incurred during installation of cables, testing of cables, cable selection criteria.</p> <p>Fabrication Techniques: Outside Vapour Phase Oxidation (OVPO), Vapour Phase Axial Deposition (VAD) and Modified Chemical Vapour Deposition (MCVD).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3 | 15 |
| Practical Component s | <ol style="list-style-type: none"> <li>1. To determine wave length and angular divergence of LASER beam.</li> <li>2. Demonstration of Temporal coherence and measurement of wavelength of laser light using Michelson interferometer.</li> <li>3. Measurement of refractive index using Brewster angle.</li> <li>4. Febry-Parrot interferometer.</li> <li>5. Study of spectrum of iodine vapour and deduce force constant for the iodine molecule.</li> <li>6. To study modulation and demodulation (Amplitude and frequency).</li> <li>7. To study and perform Pulse Amplitude Modulation and Demodulation.</li> <li>8. To study and perform Pulse Width Modulation and Demodulation.</li> <li>9. To study and perform Pulse Position Modulation and Demodulation.</li> <li>10. To determine Numerical aperture and acceptance angle of a given optical fiber.</li> <li>11. Determination of diameter of wire using He-Ne Laser.</li> <li>12. Study double slit interference by He-Ne laser.</li> <li>13. Determination of wavelength of He-Ne Laser by using a diffraction grating.</li> <li>14. To measure then numerical aperture of an optical fibre using He-Ne laser source.</li> </ol> <p><b>Note:</b> The student will perform at least six experiments.</p> | 4 | 30 |

| Suggested Evaluation Methods |       |       |                          |       |       |
|------------------------------|-------|-------|--------------------------|-------|-------|
| Internal Assessment: 30      | TH-25 | PR-05 | End Term Examination: 70 | TH-50 | PR-20 |
| Class Participation          | 5     | NA    | Written Examination      | 50    | NA    |

|                                                      |    |    |                                         |    |    |
|------------------------------------------------------|----|----|-----------------------------------------|----|----|
| Seminar/presentation/assignment/quiz/class test etc. | 5  | NA | Lab record                              | NA | 5  |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA | 05 | Viva-Voce                               | NA | 5  |
| Mid-Term Exam(s)                                     | 15 | NA | Write-up and execution of the practical | NA | 10 |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0-PHY-404.1                                        | 3                | 1                | 1                | 2                |                  | 2                | 1                |                  | 2                |                   |                   |
| 26L5.0-PHY-404.2                                        | 3                | 2                | 1                | 3                |                  | 2                | 2                |                  | 2                |                   |                   |
| 26L5.0-PHY-404.3                                        | 3                | 2                | 1                | 3                |                  | 2                | 3                | 2                | 2                |                   | 1                 |
| 26L5.0-PHY-404.4                                        | 2                | 2                | 1                | 2                |                  | 2                | 3                | 2                | 2                | 1                 | 2                 |

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Ghatak, A. (2017). Optics (6th ed.). McGraw Hill Education.</li> <li>Keiser, G. (2021). Optical fiber communications (5th ed.). McGraw Hill.</li> <li>Senior, J. M., &amp; Jamro, M. Y. (2009). Optical fiber communications: Principles and practice (3rd ed.). Pearson Education.</li> <li>Siegman, A. E. (1986). Lasers. University Science Books.</li> <li>Silfvast, W. T. (2004). Laser fundamentals (2nd ed.). Cambridge University Press.</li> <li>Thyagarajan, K., &amp; Ghatak, A. (2010). Lasers: Fundamentals and applications (2nd ed.). Springer.</li> <li>Saleh, B. E. A., &amp; Teich, M. C. (2019). Fundamentals of photonics (3rd ed.). Wiley.</li> <li>Svelto, O. (2010). Principles of lasers (5th ed.). Springer.</li> <li>Thyagarajan, K., &amp; Ghatak, A. (2007). Fiber optic essentials. Wiley India</li> <li>Indian Institute of Technology Kanpur. (n.d.). NPTEL: Laser: Fundamentals and applications. National Programme on Technology Enhanced Learning. <a href="https://nptel.ac.in">https://nptel.ac.in</a></li> <li>Indian Institute of Technology Kharagpur. (n.d.). NPTEL: Fiber optic communication technology. National Programme on Technology Enhanced Learning. <a href="https://nptel.ac.in">https://nptel.ac.in</a></li> <li>Flint, B. L., &amp; Worsnop, H. T. (1971). Advanced practical physics for students. Asia Publishing House.</li> <li>Prakash, I., &amp; Ramakrishna. (2011). A textbook of practical physics. Kitab Mahal.</li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 4             |
| Entrepreneurship                      | 4             |
| Skill Enhancement                     | 10            |
| Current Issues and Social Awareness   | 2             |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Subject                                                                                       | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Semester                                                                                      | Semester 4                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
| Nomenclature of the Course                                                                    | Physics of Nano Materials                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                      |                  |
| Course Code                                                                                   | 26L5.0-PHY-405                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                      |                  |
| Course Type                                                                                   | DSE-1                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |                  |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of solid state physics and quantum mechanics.                                                                                                                                                                                                                                                                                                                                                                           |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <b>26L5.0-PHY-405.1:</b> Understand the properties of Nano materials/ nanostructures<br><b>26L5.0-PHY-405.2:</b> Understand the basic Physics of methods for preparation of Nano materials/nanostructures<br><b>26L5.0-PHY-405.3:</b> Understand the basic Physics of Characterization& Instrumentation Technique for Nanomaterials/ nanostructures.<br><b>26L5.0-PHY-405.4:</b> Understand the application and advantages of Nanomaterials |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0                   | 1                    | 4                |
| <b>Teaching hours per week</b>                                                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0                   | 2                    | 5                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 25                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | 05                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 50                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | 20                   | 70               |
| <b>Max. Marks</b>                                                                             | 75                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | 25                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 3 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     | 2 Hours              | 3 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <b>Instructions for Examiner:</b><br><b>Theory:</b><br>The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |               |
| <b>Practical:</b><br>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Fundamentals of Nanomaterials:</b><br>Definition of nanomaterials, historical background and developments, Richard Feynman's statement, Moore's law, quantum confinement and size effects in nanosystems.<br><b>Nanostructures and Carbon Nanomaterials:</b> Quantum dots, nanowires, different allotropes of carbon, introduction to carbon nanotubes (CNTs), structure and types of CNTs (SWNTs and MWNTs), Bucky balls (C60), graphene, semiconductor nanoparticles – types and properties.<br><b>Synthesis Methods for Nanomaterials/Nanostructures:</b> Bottom-up and top-down approaches for synthesis of nanomaterials, sol-gel process, epitaxial core-shell nanoparticles and ball milling. | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |    |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <b>Characterization Techniques of Nanomaterials:</b><br>X-ray Diffraction (XRD): Basic principle and instrumentation, determination of crystallite/particle size and strain in nanomaterials using Debye-Scherrer formula and Williamson–Hall plot. UV-Visible Spectroscopy: Basic principle and instrumentation; optical energy band gap, Tauc plot and surface plasmon peaks. Photoluminescence (PL) Spectroscopy: Basic principle and instrumentation; Raman Spectroscopy: Basic principle and instrumentation; variations in Raman spectra of nanomaterials with particle size; Raman spectra of carbon nanotubes and graphene.                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2 | 15 |
| Unit-3                | <b>Applications of Nanotechnology and Nanomaterials:</b><br>Importance of nanoscale and nanotechnology, applications of nanotechnology in automobiles, electronics and devices, nano-biotechnology, materials science, medicine, food industry, textiles and fabrics, sporting equipment and goods, chemical and biosensors, water quality enhancement, space science, air quality improvement, IT sector, environmental remediation and agriculture.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 3 | 15 |
| Practical Component s | <ol style="list-style-type: none"> <li>1. To analyze the crystal structure of simple cubic, FCC and associated defects using XRD data.</li> <li>2. To study the crystallite by W-H analysis of XRD data.</li> <li>3. To study wavelength used by using standard FCC/BCC lattice in XRD.</li> <li>4. To analyze the structural of different carbonaceous material (Quantum dot, CNT, grapheme, amorphous, graphite) using RAMAN spectroscopy data.</li> <li>5. To study the RAMAN spectra of Poly carbon ate monomer structure.</li> <li>6. To study the band gap/energy gap of different materials using UV-visible spectroscopy data.</li> <li>7. To study the Transmission spectra using UV-visible spectroscopy data.</li> <li>8. To study the Absorption spectra using UV-visible spectroscopy data.</li> <li>9. To study the band transition in different luminescent materials using PL spectroscopy data.</li> <li>10. To study the e mission and absorption spectra of a material using PL spectroscopy data.</li> </ol> <p><b>Note:</b> The student will perform at least six experiments.</p> | 4 | 30 |

| Suggested Evaluation Methods                          |       |       |                                         |       |       |
|-------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                               | TH-25 | PR-05 | End Term Examination: 70                | TH-50 | PR-20 |
| Class Participation                                   | 5     | NA    | Written Examination                     | 50    | NA    |
| Seminar/presentation/assignment/quiz/cla ss test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.      | NA    | 05    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                      | 15    | NA    | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme learning Outcomes |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|--------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                              | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0-PHY-405.1                                 | 3                | 1                | 1                | 2                |                  | 2                | 1                | 1                | 2                |                   |                   |
| 26L5.0-PHY-405.2                                 | 3                | 2                | 1                | 2                |                  | 3                | 3                | 1                | 2                | 1                 | 2                 |
| 26L5.0-PHY-405.3                                 | 2                | 3                | 2                | 3                | 1                | 3                | 3                | 1                | 2                | 1                 | 2                 |
| 26L5.0-PHY-405.4                                 | 2                | 2                | 2                | 2                |                  | 2                | 2                | 3                | 2                | 2                 | 2                 |

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Cao, G., &amp; Wang, Y. (2011). <i>Nanostructures and nanomaterials: Synthesis, properties and applications</i> (2nd ed.). World Scientific Publishing.</li> <li>• Guozhong, C. (2004). <i>Nanostructures and nanomaterials: Synthesis, properties and applications</i>. Imperial College Press.</li> <li>• Kelsall, R. W., Hamley, I. W., &amp; Geoghegan, M. (2005). <i>Nanoscale science and technology</i>. John Wiley &amp; Sons.</li> <li>• Poole, C. P., Jr., &amp; Owens, F. J. (2003). <i>Introduction to nanotechnology</i>. John Wiley &amp; Sons.</li> <li>• Pradeep, T. (2017). <i>Nano: The essentials—Understanding nanoscience and nanotechnology</i> (2nd ed.). McGraw Hill Education.</li> <li>• Bhushan, B. (Ed.). (2017). <i>Springer handbook of nanotechnology</i> (4th ed.). Springer.</li> <li>• Gleiter, H. (2000). <i>Nanostructured materials: Basic concepts and microstructure</i>. Acta Materialia, 48(1), 1–29.</li> <li>• Kittel, C. (2005). <i>Introduction to solid state physics</i> (8th ed.). John Wiley &amp; Sons.</li> <li>• Schuller, I. K., &amp; Alivisatos, A. P. (Eds.). (2010). <i>Nanoscience and technology: A collection of reviews from Nature journals</i>. World Scientific.</li> <li>• Cullity, B. D., &amp; Stock, S. R. (2001). <i>Elements of X-ray diffraction</i> (3rd ed.). Prentice Hall.</li> <li>• Smith, E., &amp; Dent, G. (2019). <i>Modern Raman spectroscopy: A practical approach</i> (2nd ed.). John Wiley &amp; Sons.</li> <li>• Dresselhaus, M. S., Dresselhaus, G., &amp; Avouris, P. (Eds.). (2001). <i>Carbon nanotubes: Synthesis, structure, properties and applications</i>. Springer.</li> <li>• Yu, P. Y., &amp; Cardona, M. (2010). <i>Fundamentals of semiconductors: Physics and materials properties</i> (4th ed.). Springer.</li> <li>• Indian Institute of Technology. (n.d.). <i>Nanotechnology: Science and applications</i>. <a href="https://onlinecourses.nptel.ac.in/e-learning/preview/noc19_mm21">https://onlinecourses.nptel.ac.in/e-learning/preview/noc19_mm21</a></li> <li>• Massachusetts Institute of Technology. (n.d.). <i>MIT OpenCourseWare: Nanotechnology and nanomaterials</i>. <a href="https://ocw.mit.edu/courses/3-012-fundamentals-of-materials-science-fall-2005/">https://ocw.mit.edu/courses/3-012-fundamentals-of-materials-science-fall-2005/</a></li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 5             |
| Entrepreneurship                      | 5             |
| Skill Enhancement                     | 12            |
| Environmental Awareness               | 3             |
| Current Issues and Social Awareness   | 4             |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |                  |
| Semester                                                                                      | 2nd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |                  |
| Nomenclature of the Course                                                                    | Physics Laboratory Skill Enhancement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |                  |
| Course Code                                                                                   | 26L4.5- SEC-PHY- 201                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |                  |
| Course Type                                                                                   | SEC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                      |                  |
| Course Level                                                                                  | 100-199                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Measurements and Laboratory Practices.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L4.5- SECPHY- 201.1:</b> Explain the principles of physical measurements, uncertainty estimation, error analysis, statistical treatment of experimental data, and curve fitting, and apply them to analyze and interpret experimental results.</p> <p><b>26L4.5- SECPHY- 201.2:</b> Describe the working principles, operation, and applications of common laboratory instruments, optical devices, electrical and electronic components, and demonstrate awareness of laboratory safety, ethics, and scientific documentation.</p> <p><b>26L4.5- SECPHY- 201.3:</b> Perform physics experiments using standard laboratory instruments, acquire and analyze experimental data, estimate uncertainties, and communicate the results through well-documented laboratory reports.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0                   | 1                    | 3                |
| <b>Teaching hours per week</b>                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0                   | 2                    | 4                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     | 5                    | 20               |
| <b>End Term Exam Marks</b>                                                                    | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     | 20                   | 55               |
| <b>Max. Marks</b>                                                                             | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     | 25                   | 75               |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     | 2 Hours              | 2 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Physical quantities, SI units and dimensional analysis; accuracy, precision and calibration of measuring instruments; types and sources of errors; uncertainty estimation and propagation of errors; significant figures; statistical analysis of repeated measurements (mean, standard deviation and standard error); graphical representation of experimental data; curve fitting (linear fit and least-squares method), interpretation of slope and intercept, correlation coefficient (qualitative); use of Vernier caliper, screw gauge, spherometer, travelling microscope, spectrometer and sextant; maintenance of laboratory records and preparation of scientific reports. | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |    |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | Basic electrical and electronic components (resistors, capacitors, inductors, diodes and transistors); use of digital multimeter (DMM), regulated power supply, function generator and CRO/DSO; optical instruments (microscope, telescope, prism, diffraction grating and spectrometer) their theory and applications; basics of sensors and digital measuring devices; laboratory safety, electrical safety, handling of optical equipment and chemicals; good laboratory practices, ethics and scientific documentation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2 | 15 |
| Practical Component s | <ol style="list-style-type: none"> <li>1. Measurement of length, diameter and thickness using Vernier caliper, screw gauge and travelling microscope.</li> <li>2. Determination of the radius of curvature of a spherical surface using a spherometer.</li> <li>3. Determination of the height or area of an inaccessible object using a sextant.</li> <li>4. Identification, least count determination and alignment of a spectrometer.</li> <li>5. Determination of the refractive index of a prism using a spectrometer.</li> <li>6. Determination of the focal length/power of a convex or concave lens by an appropriate method.</li> <li>7. Determination of the focal length of a concave or convex mirror.</li> <li>8. Measurement of the resolving power of a telescope or microscope.</li> <li>9. Study of the V-I characteristics of a resistor and verification of Ohm's law.</li> <li>10. Study of the V-I characteristics of a p-n junction diode.</li> <li>11. Measurement of AC/DC voltage, current and resistance using a Digital Multimeter (DMM).</li> <li>12. Study of a regulated DC power supply and measurement of ripple voltage.</li> <li>13. Construction and testing of simple electrical circuits on a breadboard (series, parallel and voltage-divider circuits).</li> <li>14. Data analysis using spreadsheets (Excel/LibreOffice): graphical plotting, linear least-squares fitting, determination of slope/intercept, and estimation of uncertainty.</li> </ol> <p><b>Note:</b> The student will perform at least six experiments.</p> | 3 | 30 |

| Suggested Evaluation Methods                          |       |      |                                         |       |       |
|-------------------------------------------------------|-------|------|-----------------------------------------|-------|-------|
| Internal Assessment: 20                               | TH-15 | PR-5 | End Term Examination: 55                | TH-35 | PR-20 |
| Class Participation                                   | 5     | NA   | Written Examination                     | 35    | NA    |
| Seminar/presentation/assignment/quiz/cla ss test etc. | 5     | NA   | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.      | NA    | 5    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                      | 5     | NA   | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L4.5<br>-<br>SECP<br>HY-<br>201.1                     | 3                | 1                | 1                | 2                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |

|                                                                 |   |   |   |   |   |   |   |   |   |   |   |
|-----------------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|
| <b>26L4.5</b><br>-<br><b>SECP</b><br><b>HY-</b><br><b>201.2</b> | 3 | 1 | 1 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 2 |
| <b>26L4.5</b><br>-<br><b>SECP</b><br><b>HY-</b><br><b>201.3</b> | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <ul style="list-style-type: none"> <li>♦ Arora, C. L. (2015). <i>B.Sc. practical physics</i>. S. Chand Publishing.</li> <li>♦ Bevington, P. R., &amp; Robinson, D. K. (2003). <i>Data reduction and error analysis for the physical sciences</i> (3rd ed.). McGraw-Hill.</li> <li>♦ Horowitz, P., &amp; Hill, W. (2015). <i>The art of electronics</i> (3rd ed.). Cambridge University Press.</li> <li>♦ Taylor, J. R. (1997). <i>An introduction to error analysis: The study of uncertainties in physical measurements</i> (2nd ed.). University Science Books.</li> <li>♦ Lipson, A., Lipson, S. G., &amp; Lipson, H. (1995). <i>Optical physics</i> (4th ed.). Cambridge University Press.</li> <li>♦ Theraja, B. L., &amp; Theraja, A. K. (2014). <i>A textbook of electrical technology</i> (Vol. 1). S. Chand Publishing.</li> <li>♦ Gupta, S. L., &amp; Kumar, V. (2019). <i>Practical physics</i>. Pragati Prakashan.</li> <li>♦ Srivastava, S. S., &amp; Gupta, M. K. (2014). <i>Practical physics</i>. Atma Ram &amp; Sons.</li> <li>♦ Hughes, E. (2016). <i>Hughes electrical and electronic technology</i> (12th ed., J. Hiley, K. Brown, &amp; I. McKenzie Smith, Eds.). Pearson.</li> <li>♦ Wilson, J., &amp; Hernandez-Hall, C. (2015). <i>Physics laboratory experiments</i> (8th ed.). Cengage Learning.</li> </ul> |  |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Skill Enhancement                     | 30            |

| Important Notes: |
|------------------|
|                  |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                      |                  |
| Semester                                                                                      | 3rd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |                  |
| Nomenclature of the Course                                                                    | Basic Instrumentation Skills                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                      |                  |
| Course Code                                                                                   | 26L5.0- SEC-PHY- 301                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Course Type                                                                                   | SEC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                      |                  |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Electronics and Measurement Principles                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.0- SECPHY- 301.1:</b> Explain the principles of measurement, calibration, uncertainty, and electronic measuring instruments, and apply them for accurate electrical and electronic measurements.</p> <p><b>26L5.0- SECPHY- 301.2:</b> Describe the working principles, specifications, and applications of oscilloscopes, signal generators, electronic bridges, sensors, and other electronic test instruments for measurement and analysis.</p> <p><b>26L5.0- SECPHY- 301.3:</b> Operate common electronic measuring instruments, perform electrical and electronic measurements, analyze experimental data, estimate measurement uncertainties, and present results through appropriate laboratory documentation.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0                   | 1                    | 3                |
| <b>Teaching hours per week</b>                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0                   | 2                    | 4                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | 5                    | 20               |
| <b>End Term Exam Marks</b>                                                                    | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | 20                   | 55               |
| <b>Max. Marks</b>                                                                             | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | 25                   | 75               |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     | 2 Hours              | 2 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <b>Instructions for Examiner:</b><br><b>Theory:</b><br>The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |               |
| <b>Practical:</b><br>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Measurement Principles and Electronic Measuring Instruments:</b> Measurement systems; accuracy, precision, sensitivity, resolution, range and calibration; types and sources of errors, loading effects and uncertainty in measurements; <b>Digital Multimeter (DMM):</b> principles, specifications and applications for measurement of AC/DC voltage, current, resistance, continuity and capacitance; <b>Electronic Voltmeters:</b> basic principle, input impedance, sensitivity and applications; <b>Signal and Function Generators:</b> block diagram, waveform generation (sine, square, triangular and pulse), specifications and applications; basics of regulated DC power supplies. | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |    |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <b>Oscilloscopes, Electronic Test Instruments and Sensors:</b> Cathode Ray Oscilloscope (CRO) and Digital Storage Oscilloscope (DSO): block diagram, working principle, front-panel controls, probes, triggering, time-base operation and specifications; measurement of voltage, frequency, time period and phase difference using CRO/DSO; <b>Electronic Bridges and LCR Meter:</b> principles and applications of Wheatstone bridge, LCR bridge and digital LCR meter; basics of Q-meter; introduction to sensors and transducers (temperature, light, pressure and displacement), data acquisition systems and computer interfacing; laboratory safety and good instrumentation practices.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2 | 15 |
| Practical Component s | <ol style="list-style-type: none"> <li>1. Measurement of AC/DC voltage, current, resistance, continuity and capacitance using a Digital Multimeter (DMM).</li> <li>2. Study of the loading effect of a multimeter while measuring voltage across low-and high-resistance circuits.</li> <li>3. Study and operation of a regulated DC power supply and measurement of output voltage and ripple.</li> <li>4. Measurement of voltage, frequency and time period using a CRO/DSO.</li> <li>5. Measurement of phase difference between two sinusoidal signals using a dual-trace CRO/DSO.</li> <li>6. Measurement of rise time, fall time and pulse width using a CRO/DSO.</li> <li>7. Generation and observation of sine, square and triangular waveforms using a function generator and their analysis using a CRO/DSO.</li> <li>8. Measurement of resistance, inductance and capacitance using a digital LCR meter (or LCR bridge, if available).</li> <li>9. Measurement of frequency and time period using a frequency counter (or using DSO frequency measurement if a frequency counter is unavailable).</li> <li>10. Calibration and performance evaluation of measuring instruments by comparing readings of two instruments and estimating measurement uncertainty. <b>Note:</b> The student will perform at least six experiments.</li> </ol> | 3 | 30 |

| Suggested Evaluation Methods                          |       |      |                                         |       |       |
|-------------------------------------------------------|-------|------|-----------------------------------------|-------|-------|
| Internal Assessment: 20                               | TH-15 | PR-5 | End Term Examination: 55                | TH-35 | PR-20 |
| Class Participation                                   | 5     | NA   | Written Examination                     | 35    | NA    |
| Seminar/presentation/assignment/quiz/cla ss test etc. | 5     | NA   | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.      | NA    | 5    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                      | 5     | NA   | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0<br>-<br>SECP<br>HY-<br>301.1                     | 3                | 1                | 1                | 2                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |
| 26L5.0<br>-<br>SECP<br>HY-<br>301.2                     | 3                | 1                | 1                | 2                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |
| 26L5.0<br>-<br>SECP<br>HY-<br>301.3                     | 3                | 2                | 3                | 2                | 2                | 2                | 2                | 3                | 3                | 3                 | 2                 |

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <ul style="list-style-type: none"> <li>Bentley, J. P. (2005). <i>Principles of measurement systems</i> (4th ed.). Pearson Education.</li> <li>Doebelin, E. O., &amp; Manik, D. N. (2011). <i>Measurement systems: Application and design</i> (6th ed.). McGraw-Hill.</li> <li>Ghoshal, S. (2012). <i>Digital electronics</i>. Cengage Learning.</li> <li>Gupta, J. B. (2015). <i>Electronic instruments and systems</i>. S. K. Kataria &amp; Sons.</li> <li>Helfrick, A. D., &amp; Cooper, W. D. (2015). <i>Modern electronic instrumentation and measurement techniques</i>. PHI Learning.</li> <li>Horowitz, P., &amp; Hill, W. (2015). <i>The art of electronics</i> (3rd ed.). Cambridge University Press.</li> <li>Sawhney, A. K. (2015). <i>A course in electrical and electronic measurements and instrumentation</i>. Dhanpat Rai &amp; Co.</li> <li>Theraja, B. L., &amp; Theraja, A. K. (2014). <i>A textbook of electrical technology</i> (Vol. 1). S. Chand Publishing.</li> </ul> |  |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Skill Enhancement                     | 30            |

| Important Notes: |
|------------------|
|                  |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |              |
|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|--------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                      |              |
| Semester                                                                                      | 3rd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |              |
| Course Composition                                                                            | Theory (Theory + Tutorial)                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |              |
| Nomenclature of the Course                                                                    | Exploring the journey of Indian Space Satellite                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |              |
| Course Code                                                                                   | 26L5.0-VAC-PHY - 301                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                      |              |
| Course Type                                                                                   | VAC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |              |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                      |              |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Physics and Astronomy                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                      |              |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.0-VAC-PHY - 301.1:</b> Explain the concepts of satellite systems, orbital mechanics, communication satellites, Indian Space Programme, and analyze orbital parameters and satellite placement in geostationary orbit</p> <p><b>26L5.0-VAC-PHY - 301.2:</b> Describe the evolution of the Indian Space Programme, space centres, Indian satellites, launch vehicle technology, remote sensing, communication satellites, and evaluate their applications in national development</p> |                     |                      |              |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     | <b>Practical (P)</b> | <b>Total</b> |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Tutorial (T)</b> |                      |              |
| <b>Credits</b>                                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0                   | 0                    | 2            |
| <b>Teaching hours per week</b>                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0                   | 0                    | 2            |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     | 0                    | 15           |
| <b>End Term Exam Marks</b>                                                                    | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     | 0                    | 35           |
| <b>Max. Marks</b>                                                                             | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     | 0                    | 50           |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     | NA                   | 2 Hours      |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------|
| <b>Instructions for Examiner:</b><br><b>Theory:</b><br>The paper setter shall prepare <b>5 questions</b> selecting <b>two questions</b> from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be <b>compulsory</b> . Examinees will be required to attempt <b>three questions</b> : the compulsory question no. 1 and 1 question from each of the two units. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |                      |
| <b>Unit</b>                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>CLO(s)</b> | <b>Contact Hours</b> |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                              | Concept of a satellite, ideas and theories, Concept of Orbits, the transfer orbit, hurdles in launching a satellite, space scarcity in space. Indian space program, Objectives of the Indian Space Program, organizational setup, Communication Satellite: Orbit and Description: A brief History of Satellite Communication, Satellite Frequency bands, Satellite Systems, Applications, Orbital Period and Velocity, Effects of Orbital inclination, Azimuth and Elevation, Coverage and Slant range, Eclipse, Orbital perturbations, Placement of a Satellite in a Geo-Stationary Orbit. | 1             | 15                   |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                              | Space Centres and institutes, Genesis of Indian's space program, Indian Satellites, Indian Communications satellites and their applications. Classification of Satellites based on Orbit Height. Indian remote sensing satellites, Indian National Satellites, Launch vehicle technology, Milestones in India's Space Programme.                                                                                                                                                                                                                                                            | 2             | 15                   |

| Suggested Evaluation Methods                         |              |             |                                 |              |             |
|------------------------------------------------------|--------------|-------------|---------------------------------|--------------|-------------|
| <b>Internal Assessment: 15</b>                       | <b>TH-15</b> | <b>PR-0</b> | <b>End Term Examination: 35</b> | <b>TH-35</b> | <b>PR-0</b> |
| Class Participation                                  | 5            | NA          | Written Examination             | 35           | NA          |
| Seminar/presentation/assignment/quiz/class test etc. | 5            | NA          | Lab record                      | NA           | NA          |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA           | NA          | Viva-Voce                       | NA           | NA          |

|                  |   |    |                                         |    |    |
|------------------|---|----|-----------------------------------------|----|----|
| Mid-Term Exam(s) | 5 | NA | Write-up and execution of the practical | NA | NA |
|------------------|---|----|-----------------------------------------|----|----|

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0<br>-VAC-<br>PHY -<br>301.1                       | 3                | 2                |                  | 1                | 2                |                  | 2                | 3                | 3                | 3                 | 2                 |
| 26L5.0<br>-VAC-<br>PHY -<br>301.2                       | 3                | 2                | 2                | 2                | 3                | 2                | 2                | 2                | 3                | 3                 | 3                 |

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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| <ul style="list-style-type: none"> <li>India Science. (n.d.). <i>ISRO: India's space journey (E-2)</i> [Video]. <a href="https://www.indiascience.in/videos/isro-indias-space-journey-e-2">https://www.indiascience.in/videos/isro-indias-space-journey-e-2</a></li> <li>India Science. (n.d.). <i>ISRO: India's space journey (Part 2, E-1)</i> [Video]. <a href="https://www.indiascience.dst.gov.in/videos/isro-indias-space-journey-part-2-e-1">https://www.indiascience.dst.gov.in/videos/isro-indias-space-journey-part-2-e-1</a></li> <li>nsightsIAS. (n.d.). <i>Milestones in India's space programme</i>. <a href="https://www.insightsonindia.com/science-technology/space-technology/milestones-in-indias-space-programme/">https://www.insightsonindia.com/science-technology/space-technology/milestones-in-indias-space-programme/</a></li> <li>ClearIAS. (n.d.). <i>Indian space program</i>. <a href="https://www.clearias.com/indian-space-program">https://www.clearias.com/indian-space-program</a></li> <li>Basu, B. (2008). <i>Science 366: A chronicle of science and technology</i>. Universities Press</li> <li>Mishra, P. C. (2008). <i>Science and technology</i>. Chronicle Books.</li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 4             |
| Entrepreneurship                      | 2             |
| Skill Enhancement                     | 6             |
| Communication Development             | 2             |
| Indian Knowledge System               | 2             |
| Environmental Awareness               | 3             |
| Current Issues and Social Awareness   | 1             |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |              |
|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|--------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |              |
| Semester                                                                                      | 4th                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                      |              |
| Course Composition                                                                            | Theory (Theory + Tutorial)                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |              |
| Nomenclature of the Course                                                                    | Physics in Everyday Life                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |              |
| Course Code                                                                                   | 26L5.0-VAC-PHY-401                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |              |
| Course Type                                                                                   | VAC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                      |              |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |              |
| Pre-requisites for the course (if any)                                                        | Basic knowledge of Elementary Physics                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |              |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.0-VAC-PHY-401.1:</b> Explain the physics principles underlying everyday phenomena involving force, work, energy, power, pressure, fluid mechanics, heat, and their applications in common household appliances and transportation</p> <p><b>26L5.0-VAC-PHY-401.2:</b> Apply the principles of sound, optics, electricity, electromagnetism, and modern physics to explain the working of optical instruments, electrical appliances, and photoelectric devices used in daily life</p> |                     |                      |              |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     | <b>Practical (P)</b> | <b>Total</b> |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Tutorial (T)</b> |                      |              |
| <b>Credits</b>                                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0                   | 0                    | 2            |
| <b>Teaching hours per week</b>                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0                   | 0                    | 2            |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     | 0                    | 15           |
| <b>End Term Exam Marks</b>                                                                    | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     | 0                    | 35           |
| <b>Max. Marks</b>                                                                             | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     | 0                    | 50           |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | NA                   | 2 Hours      |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                      |               |                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------|
| <b>Instructions for Examiner:</b><br><b>Theory:</b><br>The paper setter shall prepare <b>5 questions</b> selecting <b>two questions</b> from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be <b>compulsory</b> . Examinees will be required to attempt <b>three questions</b> : the compulsory question no. 1 and 1 question from each of the two units. |                                                                                                                                                                                                                                                                      |               |                      |
| <b>Unit</b>                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Topics</b>                                                                                                                                                                                                                                                        | <b>CLO(s)</b> | <b>Contact Hours</b> |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                              | Everyday activities related to Force, weight, work, energy, power, and centrifuge; washing machine; variation of boiling point with pressure; pressure cooker; cooling by expansion; refrigerator; air conditioner; Bernoulli principle – Bunsen burner; aeroplane.  | 1             | 15                   |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                              | Sound waves, Doppler Effect, power of a lens, long sight and short sight, microscope, telescope, binocular camera, video camera, working of the tube light and fan, kilowatt-hour, fuse and heating elements, microwave oven, electric heater, photoelectric effect. | 2             | 15                   |

| Suggested Evaluation Methods                         |              |             |                                         |              |             |
|------------------------------------------------------|--------------|-------------|-----------------------------------------|--------------|-------------|
| <b>Internal Assessment: 15</b>                       | <b>TH-15</b> | <b>PR-0</b> | <b>End Term Examination: 35</b>         | <b>TH-35</b> | <b>PR-0</b> |
| Class Participation                                  | 5            | NA          | Written Examination                     | 35           | NA          |
| Seminar/presentation/assignment/quiz/class test etc. | 5            | NA          | Lab record                              | NA           | NA          |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA           | NA          | Viva-Voce                               | NA           | NA          |
| Mid-Term Exam(s)                                     | 5            | NA          | Write-up and execution of the practical | NA           | NA          |

| Mapping of (CLOs) to Programme Learning Outcomes |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|--------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                              | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0<br>-VAC-<br>PHY-<br>401.1                 | 3                | 2                |                  | 2                | 2                |                  | 1                | 3                | 3                | 2                 | 2                 |
| 26L5.0<br>-VAC-<br>PHY-<br>401.2                 | 3                | 2                |                  | 2                | 2                | 1                | 2                | 3                | 3                | 3                 | 3                 |

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Murugesan, R. (2006). <i>Allied Physics I &amp; II</i>. S. Chand &amp; Co.</li> <li>• .Mathur, D. S. (2010). <i>Elements of properties of matter</i>. S. Chand &amp; Company Ltd.</li> <li>• Murugesan, R. (2012). <i>Properties of matter and acoustics</i>. S. Chand &amp; Co</li> <li>• Brijlal, Subrahmanyam, N., &amp; Hemne, P. S. (2004). <i>Heat and thermodynamics</i>. S. Chand &amp; Company Ltd</li> <li>• Murugesan, R. (2010). <i>Electricity and magnetism</i>. S. Chand &amp; Company Ltd.</li> <li>• Murugesan, R., &amp; Sivaprasath, K. (2016). <i>Modern physics</i>. S. Chand &amp; Company Ltd.</li> <li>• Subrahmanyam, N., Brijlal, &amp; Avadhanulu, M. N. (2012). <i>A textbook of optics</i>. S. Chand &amp; Company Ltd.</li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 4             |
| Entrepreneurship                      | 2             |
| Skill Enhancement                     | 6             |
| Communication Development             | 2             |
| Environmental Awareness               | 2             |
| Current Issues and Social Awareness   | 2             |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |               |         |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------|---------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |               |         |
| Semester                                                                                      | 3rd                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |               |         |
| Course Composition                                                                            | Theory (Theory + Tutorial)                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |               |         |
| Nomenclature of the Course                                                                    | Basics of Indian Astronomy                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |               |         |
| Course Code                                                                                   | 26L5.0-VAC-PHY-302                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |               |         |
| Course Type                                                                                   | VAC                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |               |         |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |               |         |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Astronomy and Physics                                                                                                                                                                                                                                                                                                                                                                                                                  |              |               |         |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.0-VAC-PHY-302.1:</b> Explain the fundamentals of astronomy, astronomical coordinate systems, telescopes, observational techniques, and digital tools used in modern astronomy, and describe citizen science initiatives in astronomy</p> <p><b>26L5.0-VAC-PHY-302.2:</b> Describe the structure and evolution of the Sun, solar system, galaxies, dark matter, and Indian contributions to astronomy through observatories and space missions.</p> |              |               |         |
|                                                                                               | Theory (Th)                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              | Practical (P) | Total   |
|                                                                                               | Lecture (L)                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Tutorial (T) |               |         |
| Credits                                                                                       | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0            | 0             | 2       |
| Teaching hours per week                                                                       | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0            | 0             | 2       |
| Internal Assessment Marks (Th+P=Total)                                                        | 15                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              | 0             | 15      |
| End Term Exam Marks                                                                           | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              | 0             | 35      |
| Max. Marks                                                                                    | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              | 0             | 50      |
| Examination Duration (in Hours)                                                               | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              | NA            | 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <b>Instructions for Examiner:</b><br><b>Theory:</b><br>The paper setter shall prepare <b>5 questions</b> selecting <b>two questions</b> from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be <b>compulsory</b> . Examinees will be required to attempt <b>three questions</b> : the compulsory question no. 1 and 1 question from each of the two units. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                              | Introduction to Astronomy and Astronomical Scales: History of astronomy, wonders of the Universe, overview of the night sky, diurnal and yearly motions of the Sun, size, mass, density and temperature of astronomical objects, basic concepts of positional astronomy: Celestial sphere, Astronomical coordinate systems, Horizon system and Equatorial system, Astronomical Instruments: Observing through the atmosphere (Scintillation, Seeing, Atmospheric Windows and Extinction). Basic optical definitions for telescopes: Magnification, Light Gathering Power, Limiting magnitude, Resolving Power, Diffraction Limit. Optical telescopes, radio telescopes, Hubble space telescope, James Web space telescope, Fermi Gamma ray space telescope. Astronomy in the Internet Age: Overview of Aladin Sky Atlas, Astrometrica, Sloan Digital Sky Survey, Stellarium, virtual telescope Citizen Science Initiatives: Galaxy Zoo, SETI@Home, RAD@Home India | 1      | 15            |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                              | Sun and the solar family: Solar parameters, Sun's internal structure, solar photosphere, solar atmosphere, chromosphere, corona, solar activity, origin of the solar system, the nebular model, tidal forces and planetary rings Physics of Galaxies: Basic structure and properties of different types of Galaxies, Nature of rotation of the Milky Way (Differential rotation of the Galaxy), Idea of dark matter, Astronomy in India: Astronomy in ancient, medieval and early telescopic era of India, current Indian observatories (Hanle-Indian Astronomical Observatory, Devasthal Observatory, Vainu Bappu Observatory, Mount Abu Infrared Observatory, Gauribidanur Radio Observatory, Giant Metrewave Radio Telescope, Udaipur Solar Observatory, LIGO (India) (qualitative discussion), Indian astronomy missions (Astrosat, Aditya).                                                                                                                  | 2      | 15            |

| Suggested Evaluation Methods                         |       |      |                                         |       |      |
|------------------------------------------------------|-------|------|-----------------------------------------|-------|------|
| Internal Assessment: 15                              | TH-15 | PR-0 | End Term Examination: 35                | TH-35 | PR-0 |
| Class Participation                                  | 5     | NA   | Written Examination                     | 35    | NA   |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA   | Lab record                              | NA    | NA   |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | NA   | Viva-Voce                               | NA    | NA   |
| Mid-Term Exam(s)                                     | 5     | NA   | Write-up and execution of the practical | NA    | NA   |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0-VAC-PHY-302.1                                    | 3                | 2                | 1                | 2                | 3                |                  | 2                | 2                | 3                | 3                 | 2                 |
| 26L5.0-VAC-PHY-302.2                                    | 3                | 2                | 1                | 2                | 3                | 1                | 2                | 3                | 3                | 3                 | 3                 |

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Narlikar, J. V. (1999). <i>Seven wonders of the cosmos</i>. Cambridge University Press</li> <li>Karttunen, H., Kröger, P., Oja, H., Poutanen, M., &amp; Donner, K. J. (2007). <i>Fundamental astronomy</i> (5th ed.). Springer.</li> <li>Carroll, B. W., &amp; Ostlie, D. A. (2007). <i>An introduction to modern astrophysics</i> (2nd ed.). Addison-Wesley</li> <li>Zeilik, M., &amp; Gregory, S. A. (1998). <i>Introductory astronomy &amp; astrophysics</i> (4th ed.). Saunders College</li> <li>Tielens, A. G. G. M. (2013). The molecular universe. <i>Reviews of Modern Physics</i>, 85(3), 1021–1081. <a href="https://doi.org/10.1103/RevModPhys.85.1021">https://doi.org/10.1103/RevModPhys.85.1021</a></li> <li>Padmanabhan, T. (2014). <i>Astronomy in India: A historical perspective</i>. Springer</li> <li>Bhatia, V. B. (2001). <i>Textbook of astronomy and astrophysics with elements of cosmology</i>. Narosa Publishing House</li> <li><a href="https://aladin.u-strasbg.fr/">https://aladin.u-strasbg.fr/</a></li> <li><a href="http://www.astrometrica.at/">http://www.astrometrica.at/</a></li> <li><a href="https://www.sdss.org/">https://www.sdss.org/</a> <a href="http://stellarium.org/">http://stellarium.org/</a></li> <li><a href="https://www.zooniverse.org/projects/zookeeper/galaxy-zoo/">https://www.zooniverse.org/projects/zookeeper/galaxy-zoo/</a></li> <li><a href="https://setiathome.berkeley.edu/">https://setiathome.berkeley.edu/</a></li> <li><a href="https://www.radathomeindia.org/">https://www.radathomeindia.org/</a></li> <li></li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 4             |
| Entrepreneurship                      | 2             |
| Skill Enhancement                     | 6             |
| Communication Development             | 2             |
| Indian Knowledge System               | 4             |
| Environmental Awareness               | 2             |
| Current Issues and Social Awareness   | 3             |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                      |                     |                      |                  |
| Semester                                                                                      | 1st                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Nomenclature of the Course                                                                    | Physics Fundamentals-I                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Course Code                                                                                   | 26L4.5-PHY-104                                                                                                                                                                                                                                                                                                                                                                                    |                     |                      |                  |
| Course Type                                                                                   | MDC                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |                  |
| Course Level                                                                                  | 100-199                                                                                                                                                                                                                                                                                                                                                                                           |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic knowledge of Elementary Mathematics and Science                                                                                                                                                                                                                                                                                                                                             |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L4.5-PHY-104.1:</b> Have knowledge about the nature, scope and impact of physics on technological development of the society.</p> <p><b>26L4.5-PHY-104.2:</b> Understand and describe the laws of motion and their applications in daily life.</p> <p><b>26L4.5-PHY-104.3:</b> Understand and appreciate the importance of laws of conservation of energy and momentum in daily life.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                 | 0                   | 1                    | 3                |
| <b>Teaching hours per week</b>                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                 | 0                   | 2                    | 4                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 15                                                                                                                                                                                                                                                                                                                                                                                                |                     | 5                    | 20               |
| <b>End Term Exam Marks</b>                                                                    | 35                                                                                                                                                                                                                                                                                                                                                                                                |                     | 20                   | 55               |
| <b>Max. Marks</b>                                                                             | 50                                                                                                                                                                                                                                                                                                                                                                                                |                     | 25                   | 75               |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                           |                     | 2 Hours              | 2 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><b>Fundamentals of Physics and Motion</b></p> <p>Nature, scope and importance of Physics, major discoveries and contributions by Indian physicists, fundamental physical constants, impact of Physics on society and modern technology.</p> <p>System of units and measurements: Fundamental and derived units, errors in measurements (definitions only), accuracy and precision.</p> <p>Motion in one dimension: Scalar and vector quantities, distance and displacement, speed and velocity, acceleration, graphical analysis of motion, equations of motion and their applications.</p> | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |    |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <p><b>Force, Gravitation, Work and Energy</b></p> <p>Concept of force and Newton's laws of motion,, Universal law of gravitation, acceleration due to gravity, free fall, mass and weight, thrust, pressure, buoyancy and Archimedes' principle.</p> <p>Work and energy: Kinetic and potential energy, conservation of energy and its applications. Conservation of linear and angular momentum, elastic and inelastic collisions, center of mass and applications in daily life such as cycling, rock climbing and skating.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2 | 15 |
| Practical Component s | <ol style="list-style-type: none"> <li>To measure the diameter of a small spherical/ cylindrical body.</li> <li>To measure the length, width and height of the given rectangular block.</li> <li>To measure the internal diameter and depth of a given beaker/calorimeter and hence find its volume.</li> <li>Use of screw gauge:(i) to measure diameter of a given wire and (ii) to measure thickness of a given sheet.</li> <li>To determine radius of curvature of a given spherical surface by a spherometer.</li> <li>To find the downward force, along an inclined plane, acting on a roller due to gravitational pull of the earth and study its relationship with the angle of inclination by plotting graph between force and <math>\sin\theta</math>.</li> <li>To find the weight of a given body using parallelogram law of vectors.</li> <li>Verification of Archimedes principle.</li> <li>Verification of Work-energy theorem.</li> <li>Acceleration due to gravity(g) by bar pendulum.</li> <li>To determine the moment of Inertia of a fly-wheel.</li> <li>Study of law of conservation of linear momentum and Kinetic Energy.</li> </ol> <p><b>Note:</b> Student will perform at least six experiments</p> | 3 | 30 |

| Suggested Evaluation Methods                         |       |      |                                         |       |       |
|------------------------------------------------------|-------|------|-----------------------------------------|-------|-------|
| Internal Assessment: 20                              | TH-15 | PR-5 | End Term Examination: 55                | TH-35 | PR-20 |
| Class Participation                                  | 5     | NA   | Written Examination                     | 35    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA   | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 5    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                     | 5     | NA   | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                            | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L4.5-PHY-104.1                               | 3                | 1                | 2                | 1                |                  | 1                | 1                | 3                | 2                | 2                 |                   |
| 26L4.5-PHY-104.2                               | 3                | 1                | 1                | 3                |                  | 3                | 1                | 2                | 2                | 1                 |                   |

|                                   |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |
|-----------------------------------|---|---|---|---|--|---|---|---|---|---|---|---|---|---|---|
| <b>26L4.5<br/>-PHY-<br/>104.3</b> | 3 | 2 | 1 | 3 |  | 3 | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 2 | 3 |
|-----------------------------------|---|---|---|---|--|---|---|---|---|---|---|---|---|---|---|

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| <ul style="list-style-type: none"> <li>Halliday, D., Resnick, R., &amp; Walker, J. (2021). Fundamentals of physics (12th ed.). John Wiley &amp; Sons.</li> <li>Kleppner, D., &amp; Kolenkow, R. J. (2014). An introduction to mechanics (2nd ed.). Cambridge University Press.</li> <li>Serway, R. A., &amp; Jewett, J. W. (2018). Physics for scientists and engineers (10th ed.). Cengage Learning.</li> <li>Young, H. D., &amp; Freedman, R. A. (2020). University physics with modern physics (15th ed.). Pearson.</li> <li>Feynman, R. P., Leighton, R. B., &amp; Sands, M. (2011). The Feynman lectures on physics (Vol. 1, New Millennium ed.). Basic Books.</li> <li>Kittel, C., Knight, W. D., &amp; Ruderman, M. A. (1973). Berkeley physics course: Mechanics (Vol. 1, 2nd ed.). McGraw-Hill.</li> <li>Marion, J. B., &amp; Thornton, S. T. (2003). Classical dynamics of particles and systems (5th ed.). Brooks/Cole.</li> <li>Bevington, P. R., &amp; Robinson, D. K. (2003). Data reduction and error analysis for the physical sciences (3rd ed.). McGraw-Hill.</li> <li>Taylor, J. R. (1997). An introduction to error analysis: The study of uncertainties in physical measurements (2nd ed.). University Science Books.</li> <li>Kameshwar C. Wali. (1991). Chandra: A biography of S. Chandrasekhar. University of Chicago Press.</li> <li>Kumar, D. (2011). The scientific edge: The Indian scientist from Vedic to modern times. Pearson Education India.</li> <li>Bureau International des Poids et Mesures. (2019). The International System of Units (SI) (9th ed.). BIPM. <a href="https://www.bipm.org">https://www.bipm.org</a></li> <li>National Institute of Standards and Technology. (n.d.). CODATA fundamental physical constants. <a href="https://physics.nist.gov/constants">https://physics.nist.gov/constants</a></li> </ul> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 3             |
| Entrepreneurship                      | 3             |
| Skill Enhancement                     | 10            |
| Indian Knowledge System               | 1             |
| Environmental Awareness               | 2             |
| Current Issues and Social Awareness   | 3             |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Semester                                                                                      | 2nd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
| Nomenclature of the Course                                                                    | Physics Fundamentals-II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |                  |
| Course Code                                                                                   | 26L4.5-PHY-204                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                      |                  |
| Course Type                                                                                   | MDC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |                  |
| Course Level                                                                                  | 100-199                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Physics                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L4.5-PHY-204.1:</b> Have basic knowledge about nature of light, the associated phenomena and their importance in daily life.</p> <p><b>26L4.5-PHY-204.2:</b> Understand and describe the working of important optical instruments through the learning of image formation by mirrors and lenses.</p> <p><b>26L4.5-PHY-204.3:</b> Have basic knowledge about electric current, electric circuit, electric components, and practical utility of heating and magnetic effects of electric current.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0                   | 1                    | 3                |
| <b>Teaching hours per week</b>                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0                   | 2                    | 4                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | 5                    | 20               |
| <b>End Term Exam Marks</b>                                                                    | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | 20                   | 55               |
| <b>Max. Marks</b>                                                                             | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | 25                   | 75               |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     | 2 Hours              | 2 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><b>Light and Optics</b></p> <p>Nature and properties of light; speed, frequency and wavelength, Reflection of light: types, laws, multiple reflection using mirrors and applications in daily life, Refraction of light: laws of refraction, refractive index, refraction through prism (dispersion), rainbow formation, twinkling of stars, advanced sunrise and delayed sunset. Scattering of light and blue colour of sky; apparent depth; total internal reflection and its applications.</p> <p><b>Image formation:</b> plane mirrors, multiple images using two mirrors, optical illusions. Concave and convex mirrors, ray diagrams, mirror equation and magnification; applications of mirrors.</p> | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |    |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <p><b>Lenses and Optical Instruments:</b></p> <p>Image formation by lenses: convex and concave lenses, ray diagrams, lens equation. Optical instruments: camera, eye, telescope and microscope.</p> <p><b>Electricity:</b> electric charge, current, conductors and insulators; resistance, resistivity and Ohm's law; potential difference and EMF; electric circuits (resistors, capacitors, battery, ammeter, voltmeter); series and parallel combinations; household wiring and safety (fuse, earthing, short circuit); electric power and transmission; heating effect of current and applications.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2 | 15 |
| Practical Component s | <ol style="list-style-type: none"> <li>To find the focal length of a convex mirror using a convex lens.</li> <li>To find the value of v for different values of u in the case of a concave mirror and to find the focal length.</li> <li>To find the focal length of a concave lens using a convex lens.</li> <li>To determine the refractive index of a glass slab.</li> <li>To find the refractive index of a liquid using a convex lens and plane mirror.</li> <li>To determine the resistivity of different wires by plotting a graph for potential difference versus current.</li> <li>To verify Ohm's law for metallic conductor and to determine its resistance.</li> <li>To find the frequency of AC mains with a sonometer.</li> <li>Use of Multi meter for measuring Resistance, A.C. and D.C. Voltage and Current, checking of electrical fuses.</li> <li>Use of Multi meter to check the working condition of diode, an LED, a resistor and a capacitor.</li> </ol> <p><b>Note:</b> Student will perform at least six experiments.</p> | 3 | 30 |

| Suggested Evaluation Methods                         |       |      |                                         |       |       |
|------------------------------------------------------|-------|------|-----------------------------------------|-------|-------|
| Internal Assessment: 20                              | TH-15 | PR-5 | End Term Examination: 55                | TH-35 | PR-20 |
| Class Participation                                  | 5     | NA   | Written Examination                     | 35    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA   | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 5    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                     | 5     | NA   | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                            | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L4.5-PHY-204.1                               | 3                | 1                | 1                | 2                |                  | 2                | 1                | 2                | 2                |                   |                   |
| 26L4.5-PHY-204.2                               | 3                | 2                | 1                | 3                |                  | 2                | 2                | 1                | 2                |                   | 1                 |
| 26L4.5-PHY-204.3                               | 3                | 2                | 1                | 3                |                  | 3                | 2                | 2                | 2                | 1                 | 1                 |

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Ghatak, A. (2017). <i>Optics</i> (6th ed.). McGraw Hill Education.</li> <li>• Halliday, D., Resnick, R., &amp; Walker, J. (2021). <i>Fundamentals of physics</i> (12th ed.). John Wiley &amp; Sons. Serway, R. A., &amp; Jewett, J. W. (2018). <i>Physics for scientists and engineers</i> (10th ed.). Cengage Learning.</li> <li>• Young, H. D., &amp; Freedman, R. A. (2020). <i>University physics with modern physics</i> (15th ed.). Pearson.</li> <li>• Hecht, E. (2017). <i>Optics</i> (5th ed.). Pearson.</li> <li>• Pedrotti, F. L., Pedrotti, L. M., &amp; Pedrotti, L. S. (2018). <i>Introduction to optics</i> (3rd ed.). Cambridge University Press. Purcell, E. M., &amp; Morin, D. J. (2013). <i>Electricity and magnetism</i> (3rd ed.). Cambridge University Press.</li> <li>• Tipler, P. A., &amp; Mosca, G. (2008). <i>Physics for scientists and engineers</i> (6th ed.). W. H. Freeman.</li> <li>• Floyd, T. L. (2017). <i>Electronic devices</i> (10th ed.). Pearson.</li> <li>• Malvino, A. P., &amp; Bates, D. J. (2016). <i>Electronic principles</i> (8th ed.). McGraw-Hill Education.</li> <li>• Bevington, P. R., &amp; Robinson, D. K. (2003). <i>Data reduction and error analysis for the physical sciences</i> (3rd ed.). McGraw-Hill.</li> <li>• Taylor, J. R. (1997). <i>An introduction to error analysis: The study of uncertainties in physical measurements</i> (2nd ed.). University Science Books.</li> <li>• Massachusetts Institute of Technology. (n.d.). <i>Electricity and magnetism</i>. <a href="https://ocw.mit.edu/courses/8-02-physics-ii-electricity-and-magnetism-spring-2007/">https://ocw.mit.edu/courses/8-02-physics-ii-electricity-and-magnetism-spring-2007/</a></li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 4             |
| Entrepreneurship                      | 3             |
| Skill Enhancement                     | 10            |
| Environmental Awareness               | 1             |
| Current Issues and Social Awareness   | 3             |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Semester                                                                                      | 3rd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                      |                  |
| Nomenclature of the Course                                                                    | Physics Fundamentals-III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Course Code                                                                                   | 26L5.0-PHY-304                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
| Course Type                                                                                   | MDC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |                  |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Physics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.0-PHY-304.1:</b> Understand the fundamental concepts of semiconductors, P–N junction diodes, and basic semiconductor devices along with their applications.</p> <p><b>26L5.0-PHY-304.2:</b> Understand the basic principles, working, and applications of lasers, optical fibres, and nuclear phenomena in science and technology.</p> <p><b>26L5.0-PHY-304.3:</b> Demonstrate proficiency in conducting experiments related to semiconductor devices, lasers, and optical fibres, and analyze the observed characteristics and measurements accurately.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0                   | 1                    | 3                |
| <b>Teaching hours per week</b>                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0                   | 2                    | 4                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     | 5                    | 20               |
| <b>End Term Exam Marks</b>                                                                    | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     | 20                   | 55               |
| <b>Max. Marks</b>                                                                             | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     | 25                   | 75               |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     | 2 Hours              | 2 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        |               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 10.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><b>Semiconductor Physics:</b></p> <p>Atomic structure and energy levels; energy bands (basic idea); conductors, semiconductors and insulators based on band gap, Intrinsic and extrinsic semiconductors (p-type and n-type); P–N junction diode: depletion layer, forward and reverse biasing, V–I characteristics.</p> <p><b>Semiconductor devices:</b> Zener diode, photodiode, solar cell and LED—principle, working and applications. Basic idea of transistor; semiconductors in computers and integrated circuits.</p> | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |    |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <p><b>Photonics and Advanced Materials:</b></p> <p>LASER: introduction, properties of laser light, principle (population inversion, pumping), working (three-level systems), applications of lasers in science and technology.</p> <p>Optical fibres: introduction; total internal reflection, structure and types (basic idea), advantages and disadvantages; optical communication system (basic idea), applications of optical fibres.</p> <p><b>Nuclear physics:</b> atomic nucleus and nucleons, atomic number, mass number, isotopes, isobars, isotones. Nuclear binding energy, laws of radioactivity, decay constant, half-life, average life, radioisotopes and applications (carbon dating). Nuclear fission and fusion, fusion as stellar energy source.</p>                                                                          | 2 | 15 |
| Practical Component s | <ol style="list-style-type: none"> <li>1. V-I characteristics of p-n junction diode.</li> <li>2. V-I characteristics of Zener diode.</li> <li>3. Characteristics of Solar Cell.</li> <li>4. To verify the inverse square law of light using a photo-voltaic cell.</li> <li>5. To determine value of Boltzmann constant using V-I characteristic of P N diode.</li> <li>6. To study the effect of intensity of light (by varying distance of the source) on an LDR.</li> <li>7. To verify the characteristics of LASER.</li> <li>8. To measure the numerical aperture of an optical fibre using He-Ne laser source.</li> <li>9. Study double slit interference by He-Ne laser.</li> <li>10. Determine the diameter of a wire using (He-Ne Laser) diffraction method.</li> </ol> <p><b>Note:</b> Student will perform atleast six experiments.</p> | 3 | 30 |

| Suggested Evaluation Methods                          |       |      |                                         |       |       |
|-------------------------------------------------------|-------|------|-----------------------------------------|-------|-------|
| Internal Assessment: 20                               | TH-15 | PR-5 | End Term Examination: 55                | TH-35 | PR-20 |
| Class Participation                                   | 5     | NA   | Written Examination                     | 35    | NA    |
| Seminar/presentation/assignment/quiz/cla ss test etc. | 5     | NA   | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.      | NA    | 5    | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                      | 5     | NA   | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                            | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0<br>-PHY-<br>304.1                       | 3                | 1                | 1                | 3                |                  | 2                | 2                | 2                | 2                | 1                 | 1                 |
| 26L5.0<br>-PHY-<br>304.2                       | 3                | 2                | 1                | 3                |                  | 2                | 3                | 3                | 2                | 1                 | 2                 |
| 26L5.0<br>-PHY-<br>304.3                       | 3                | 2                | 2                | 3                | 2                | 3                | 3                | 1                | 2                | 2                 | 2                 |

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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| <ul style="list-style-type: none"> <li>• Bube, R. H. (1992). <i>Electronic properties of crystalline solids: An introduction to fundamentals</i>. Academic Press.</li> <li>• Ghatak, A. (2017). <i>Optics</i> (6th ed.). McGraw Hill Education.</li> <li>• Halliday, D., Resnick, R., &amp; Walker, J. (2021). <i>Fundamentals of physics</i> (12th ed.). John Wiley &amp; Sons.</li> <li>• Neamen, D. A. (2012). <i>Semiconductor physics and devices: Basic principles</i> (4th ed.). McGraw-Hill Education.</li> <li>• Serway, R. A., Moses, C. J., &amp; Moyer, C. A. (2020). <i>Modern physics</i> (4th ed.). Cengage Learning.</li> <li>• Young, H. D., &amp; Freedman, R. A. (2020). <i>University physics with modern physics</i> (15th ed.). Pearson.</li> <li>• Beiser, A. (2003). <i>Concepts of modern physics</i> (6th ed.). McGraw-Hill.</li> <li>• Keiser, G. (2021). <i>Optical fiber communications</i> (5th ed.). McGraw Hill.</li> <li>• Saleh, B. E. A., &amp; Teich, M. C. (2019). <i>Fundamentals of photonics</i> (3rd ed.). Wiley.</li> <li>• Silfvast, W. T. (2004). <i>Laser fundamentals</i> (2nd ed.). Cambridge University Press.</li> <li>• Sze, S. M., &amp; Ng, K. K. (2007). <i>Physics of semiconductor devices</i> (3rd ed.). John Wiley &amp; Sons.</li> <li>• Thyagarajan, K., &amp; Ghatak, A. (2010). <i>Lasers: Fundamentals and applications</i> (2nd ed.). Springer.</li> <li>• Krane, K. S. (1988). <i>Introductory nuclear physics</i>. John Wiley &amp; Sons.</li> <li>• Lilley, J. (2001). <i>Nuclear physics: Principles and applications</i>. John Wiley &amp; Sons.</li> <li>• Indian Institute of Technology. (n.d.). <i>Semiconductor devices</i>. <a href="https://nptel.ac.in/courses/108106181">https://nptel.ac.in/courses/108106181</a></li> <li>• Massachusetts Institute of Technology. (n.d.). <i>Semiconductor electronics</i>. <a href="https://ocw.mit.edu/courses/6-780-semiconductor-manufacturing-spring-2003/">https://ocw.mit.edu/courses/6-780-semiconductor-manufacturing-spring-2003/</a></li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 4             |
| Entrepreneurship                      | 5             |
| Skill Enhancement                     | 10            |
| Environmental Awareness               | 3             |
| Current Issues and Social Awareness   | 4             |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                      |                  |
| Semester                                                                                      | 2nd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |                  |
| Nomenclature of the Course                                                                    | Elementary Electricity, Magnetism & EM theory                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Course Code                                                                                   | 26L4.5-PHY-202                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                      |                  |
| Course Type                                                                                   | Minor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                      |                  |
| Course Level                                                                                  | 100-199                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Electricity and Mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L4.5-PHY-202.1:</b> Explain the fundamental concepts of vector analysis, electrostatics, magnetostatics, electromagnetic induction, electromagnetic waves, and electrical circuits, and apply them to analyze and solve elementary problems in electromagnetism.</p> <p><b>26L4.5-PHY-202.2:</b> Perform experiments on electrical and magnetic circuits using standard laboratory instruments, analyze experimental data with appropriate techniques, and interpret the results using scientific reasoning.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0                   | 1                    | 2                |
| <b>Teaching hours per week</b>                                                                | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0                   | 2                    | 3                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     | 5                    | 10               |
| <b>End Term Exam Marks</b>                                                                    | 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     | 20                   | 40               |
| <b>Max. Marks</b>                                                                             | 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     | 25                   | 50               |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     | 2 Hours              | 2 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 4 questions from unit 01 with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 6 short answer type questions carrying one mark each (total 06 marks). The remaining questions will be carrying 07 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 02 questions from other 03 questions.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 5.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p><b>Vector Analysis and Electrostatics:</b> Gradient, divergence and curl of scalar/vector fields and their physical significance; line, surface and volume integrals; Gauss's divergence theorem and Stokes' theorem (statements and applications); Coulomb's law and the electric field, electric potential, Gauss's law (integral and differential form), capacitance and dielectrics, boundary conditions on E and D. <b>Magnetic Fields and Materials:</b> Biot-Savart law, Ampère's law, magnetic induction, magnetic flux, solenoidal nature of magnetic field, magnetic materials and hysteresis. <b>Electromagnetic Induction and Waves:</b> Faraday's and Lenz's laws, displacement current and the Ampère-Maxwell law, Maxwell's equations (physical significance), derivation of the electromagnetic wave equation, basic properties of plane electromagnetic waves, and the Poynting vector. <b>Electrical Circuits:</b> Thevenin's, Norton's and Superposition theorems, series and parallel LCR circuits, and resonance.</p> | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |    |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Practical Component s | <ol style="list-style-type: none"> <li>1. Use of Multimeter for measuring Resistance, A.C. and D.C. Voltage and Current, checking of electrical fuses.</li> <li>2. Low resistance by Carey Foster's bridge with calibration.</li> <li>3. Determination of Impedance of an A.C. circuit and its verification.</li> <li>4. Frequency of A.C. mains using an electromagnet.</li> <li>5. Frequency of A.C. mains Electrical vibrator.</li> <li>6. High resistance by substitution method.</li> <li>7. To compare capacitances using De'Sauty bridge.</li> <li>8. To study the Characteristics of a Series RC Circuit.</li> <li>9. To study a series LCR circuit and determine its (a)Resonant frequency, (b) Quality factor.</li> <li>10. To study a parallel LCR circuit and determine its (a)Anti-resonant frequency and (b) Quality factor.</li> </ol> <p><b>Note:</b> The student will perform at least six experiments.</p> | 2 | 30 |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|

| Suggested Evaluation Methods                         |       |       |                                         |       |       |
|------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 15                              | TH-05 | PR-05 | End Term Examination: 35                | TH-20 | PR-20 |
| Class Participation                                  | 5     | NA    | Written Examination                     | 20    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | NA    | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 5     | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                     | NA    | NA    | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L4.5-PHY-202.1                                        | 3                | 1                | 1                | 1                | 2                | 1                | 2                | 3                | 3                | 2                 | 2                 |
| 26L4.5-PHY-202.2                                        | 3                | 2                | 3                | 1                | 2                | 2                | 2                | 3                | 3                | 3                 | 2                 |

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Griffiths, D. J. (2017). <i>Introduction to electrodynamics</i> (4th ed.). Cambridge University Press.</li> <li>Feynman, R. P., Leighton, R. B., &amp; Sands, M. (2011). <i>The Feynman lectures on physics</i> (Vol. 2, New Millennium ed.). Basic Books.</li> <li>Purcell, E. M., &amp; Morin, D. J. (2013). <i>Electricity and magnetism</i> (3rd ed., Berkeley Physics Course, Vol. 2). Cambridge University Press.</li> <li>Halliday, D., Resnick, R., &amp; Walker, J. (2018). <i>Fundamentals of physics</i> (11th ed.). Wiley.</li> <li>Mahajan, A. S., &amp; Rangwala, A. A. (2015). <i>Electricity and magnetism</i>. McGraw Hill Education.</li> <li>Sadiku, M. N. O. (2018). <i>Elements of electromagnetics</i> (7th ed.). Oxford University Press.</li> <li>Hayt, W. H., &amp; Buck, J. A. (2019). <i>Engineering electromagnetics</i> (9th ed.). McGraw Hill.</li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Skill Enhancement                     | 30            |

| Important Notes: |
|------------------|
|                  |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                      |                  |
| Semester                                                                                      | 1st                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                      |                  |
| Nomenclature of the Course                                                                    | Elementary Mechanics                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Course Code                                                                                   | 26L4.5-PHY-103                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |                  |
| Course Level                                                                                  | 100-199                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |                  |
| Course Type                                                                                   | Minor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Mechanics and Mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L4.5-PHY-103.1:</b> Explain the fundamental concepts of rigid body dynamics, elasticity, central force motion, and special theory of relativity, and apply these concepts to solve elementary problems in mechanics.</p> <p><b>26L4.5-PHY-103.2:</b> Perform basic experiments related to mechanics and properties of matter using standard laboratory instruments, analyze experimental data with appropriate error analysis, and interpret the results with scientific reasoning.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0                   | 1                    | 2                |
| <b>Teaching hours per week</b>                                                                | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0                   | 2                    | 3                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     | 5                    | 10               |
| <b>End Term Exam Marks</b>                                                                    | 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     | 20                   | 40               |
| <b>Max. Marks</b>                                                                             | 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     | 25                   | 50               |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     | 2 Hours              | 2 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 4 questions from unit 01 with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory comprising 6 short answer type questions carrying one mark each (total 06 marks). The remaining questions will be carrying 07 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 02 questions from other 03 questions.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 5.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p><b>Rigid body dynamics:</b> Moment of Inertia and Radius of Gyration; Theorems of Perpendicular and Parallel Axes (applications); Moment of Inertia of Ring, Disc and Solid Cylinder; <b>Elasticity:</b> stress, strain, Hooke's law, Young's modulus, shear modulus and Poisson's ratio; <b>Central Force Motion:</b> gravitational force as a central force, gravitational potential and field, motion under inverse-square law, concept of effective potential, circular and stable orbits (qualitative); <b>Introduction to Special Theory of Relativity:</b> Michelson–Morley experiment, postulates of special relativity, time dilation, length contraction and mass–energy equivalence.</p> | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |    |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Practical Component s | <ol style="list-style-type: none"> <li>1. Measurement of length (or diameter) using Vernier Caliper, Screw Gauge and Travelling Microscope.</li> <li>2. Error analysis and propagation of errors using repeated measurements.</li> <li>3. Determination of the area (or height of an inaccessible object) using a Sextant (or replace with Theodolite if available).</li> <li>4. Determination of the Moment of Inertia of a Flywheel.</li> <li>5. Determination of the Moment of Inertia of an irregular body using a Torsion Pendulum.</li> <li>6. Determination of Young's Modulus by Uniform Bending of a Beam.</li> <li>7. Determination of Young's Modulus by Koenig's Method (or Cantilever Method if Koenig's apparatus is unavailable).</li> <li>8. Determination of the Modulus of Rigidity of a Wire using Maxwell's Needle.</li> <li>9. Determination of Young's Modulus / Elastic Constants using Searle's Apparatus.</li> <li>10. Determination of the Acceleration due to Gravity (g) using a Bar Pendulum.</li> </ol> <p><b>Note:</b> The student will perform at least six experiments.</p> | 2 | 30 |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|

| Suggested Evaluation Methods                         |       |       |                                         |       |       |
|------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 15                              | TH-05 | PR-05 | End Term Examination: 35                | TH-20 | PR-20 |
| Class Participation                                  | 5     | NA    | Written Examination                     | 20    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | NA    | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 5     | Viva-Voce                               | NA    | 5     |
| Mid-Term Exam(s)                                     | NA    | NA    | Write-up and execution of the practical | NA    | 10    |

| Mapping of (CLOs) to Programme Learning Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|---------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                                     | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L4.5-PHY-103.1                                        | 3                | 2                | 1                | 1                | 2                | 1                | 2                | 3                | 3                | 2                 | 1                 |
| 26L4.5-PHY-103.2                                        | 3                | 2                | 3                | 1                | 2                | 2                | 2                | 3                | 3                | 3                 | 2                 |

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Halliday, D., Resnick, R., &amp; Walker, J. (2018). <i>Fundamentals of physics</i> (11th ed.). Wiley.</li> <li>• Kleppner, D., &amp; Kolenkow, R. J. (2014). <i>An introduction to mechanics</i> (2nd ed.). Cambridge University Press.</li> <li>• Kittel, C., Knight, W. D., &amp; Ruderman, M. A. (1973). <i>Mechanics</i> (2nd ed., Berkeley Physics Course, Vol. 1). Tata McGraw-Hill.</li> <li>• Upadhyaya, J. C. (2019). <i>Classical mechanics</i>. Himalaya Publishing House.</li> <li>• Arora, C. L. (2018). <i>B.Sc. practical physics</i>. S. Chand Publishing.</li> <li>• Jewett, J. W., Jr., &amp; Serway, R. A. (2019). <i>Physics for scientists and engineers with modern physics</i> (10th ed.). Cengage Learning.</li> <li>• Mathur, D. S. (2010). <i>Elements of properties of matter</i>. S. Chand &amp; Company.</li> <li>• Mathur, D. S. (2000). <i>Mechanics</i>. S. Chand &amp; Company.</li> <li>• Gupta, S. L., &amp; Kumar, V. (2016). <i>Practical physics</i>. Pragati Prakashan.</li> <li>• Srivastava, S. S., &amp; Gupta, M. K. (2015). <i>Practical physics</i>. Atma Ram &amp; Sons.</li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Skill Enhancement                     | 30            |

|                         |
|-------------------------|
| <b>Important Notes:</b> |
|                         |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Semester                                                                                      | 4th                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                      |                  |
| Nomenclature of the Course                                                                    | Maintenance of Laboratory Instruments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                      |                  |
| Course Code                                                                                   | 26L5.0-VOC-PHY-401                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                      |                  |
| Course Type                                                                                   | Minor (Vocational)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                      |                  |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of laboratory Instruments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.0-VOC-PHY-401.1:</b> Demonstrate knowledge of laboratory safety practices, standard operating procedures, and equipment maintenance documentation in Physics laboratories.</p> <p><b>26L5.0-VOC-PHY-401.2:</b> Perform routine maintenance, troubleshooting, and calibration of electronic laboratory instruments and semiconductor-based devices.</p> <p><b>26L5.0-VOC-PHY-401.3:</b> Apply appropriate maintenance techniques for mechanical and optical laboratory equipment to ensure their safe, accurate, and efficient operation.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0                   | 2                    | 4                |
| <b>Teaching hours per week</b>                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0                   | 4                    | 6                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     | 15                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     | 35                   | 70               |
| <b>Max. Marks</b>                                                                             | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     | 50                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     | 2 Hours              | 2 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <b>Instructions for Examiner:</b><br><b>Theory:</b><br>The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |               |
| <b>Practical:</b><br>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 20.                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Laboratory Safety, Documentation and Electronics Equipment Maintenance</b><br><br>Standard Operating Procedures (SOP) for the maintenance of laboratory equipment; laboratory safety rules and policies; special safety considerations in Physics laboratories; factors influencing laboratory safety programmes; equipment maintenance documentation; maintenance of electronics laboratory equipment; electronic symbols and terminal identification; applications and maintenance aspects of semiconductor devices including diodes, transistors, SCR and UJT; introduction to voltage regulators and their types; maintenance and basic operation of Cathode Ray Oscilloscope (CRO) and Geiger–Müller (GM) Counter. | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |    |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <b>Maintenance of Mechanical and Optical Equipment</b><br><br>Basic terms and maintenance of mechanical laboratory equipment including Vernier Caliper, Screw Gauge, Spherometer, Flywheel, Bar Pendulum, Torsion Pendulum, Jaeger Apparatus, Barometer and Maxwell Needle; basic terms and maintenance of optical laboratory equipment including Sextant, Lasers, Spectrometer, Sodium Lamp, Mercury Lamp, Travelling Microscope, Fresnel Biprism and Optical Bench.                                                                                                                                                                                                                          | 2 | 15 |
| Practical Component s | 1. Maintenance of electrical instruments.<br>2. Maintenance of optical instruments.<br>3. Maintenance of mechanical instruments.<br>4. To study the construction and functioning of CRO.<br>5. To design sawtooth wave generator using UJT.<br>6. To design and check the half wave rectifier circuit.<br>7. To design and check the full wave rectifier circuit.<br>8. To design voltage regulator circuit using Zener diode and find line. and load regulation.<br>9. To design CE amplifier circuit.<br>10. To design CB amplifier circuit.<br><br><b>Note:</b> Student will perform at least eight experiments. The examiner will allot one practical at the time of end term examination. | 3 | 60 |

| Suggested Evaluation Methods                          |       |       |                                         |       |       |
|-------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                               | TH-15 | PR-15 | End Term Examination: 70                | TH-35 | PR-35 |
| Class Participation                                   | 5     | 5     | Written Examination                     | 35    | NA    |
| Seminar/presentation/assignment/quiz/cla ss test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.      | NA    | 10    | Viva-Voce                               | NA    | 10    |
| Mid-Term Exam(s)                                      | 5     | NA    | Write-up and execution of the practical | NA    | 20    |

| Mapping of (CLOs) to Programme Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                            | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0-VOC-PHY-401.1                           | 2                | 1                | 2                | 1                | 1                | 2                | 2                | 3                | 2                | 3                 | 2                 |
| 26L5.0-VOC-PHY-401.2                           | 3                | 3                | 2                | 3                | 2                | 3                | 3                | 2                | 2                | 2                 | 3                 |

|                                            |   |   |   |   |   |   |   |   |   |   |   |
|--------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|
| <b>26L5.0<br/>-VOC-<br/>PHY-<br/>401.3</b> | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
|--------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <ul style="list-style-type: none"> <li>• Bell, D. A. (2018). <i>Electronic devices and circuits</i> (6th ed.). Oxford University Press.</li> <li>• Horowitz, P., &amp; Hill, W. (2015). <i>The art of electronics</i> (3rd ed.). Cambridge University Press.</li> <li>• National Research Council. (2011). <i>Prudent practices in the laboratory: Handling and management of chemical hazards</i> (Updated ed.). National Academies Press. <a href="https://doi.org/10.17226/12654">https://doi.org/10.17226/12654</a></li> <li>• Sawhney, A. K. (2015). <i>A course in electrical and electronic measurements and instrumentation</i>. Dhanpat Rai &amp; Co.</li> <li>• Squires, G. L. (2001). <i>Practical physics</i> (4th ed.). Cambridge University Press.</li> <li>• Gupta, S. L., &amp; Kumar, V. (2019). <i>Practical physics</i>. Pragati Prakashan.</li> <li>• Singh, S. P. (2014). <i>Advanced practical physics</i> (18th ed.). Pragati Prakashan.</li> <li>• Worsnop, B. L., &amp; Flint, H. T. (2018 reprint). <i>Advanced practical physics for students</i>. CBS Publishers &amp; Distributors. (Original work published 1927)</li> <li>• Chattopadhyay, D., Rakshit, P. C., Saha, B., &amp; Purkait, N. N. (2019). <i>Foundation course in electronics</i>. New Age International.</li> <li>• Malvino, A. P., &amp; Bates, D. J. (2016). <i>Electronic principles</i> (8th ed.). McGraw-Hill Education.</li> <li>• Boylestad, R. L., &amp; Nashelsky, L. (2019). <i>Electronic devices and circuit theory</i> (12th ed.). Pearson.</li> <li>• Helfrick, A. D., &amp; Cooper, W. D. (2010). <i>Modern electronic instrumentation and measurement techniques</i>. Pearson Education.</li> </ul> |  |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 4             |
| Entrepreneurship                      | 4             |
| Skill Enhancement                     | 8             |
| Communication Development             | 4             |
| Current Issues and Social Awareness   | 2             |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |                  |
| Semester                                                                                      | 5th                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |                  |
| Nomenclature of the Course                                                                    | Refrigeration and Air Conditioning                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |                  |
| Course Code                                                                                   | 26L5.5- VOC-PHY- 501                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |                  |
| Course Type                                                                                   | Minor (Vocational)                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |                  |
| Course Level                                                                                  | 300-399                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Thermodynamics and Heat Transfer.                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <b>26L5.5- VOC-PHY- 501.1:</b> Explain the principles and methods of food preservation and ice manufacturing for maintaining food quality and safety.<br><b>26L5.5- VOC-PHY- 501.2:</b> Apply refrigeration and air-conditioning principles in commercial and industrial applications.<br><b>26L5.5- VOC-PHY- 501.3:</b> Evaluate appropriate refrigeration, cold storage, and air-conditioning systems for food preservation and industrial requirements. |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0                   | 2                    | 4                |
| <b>Teaching hours per week</b>                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0                   | 4                    | 6                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 15                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     | 15                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     | 35                   | 70               |
| <b>Max. Marks</b>                                                                             | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     | 50                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     | 2 Hours              | 2 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <b>Instructions for Examiner:</b><br><b>Theory:</b><br>The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |               |
| <b>Practical:</b><br>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 20.                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Food Preservation and Ice Manufacturing</b><br><br>Introduction to food preservation; factors contributing to food spoilage; causes of food spoilage; methods of food preservation; freezing method of food preservation; preservation of food by direct contact with liquid nitrogen (N <sub>2</sub> ); freeze drying; preservation of different food products; cold storage and commercial cabinets. Introduction to ice manufacturing; principles of ice production; different methods of ice manufacturing; treatment of water for ice production; brines; freezing tanks; ice cans; quality of ice. | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |    |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <b>Commercial and Industrial Applications of Refrigeration and Air Conditioning</b><br><br>Introduction to commercial applications of air conditioning; air conditioning of houses, offices, hotels, restaurants, departmental stores, theatres, auditoriums, hospitals and medical stores. Industrial applications of refrigeration; importance of relative humidity in different industries; ice-cream manufacturing; refrigeration for breweries; selection of refrigerants for breweries; use of liquid nitrogen (N <sub>2</sub> ) in fabric processing; refrigeration and air conditioning in textile and photographic industries.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2 | 15 |
| Practical Component s | 1. To check and replace electrical components of refrigerator.<br>2. To check Common faults and their remedies in conventional refrigerator.<br>3. To install and inspect a new domestic refrigerator.<br>4. Checking door alignment & replacing gaskets.<br>5. To strip out defective compressor.<br>6. To clean and flush for contamination in condenser coil, evaporator coil of conventional refrigerator.<br>7. Evacuating, leakage testing and gas charging in refrigerator.<br>8. To check and test electrical accessories in frost free refrigerator.<br>9. Servicing of components of frost free refrigerator.<br>10. Identification the electrical and mechanical components of window air conditioner.<br>11. Servicing and maintenance of window air conditioner.<br>12. Leak testing in window air conditioner.<br>13. Evacuation and gas charging in window air conditioner.<br>14. Identifying various components of split air conditioner.<br>15. Leakage testing in split air conditioner.<br>16. Evacuation and gas charging in split air conditioner.<br><br><b>Note:</b> Student will perform at least eight experiments. The examiner will allot one practical at the time of end term examination. | 3 | 60 |

| Suggested Evaluation Methods                         |       |       |                                         |       |       |
|------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                              | TH-15 | PR-15 | End Term Examination: 70                | TH-35 | PR-35 |
| Class Participation                                  | 5     | 5     | Written Examination                     | 35    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 10    | Viva-Voce                               | NA    | 10    |
| Mid-Term Exam(s)                                     | 5     | NA    | Write-up and execution of the practical | NA    | 20    |

| Mapping of (CLOs) to Programme Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                            | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.5 - VOC-PHY-501.1                         | 3                |                  |                  | 2                |                  | 2                | 2                | 2                | 1                | 1                 |                   |

|                                             |   |   |   |   |   |   |   |   |   |   |   |
|---------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|
| <b>26L5.5<br/>- VOC-<br/>PHY-<br/>501.2</b> | 3 | 3 |   | 3 | 1 | 2 | 3 | 2 | 1 | 1 | 2 |
| <b>26L5.5<br/>- VOC-<br/>PHY-<br/>501.3</b> | 3 | 2 | 1 | 3 | 1 | 3 | 3 | 2 | 2 | 1 | 3 |

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |  |  |  |  |  |  |  |  |  |  |
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| <ul style="list-style-type: none"> <li>Arora, C. P. (2010). <i>Refrigeration and air conditioning</i> (3rd ed.). McGraw Hill Education (India).</li> <li>Dossat, R. J., Horan, T. J., &amp; Jones, W. F. (2002). <i>Principles of refrigeration</i> (5th ed.). Prentice Hall. Stoecker, W. F., &amp; Jones, J. W. (1982). <i>Refrigeration and air conditioning</i> (2nd ed.). McGraw-Hill. Gosney, W. B. (1982). <i>Principles of refrigeration</i>. Cambridge University Press.</li> <li>Fellows, P. J. (2017). <i>Food processing technology: Principles and practice</i> (4th ed.). Woodhead Publishing. Rahman, M. S. (Ed.). (2007). <i>Handbook of food preservation</i> (2nd ed.). CRC Press.</li> <li>James, S. J., &amp; James, C. (2014). <i>Chilling and freezing of foods</i>. Woodhead Publishing.</li> <li>ASHRAE. (2022). <i>ASHRAE handbook—Refrigeration</i>. American Society of Heating, Refrigerating and Air-Conditioning Engineers. Trott, A. R., &amp; Welch, T. (2000). <i>Refrigeration and air conditioning</i> (3rd ed.). Butterworth-Heinemann.</li> <li>Manay, N. S., &amp; Shadaksharaswamy, M. (2008). <i>Foods: Facts and principles</i> (2nd ed.). New Age International Publishers.</li> <li>Wang, L. K. (Ed.). (2006). <i>Handbook of industrial and hazardous wastes treatment</i> (2nd ed.). CRC Press. (Useful for environmental aspects of refrigeration and industrial cooling.)</li> <li>Cengel, Y. A., &amp; Boles, M. A. (2019). <i>Thermodynamics: An engineering approach</i> (9th ed.). McGraw-Hill Education. Arora, C. P. (2010). <i>Refrigeration and air conditioning</i> (3rd ed.). McGraw Hill Education (India).</li> <li>Fellows, P. J. (2017). <i>Food processing technology: Principles and practice</i> (4th ed.). Woodhead Publishing. Rahman, M. S. (Ed.). (2007). <i>Handbook of food preservation</i> (2nd ed.). CRC Press.</li> <li>Dossat, R. J., Horan, T. J., &amp; Jones, W. F. (2002). <i>Principles of refrigeration</i> (5th ed.). Prentice Hall.</li> <li>ASHRAE. (2022). <i>ASHRAE handbook—Refrigeration</i>. American Society of Heating, Refrigerating and Air-Conditioning Engineers.</li> </ul> |  |  |  |  |  |  |  |  |  |  |  |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 5             |
| Entrepreneurship                      | 5             |
| Skill Enhancement                     | 10            |
| Communication Development             | 2             |
| Environmental Awareness               | 4             |
| Current Issues and Social Awareness   | 3             |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
| Semester                                                                                      | 6th                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                      |                  |
| Nomenclature of the Course                                                                    | Installation and Maintenance of Solar Panels                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
| Course Code                                                                                   | 26L5.5-VOC-PHY-601                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                      |                  |
| Course Type                                                                                   | Minor (Vocational)                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                      |                  |
| Course Level                                                                                  | 300-399                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Electricity and Solar Energy                                                                                                                                                                                                                                                                                                                                                                                   |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <p><b>26L5.5-VOC-PHY-601.1:</b> Understand the principles, components, and applications of solar photovoltaic (SPV) systems.</p> <p><b>26L5.5-VOC-PHY-601.2:</b> Install and test solar photovoltaic (SPV) systems using appropriate tools, techniques, and safety practices.</p> <p><b>26L5.5-VOC-PHY-601.3:</b> Learn to present observations, results, analysis and different concepts related to solar photo voltaic systems.</p> |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                    |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0                   | 2                    | 4                |
| <b>Teaching hours per week</b>                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0                   | 4                    | 6                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 15                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     | 15                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 35                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     | 35                   | 70               |
| <b>Max. Marks</b>                                                                             | 50                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     | 50                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                               |                     | 2 Hours              | 2 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Instructions for Examiner:</b></p> <p><b>Theory:</b><br/>The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.</p> <p><b>Practical:</b><br/>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 20.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <p><b>Fundamentals of Solar Photovoltaic Systems and Components</b></p> <p>Introduction to solar energy and its potential; harnessing solar energy; need for solar energy to electrical energy conversion; Solar Photovoltaic (SPV) systems; SPV panels, their types, advantages and disadvantages of SPV panels; basics of load calculation and SPV system requirements. Off-grid and on-grid solar systems; applications of SPV systems; components of SPV systems including solar panels, stand-alone and grid-tied inverters, Battery Energy Storage Systems (BESS), and charge controllers. Tools and equipment used for SPV installation and maintenance, including digital multimeter, clamp meter, hydrometer, sun pathfinder, thermography camera, pyranometer, personal protective equipment (PPE), battery maintenance kit, and battery water filler.</p> | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |    |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <b>Installation, Testing, Maintenance and Troubleshooting of SPV Systems</b><br><br>Site selection criteria for SPV installation; steps and procedures for solar panel array installation; different mounting structures; installation of AC and DC distribution boxes; earthing and grounding systems; optimal cable sizing and cable laying. Testing and inspection methods for SPV systems, including testing of open-circuit and load voltage, battery state of charge (SOC), protective systems, earth resistance, inspection of connected systems, and performance testing. Scheduled and unscheduled maintenance of SPV systems; checking dust accumulation, module shading, module mismatch, physical integrity, and standard troubleshooting procedures.                                                                                                                                                                                                                                                                                                                                                                             | 2 | 15 |
| Practical Component s | 1. To study the various components of A Residential Solar Electric System.<br>2. To study the Series and Parallel Connection in Solar system.<br>3. To study the various Parameters in Solar Panel Installations.<br>4. To study the Solar energy system components used in the Installation of solar panel.<br>5. To study the solar tracking system.<br>6. Measurement of PV module parameters and study of their characteristics.<br>7. Testing of Standalone PV system<br>8. To Measure voltage, current and power of solar photovoltaic modules<br>9. Identify the components of solar photovoltaic system.<br>10. Identification of types of solar photovoltaic systems.<br>11. Define solar cell parameters List the types of connections of solar photovoltaic panel.<br>12. Identify the batteries used in PV system and describe standard parameters of battery.<br>13. Recognize functions of a charge controller.<br>14. Identify prerequisites for installing a solar PV system.<br><br><b>Note:</b> Student will perform at least eight experiments. The examiner will allot one practical at the time of end term examination. | 3 | 60 |

| Suggested Evaluation Methods                         |       |       |                                         |       |       |
|------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                              | TH-15 | PR-15 | End Term Examination: 70                | TH-35 | PR-35 |
| Class Participation                                  | 5     | 5     | Written Examination                     | 35    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 10    | Viva-Voce                               | NA    | 10    |
| Mid-Term Exam(s)                                     | 5     | NA    | Write-up and execution of the practical | NA    | 20    |

| Mapping of (CLOs) to Programme Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                            | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.5-VOC-PHY-601.1                           | 3                | 1                |                  | 2                |                  | 2                | 2                | 3                | 2                | 1                 |                   |
| 26L5.5-VOC-PHY-601.2                           | 2                | 2                | 1                | 3                | 2                | 3                | 3                | 3                | 2                | 3                 | 2                 |
| 26L5.5-VOC-PHY-601.3                           | 2                | 2                | 3                | 2                | 2                | 2                | 2                | 1                | 2                | 2                 | 1                 |

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Dunlop, J. P. (2012). <i>Photovoltaic systems</i> (3rd ed.). American Technical Publishers.</li> <li>Solanki, C. S. (2015). <i>Solar photovoltaic: Fundamentals, technologies and applications</i> (3rd ed.). PHI Learning Pvt. Ltd. Messenger, R. A., &amp; Ventre, J. (2010). <i>Photovoltaic systems engineering</i> (3rd ed.). CRC Press.</li> <li>Kalogirou, S. A. (2014). <i>Solar energy engineering: Processes and systems</i> (2nd ed.). Academic Press. Nelson, J. (Ed.). (2003). <i>The physics of solar cells</i>. Imperial College Press.</li> <li>Green, M. A. (1982). <i>Solar cells: Operating principles, technology, and system applications</i>. Prentice-Hall. Goswami, D. Y., Kreith, F., &amp; Kreider, J. F. (2000). <i>Principles of solar engineering</i> (2nd ed.). Taylor &amp; Francis.</li> <li>Partain, L. D. (Ed.). (1995). <i>Solar cells and their applications</i>. John Wiley &amp; Sons.</li> <li>Luque, A., &amp; Hegedus, S. (Eds.). (2011). <i>Handbook of photovoltaic science and engineering</i> (2nd ed.). John Wiley &amp; Sons. Boxwell, M. (2023). <i>Solar electricity handbook: A simple, practical guide to solar energy</i> (15th ed.). Greenstream Publishing. Solanki, C. S. (2015). <i>Solar photovoltaic: Fundamentals, technologies and applications</i> (3rd ed.). PHI Learning Pvt. Ltd.</li> <li>Dunlop, J. P. (2012). <i>Photovoltaic systems</i> (3rd ed.). American Technical Publishers. Messenger, R. A., &amp; Ventre, J. (2010). <i>Photovoltaic systems engineering</i> (3rd ed.). CRC Press.</li> <li>Kalogirou, S. A. (2014). <i>Solar energy engineering: Processes and systems</i> (2nd ed.). Academic Press.</li> <li>Boxwell, M. (2023). <i>Solar electricity handbook: A simple, practical guide to solar energy</i> (15th ed.). Greenstream Publishing.</li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 5             |
| Entrepreneurship                      | 5             |
| Skill Enhancement                     | 10            |
| Communication Development             | 2             |
| Environmental Awareness               | 4             |
| Current Issues and Social Awareness   | 3             |

| Introduction                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |                  |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|------------------|
| Department Name                                                                               | Physics - UG                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |                  |
| Semester                                                                                      | 3rd                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                      |                  |
| Course Composition                                                                            | Theory + Practical                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Nomenclature of the Course                                                                    | Refrigeration and Air Conditioning                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Course Code                                                                                   | 26L5.0- VOC-PHY- 301                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                      |                  |
| Course Type                                                                                   | Minor (Vocational)                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                      |                  |
| Course Level                                                                                  | 200-299                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |                  |
| Pre-requisites for the course (if any)                                                        | Basic understanding of Electricity and Solar Energy                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                      |                  |
| Course Learning Outcomes (CLOs)<br>After completing this course, the learner will be able to: | <b>26L5.0- VOC-PHY- 301 .1:</b> Explain the principles and methods of food preservation and ice manufacturing for maintaining food quality and safety.<br><b>26L5.0- VOC-PHY- 301 .2:</b> Apply refrigeration and air-conditioning principles in commercial and industrial applications.<br><b>26L5.0- VOC-PHY- 301 .3:</b> Evaluate appropriate refrigeration, cold storage, and air-conditioning systems for food preservation and industrial requirements. |                     |                      |                  |
|                                                                                               | <b>Theory (Th)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     | <b>Practical (P)</b> | <b>Total</b>     |
|                                                                                               | <b>Lecture (L)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Tutorial (T)</b> |                      |                  |
| <b>Credits</b>                                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0                   | 2                    | 4                |
| <b>Teaching hours per week</b>                                                                | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0                   | 4                    | 6                |
| <b>Internal Assessment Marks (Th+P=Total)</b>                                                 | 15                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     | 15                   | 30               |
| <b>End Term Exam Marks</b>                                                                    | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     | 35                   | 70               |
| <b>Max. Marks</b>                                                                             | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     | 50                   | 100              |
| <b>Examination Duration (in Hours)</b>                                                        | 2 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     | 2 Hours              | 2 Hours, 2 Hours |

| Contents of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <b>Instructions for Examiner:</b><br><b>Theory:</b><br>The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |               |
| <b>Practical:</b><br>Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 20.                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CLO(s) | Contact Hours |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Food Preservation and Ice Manufacturing</b><br><br>Introduction to food preservation; factors contributing to food spoilage; causes of food spoilage; methods of food preservation; freezing method of food preservation; preservation of food by direct contact with liquid nitrogen (N <sub>2</sub> ); freeze drying; preservation of different food products; cold storage and commercial cabinets. Introduction to ice manufacturing; principles of ice production; different methods of ice manufacturing; treatment of water for ice production; brines; freezing tanks; ice cans; quality of ice. | 1      | 15            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |    |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
| Unit-2                | <b>Commercial and Industrial Applications of Refrigeration and Air Conditioning</b><br>Introduction to commercial applications of air conditioning; air conditioning of houses, offices, hotels, restaurants, departmental stores, theatres, auditoriums, hospitals and medical stores. Industrial applications of refrigeration; importance of relative humidity in different industries; ice-cream manufacturing; refrigeration for breweries; selection of refrigerants for breweries; use of liquid nitrogen (N <sub>2</sub> ) in fabric processing; refrigeration and air conditioning in textile and photographic industries.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2 | 15 |
| Practical Component s | <ol style="list-style-type: none"> <li>1. To check and replace electrical components of refrigerator.</li> <li>2. To check Common faults and their remedies in conventional refrigerator.</li> <li>3. To install and inspect a new domestic refrigerator.</li> <li>4. Checking door alignment &amp; replacing gaskets.</li> <li>5. To strip out defective compressor.</li> <li>6. To clean and flush for contamination in condenser coil, evaporator coil of conventional refrigerator.</li> <li>7. Evacuating, leakage testing and gas charging in refrigerator.</li> <li>8. To check and test electrical accessories in frost free refrigerator.</li> <li>9. Servicing of components of frost free refrigerator.</li> <li>10. Identification the electrical and mechanical components of window air conditioner.</li> <li>11. Servicing and maintenance of window air conditioner.</li> <li>12. Leak testing in window air conditioner.</li> <li>13. Evacuation and gas charging in window air conditioner.</li> <li>14. Identifying various components of split air conditioner.</li> <li>15. Leakage testing in split air conditioner.</li> <li>16. Evacuation and gas charging in split air condition</li> </ol> <p><b>Note:</b> Student will perform at least eight experiments. The examiner will allot one practical at the time of end term examination.</p> | 3 | 60 |

| Suggested Evaluation Methods                         |       |       |                                         |       |       |
|------------------------------------------------------|-------|-------|-----------------------------------------|-------|-------|
| Internal Assessment: 30                              | TH-15 | PR-15 | End Term Examination: 70                | TH-35 | PR-35 |
| Class Participation                                  | 5     | 5     | Written Examination                     | 35    | NA    |
| Seminar/presentation/assignment/quiz/class test etc. | 5     | NA    | Lab record                              | NA    | 5     |
| Seminar/Demonstration/Viva-voce/Lab records etc.     | NA    | 10    | Viva-Voce                               | NA    | 10    |
| Mid-Term Exam(s)                                     | 5     | NA    | Write-up and execution of the practical | NA    | 20    |

| Mapping of (CLOs) to Programme Outcomes (PLOs) |                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |
|------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| CLO                                            | PLO <sub>1</sub> | PLO <sub>2</sub> | PLO <sub>3</sub> | PLO <sub>4</sub> | PLO <sub>5</sub> | PLO <sub>6</sub> | PLO <sub>7</sub> | PLO <sub>8</sub> | PLO <sub>9</sub> | PLO <sub>10</sub> | PLO <sub>11</sub> |
| 26L5.0<br>- VOC-<br>PHY-301<br>.1              | 3                |                  |                  | 2                |                  | 2                | 2                | 2                | 1                | 1                 |                   |
| 26L5.0<br>- VOC-<br>PHY-301<br>.2              | 3                | 3                |                  | 3                | 1                | 2                | 3                | 2                | 1                | 1                 | 2                 |
| 26L5.0<br>- VOC-<br>PHY-301<br>.3              | 3                | 2                | 1                | 3                | 1                | 3                | 3                | 2                | 2                | 1                 | 3                 |

\* Note: This is a University Pool course with independent mapping.

| Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Arora, C. P. (2010). <i>Refrigeration and air conditioning</i> (3rd ed.). McGraw Hill Education (India).</li> <li>Dossat, R. J., Horan, T. J., &amp; Jones, W. F. (2002). <i>Principles of refrigeration</i> (5th ed.). Prentice Hall.</li> <li>Stoecker, W. F., &amp; Jones, J. W. (1982). <i>Refrigeration and air conditioning</i> (2nd ed.). McGraw-Hill.</li> <li>Gosney, W. B. (1982). <i>Principles of refrigeration</i>. Cambridge University Press.</li> <li>Fellows, P. J. (2017). <i>Food processing technology: Principles and practice</i> (4th ed.). Woodhead Publishing.</li> <li>Rahman, M. S. (Ed.). (2007). <i>Handbook of food preservation</i> (2nd ed.). CRC Press.</li> <li>James, S. J., &amp; James, C. (2014). <i>Chilling and freezing of foods</i>. Woodhead Publishing.</li> <li>ASHRAE. (2022). <i>ASHRAE handbook—Refrigeration</i>. American Society of Heating, Refrigerating and Air-Conditioning Engineers.</li> <li>Trott, A. R., &amp; Welch, T. (2000). <i>Refrigeration and air conditioning</i> (3rd ed.). Butterworth-Heinemann.</li> <li>Manay, N. S., &amp; Shadaksharaswamy, M. (2008). <i>Foods: Facts and principles</i> (2nd ed.). New Age International Publishers.</li> <li>Wang, L. K. (Ed.). (2006). <i>Handbook of industrial and hazardous wastes treatment</i> (2nd ed.). CRC Press. (Useful for environmental aspects of refrigeration and industrial cooling).</li> <li>Cengel, Y. A., &amp; Boles, M. A. (2019). <i>Thermodynamics: An engineering approach</i> (9th ed.). McGraw-Hill Education.</li> <li>Arora, C. P. (2010). <i>Refrigeration and air conditioning</i> (3rd ed.). McGraw Hill Education (India).</li> <li>Fellows, P. J. (2017). <i>Food processing technology: Principles and practice</i> (4th ed.). Woodhead Publishing.</li> <li>Rahman, M. S. (Ed.). (2007). <i>Handbook of food preservation</i> (2nd ed.). CRC Press.</li> <li>Dossat, R. J., Horan, T. J., &amp; Jones, W. F. (2002). <i>Principles of refrigeration</i> (5th ed.). Prentice Hall.</li> <li>ASHRAE. (2022). <i>ASHRAE handbook—Refrigeration</i>. American Society of Heating, Refrigerating and Air-Conditioning Engineers.</li> </ul> |

| Content Mapping with NEP thrust areas |               |
|---------------------------------------|---------------|
| Field                                 | Hours Devoted |
| Employability                         | 5             |
| Entrepreneurship                      | 5             |
| Skill Enhancement                     | 10            |
| Communication Development             | 2             |
| Environmental Awareness               | 4             |
| Current Issues and Social Awareness   | 3             |