

INDIRA GANDHI UNIVERSITY MEERPUR

(Established under Haryana Act No. 29 of 2013)



Scheme of Examination and Syllabus for Undergraduate Programme Subject: PHYSICS

1st to 4th Semester syllabus approved by UGBOS :16/05/2024

5th to 8th Semester syllabus approved by UGBOS (Through Circulation):29/07/2026

**Under Multiple Entry-Exit, Internships and
CBCS-LOCF in accordance to NEP 2020
w.e.f. 2024-25 (in phased manner)**


CHAIRPERSON
DEPARTMENT OF PHYSICS
INDIRA GANDHI UNIVERSITY
MEERPUR REWARI-122507


Indira Gandhi University Meerpur
Scheme and Syllabus of Examination for
Undergraduate programme
Subject: PHYSICS

Under Multiple Entry-Exit, Internships and
CBCS-LOCF in accordance to NEP 2020
w.e.f. 2024-25 (in phased manner)

Semester	Applicable Scheme	Course Type	Course Code	Nomenclature of paper	Credits	Contact hours	Internal marks	End term Marks	Total Marks	Duration of exam (Hrs) T+P
1	A, B & C	CC-1/ MCC-1	24L4.5-PHY-101	Mechanics	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
	C	MCC-2	24L4.5-PHY-102	Mathematical Physics	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
	A, B, C & D	CC-M1	24L4.5-PHY-103	Elementary Mechanics	1	1	10	20	30	3
				Practicum	1	2	5	15	20	3
	A, B, C & D	MDC1	24L4.5-PHY-104	Physics Fundament als-I	2	2	15	35	50	3
				Practicum	1	2	5	20	25	3
	C	CC-M1 4credits	From Available CC-1/MCC-1 of 4 credits as per NEP							
	A, B & C	AEC-1 2credits	From Available pool of AEC-1 of 2 credits as per NEP							
		SEC-1 3credits	From Available pool of SEC-1 of 3 credits as per NEP							
		VAC-1 2credits	From Available pool of VAC-1 of 2 credits as per NEP							
	Course	CC : Core Course MDC : Multidisciplinary Course SEC : Skill Enhancement Course				CC-M : Minor Course AEC : Ability Enhancement VAC : Value Added Course				
2	A, B & C	CC-2 / MCC-3	24L4.5-PHY-201	Electricity and Magnetism & EM Theory	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
	A, B & D	CC-M2	24L4.5-PHY-202	Elementary Electricity, Magnetism &	1	1	10	20	30	3

			EM Theory						
			Practicum	1	2	5	15	20	3
C	DSEC-1	24L4.5-PHY-203	Computational Physics	3	3	20	50	70	3
			Practicum	1	2	10	20	30	3
A, B & D	MDC-2	24L4.5-PHY-204	Physics Fundamentals-II	2	2	15	35	50	3
			Practicum	1	2	5	20	25	3
	C	CC-M2 4credits	From Available CC-2/MCC-3 of 4 credits as per NEP						
	A, B & C	AEC-2 2credits	From Available Pool of AEC-2 of 2 credits as per NEP						
		SEC-2 3credits	From Available Pool of SEC-2 of 3 credits as per NEP						
		VAC-2 2credits	From Available Pool of VAC-2 of 2 credits as per NEP						
	* Internship of 4credits of 4-6weeks duration								
Course	CC : Core Course MDC : Multidisciplinary Course SEC : Skill Enhancement Course DSEC : Discipline Skill Enhancement Course CC-M : Minor Course AEC : Ability Enhancement VAC : Value Added Course *Applicable for those students who wish to exit after 2nd Semester Note: UG Certificate in Physical Sciences (with credits 52) / Physics (with 48 Credits) will be provided, if student want to exit after 2nd Semester, on submitting 4-6 weeks Internship Report (4 Credits).								

3	A, B & C	CC-3/ MCC-4	24L5.0-PHY-301	Thermodynamics & Statistical Physics	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
	B	MCC-2	24L5.0-PHY-102	Mathematical Physics	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3

	B & C	MCC-5	24L5.0-PHY-303	Classical Mechanics	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
	A, B, C & D	MDC3	24L5.0-PHY-304	Physics Fundamentals-III	2	2	15	35	50	3
				Practicum	1	2	5	20	25	3
	A & C	CC-M3 4credits	From Available CC-3/MCC-4 of 4 credits as per NEP							
	B	CC-M3 (V) 4 credits	From Available pool of VOC-1 of 4 credits as per NEP							
	A, B & C	AEC-3 2credits	From Available pool of AEC-3 of 2 credits as per NEP							
		SEC-3 3credits	From Available pool of SEC-3 of 3 credits as per NEP							
	C	VAC-3 2 credits	From Available pool of VAC-3 of 2 credits as per NEP							
Course	CC: Core Course MDC : Multidisciplinary Course CC-M (V) : Minor (Vocational) AEC : Ability Enhancement SEC : Skill Enhancement Course VAC : Value Added Course									
4	A, B & C	CC-4/ MCC-6	24L5.0-PHY-401	Waves and Optics	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
	B & C	MCC-7	24L5.0-PHY-402	Introductory Quantum Mechanics	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
	B & C	MCC-8	24L5.0-PHY-403	Atomic Spectroscopy	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
	B & C	DSE-1	24L5.0-PHY-404	Laser Physics and Fiber Optics	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
			OR							
			24L5.0-PHY-405	Physics of Nano Materials	3	3	20	50	70	3

				Practicum	1	2	10	20	30	3
	A, &C	CC-M4 (V) 4 credits	From Available pool of VOC-1 of 4 credits as per NEP							
	B	CC-M4 (V) 4 credits	From Available pool of VOC-2 of 4 credits as per NEP							
	A, B &C	AEC-4 2 credits	From Available AEC-3 of 2 credits as per NEP							
	A, B	VAC-3 2 credits	From Available pool of VAC-3 of 2 credits as per NEP							
	C	VAC-4 2 credits	From Available pool of VAC-4 of 2 credits as per NEP							
	*Internship of 4 credits of 4-6 weeks duration for students who wish to exit after 4 th semester									
	Course	CC : Core Course MDC : Multidisciplinary Course SEC : Skill Enhancement Course				CC-M(V) : Minor (Vocational) AEC : Ability Enhancement VAC : Value Added Course				
Note: UG Diploma in Physical Sciences (with credits 96) / Physics (with 92 Credits) will be provided, if student want to exit after 4 th Semester on submitting the 4-6 weeks Internship Report (4 Credits).										
5	A, B & C	CC-5 MCC-9	24L5.5-PHY-501	Modern Physics	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
	B & C	MCC-10	24L5.5-PHY-502	Nuclear Physics	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
	B & C	DSE-2	24L5.5-PHY-503	Environmental Physics	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
			OR							
			24L5.5-PHY-504	Non-Linear Dynamics	3	3	20	50	70	3
				Practicum	1	2	10	20	30	3
			B & C	DSE-3	24L5.5-PHY-505	Instrumentation and Analytical Methods	3	3	20	50
	Practicum	1				2	10	20	30	3

		PC-H: Practicum Course in Honors Subject								
8	B & C	CC-H4	24L6.0-PHY-801	Electrodynamics and Plasma Physics	4	4	30	70	100	3
	B & C	CC-H5	24L6.0-PHY-802	Advance Quantum Mechanics	4	4	30	70	100	3
	B & C	CC-H6 (Not applicable to degree with research)	24L6.0-PHY-803	Digital Electronics	4	4	30	70	100	3
	B & C	DSE-7	24L6.0-PHY-804	Solid State Physics-II	4	4	30	70	100	3
			OR							
			24L6.0-PHY-805	Condensed Matter Physics-II	4	4	30	70	100	3
	B & C	PC-H2 (Not applicable to degree with research)	24L6.0-PHY-806	Practicum Course	4	8	30	70	100	6
	B & C	Research	24L6.0-PHY-R-807	Project/Dissertation	12			300	300	
B & C	CC-HM2 4 credits	From Available Minor of 4 credits as per NEP								
		CC: Core Course PC: Practicum Course Note: Bachelor (Hons.) Degree in Subject / Discipline with 184 / 180 credits will be awarded. Note: Bachelor (Hons.) Degree (With Research) in Subject / Discipline with 184 / 180 credits will be awarded.								

Scheme of Examination for VAC/VOC offered by the Department of Physics

Semester	Scheme	Course Type	Course Code	Nomenclature of paper	Credits	Contact hours	Internal marks	End term Marks	Total Marks	Duration of exam (Hrs)
3 rd	C	VAC-3	24L5.0-VAC-PHY-301	Exploring the Journey of Indian Space Satellites	2	2	15	35	50	3
4 th	C	VAC-4	24L5.0-VAC-PHY-401	Physics in Everyday Life	2	2	15	35	50	3
	A, B, D	VAC-3								
3 rd	B	VOC-1	24L5.0-VOC-PHY-301	Refrigeration and Air Conditioning (RAC)	4	4	30	70	100	3
4 th	A, C, D	VOC-1	24L5.0-VOC-PHY-401	Maintenance of Laboratory Instruments	4	4	30	70	100	3
	B	VOC-2								
5 th	A, C, D	VOC-2	24L5.5-VOC-PHY-501	Refrigeration and Air Conditioning (RAC)	4	4	30	70	100	3
6 th	A, B, C, D	VOC-3	24L5.5-VOC-PHY-601	Solar Panel Installation	4	4	30	70	100	3

Indira Gandhi University Meerpur**Undergraduate Programs****Course: CC-1/MCC-1**

Session:2024-25			
Part A-Introduction			
Subject	Physics		
Semester	1 st		
Name of the Course	Mechanics		
Course Code	24L4.5-PHY-101		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Physics as main subject at level 4(i.e. 10+2 or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the dynamics of system of particles, conservation of energy and momentum application of both translational and rotational dynamics motions simultaneously in analyzing rolling with slipping. 2. Differentiate between elastic and plastic body. Elastic constants, determination and their physical significance. Torque and its significance. 3. Familiar about the special theory of relativity and its applications. Michelson's Morley experiments and its finding. 4. Analyze the two body Central Force problem and its applications 5. Learn to present observations, results, analysis and different concepts related to experiments of Mechanics.		
Credits	Theory	Practical	Total
	3	1	4

Contact Hours	3	2	5
---------------	---	---	---

Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3hrs
Part B-Contents of the Course		
<u>Instructions for Paper-Setter</u> 1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.		
Unit	Topics	Contact Hours
I	Fundamentals of Dynamics: Rigid body, Moment of Inertia, Radius of Gyration, Theorems of perpendicular and parallel axis (with proof), Moment of Inertia of rod, ring, Disc, Angular Disc, Solid cylinder, Solid sphere, Hollow sphere, Rectangular plate, Square plate, Solid cone, Triangular plate, Torque, Rotational Kinetic Energy, Angular momentum, Law of conservation of angular momentum, Rolling motion, condition for pure rolling, acceleration of body rolling down an inclined plane, Fly wheel, Moment of Inertia of an irregular body.	11
II	Elasticity: Deforming force, Elastic limit, stress, strain and their types, Hooke's law, Modulus of rigidity, Relation between shear angle and angle of twist, elastic energy stored/volume in an elastic body, Elongation produced in heavy rod due to its own weight and elastic potential energy stored in it, Tension in rotating rod, Poisson's ratio and its limiting value, Elastic Constants and their relations. Torque required for twisting cylinder, Hollow shaft is stiffer than solid one. Bending of beam, bending moment and its magnitude, Flexural rigidity, Geometrical moment of inertia for beam of rectangular cross-section and circular cross-section. Bending of cantilever (loaded by a weight W at its free end), weight of cantilever uniformly distributed over its entire length. Dispersion of a centrally loaded beam supported at its ends, determination of elastic constants for material of wire by Searle's method.	12

III	Special Theory of Relativity: Michelson's Morley experiment and its outcomes, Postulates of special theory of relativity, Lorentz Transformations, Simultaneity and order of events, Lorentz contraction, Time dilation, Relativistic transformation of velocity, relativistic addition of velocities, variation of mass-energy equivalence, relativistic Doppler effect, relativistic kinematics, transformation of energy and momentum, transformation of force, Problems of relativistic dynamics.	11
IV	Gravitation and central force motion: Law of gravitation, Potential and field due to spherical shell and solid sphere. Motion of a particle under central force field, Two body problem and its reduction to one body problem and its solution, compound pendulum or physical pendulum in form of elliptical lamina and expression of time period, determination of g by means of bar pendulum, Normal coordinates and normal modes, Normal modes of vibration for given spring mass system, possible angular frequencies of oscillation of two identical simple pendulums of length (l) and small bob of mass m_0 joined together with spring of spring constant (k).	11
	<u>Practicum</u> 1. Measurement of length (or diameter) using Vernier Caliper, screw gauge and travelling microscope. 2. To study the random error in observations. 3. To determine the area of window using a sextant. 4. Moment of Inertia of a Flywheel. 5. Moment of Inertia of irregular body using a Torsion Pendulum. 6. Young's Modulus by Bending of Beam. 7. Modulus of rigidity of material of wire by Maxwell's Needle. 8. Elastic constants by Searle's method. 9. To determine the value of 'g' by using Bar pendulum. 10. To find the Poisson ratio of rubber by Rubber tube method. 11. To compare Moment of Inertia of a solid Sphere, Hollow Sphere and solid Disc of same mass with the help of Torsion Pendulum. 12. To determine the bending moment of a cantilever beam with uniformly distributed load, uniformly varying load and point load. Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.	30

Indira Gandhi University, Meerpur
Undergraduate Programs
Course: MCC-2

Session: 2024-25			
Part A-Introduction			
Subject	Physics		
Semester	1 st		
Name of the Course	Mathematical Physics		
Course Code	24L4.5-PHY-102		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Physics as main subject at level 4 (i.e. 10+2or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Learn the Fourier analysis of periodic functions and their applications in physical problems. Learn the beta, gamma and the error functions and their applications in doing integrations. 2. Acquire knowledge of methods to solve partial differential equations with the examples of important partial differential equations in Physics. 3. Write given function in terms of sine and cosine terms in Fourier series and also to get knowledge in Fourier transforms 4. Learn about beta gamma function, their properties, solve Legendre equations find generating function for Legendre Polynomial, Hermite equation, study orthogonal properties of Hermite Polynomials, recurrence relations of complex numbers and their properties such as analyticity, poles and residues. 5. Learn about the methods to solve the mathematical problem using Fortran		
Credits	Theory	Practical	Total
	3	1	4

Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3hrs	
Part B-Contents of the Course			
<u>Instructions for Paper-Setter</u>			
1.Nine questions will be set in total.			
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.			
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.			
4. 20 % numerical problems are to be set.			
5. Use of scientific (non-programmable) calculator is allowed.			
Unit	Topics		Contact Hours
I	Theory of Errors: Systematic and Random errors, Propagation of errors, Normal law of errors, Standard and Probable error, Least square fit, error on slope and intercept of fitted line. Matrices: Normal Matrices, Orthogonal Matrices, Hermitian Matrices, Unitary Matrices, Symmetric and Anti-symmetric Matrices, Conjugate of a Matrix, Anti-Hermitian Matrices, Rank & Trace of Matrix, Eigen values and eigen vectors of Matrices, Diagonalization of Matrices.		11
II	Method of expansion of a function: Taylor’s expansion, Power series, Laurent’s theorem. Partial and ordinary differential equations, Partial Differential equations, First order differential equations, Method of separation of variables, Singular points, Vibrations of an elastic string, One dimensional Heat Flow, Heat conduction equation for a 3- dimensional rectangular configuration and apply it to the cooling of a brick (assuming constant initial temperature distribution), vibrations of rectangular and circular membrane, Method of Frobenius, Diffusion equation, Laplace’s equation in problems of rectangular , cylindrical and spherical symmetry, Inhomogeneous partial differential equation-Green’s function.		12

III	Fourier series and Integrals: Introduction, Evaluation of coefficients of Fourier series, cosine series, sine series, Dirichlet's theorem; representation of Even and odd functions, Extension of interval, complex form of Fourier series, Properties of Fourier series: Convergence, Integration, Differentiation, Parseval's theorem, Physical applications of Fourier series analysis: square wave, Half wave rectifier, Full wave rectifier, saw tooth wave, triangular wave; Fourier Integrals, deduction of expressions for the Fourier Transform and its inverse.	11
IV	Beta and Gamma Functions: Definition of gamma function, beta function, other forms of beta function, Relationship between beta and gamma function, Legendre's equation, Legendre's Polynomial, Legendre's function of second kind, General solution of Legendre's equation, Generating function of Legendre's polynomial, orthogonality of Legendre's polynomials, Deduction of Rodrigue's formula for the Legendre's Polynomials, recursion relation for Legendre Polynomial, Hermite Polynomial, Hermite differential equation, Generating function of Hermite Polynomial, deduction of recursion relation for H_n of 1st kind and 2nd.	11

[illegible]

Indira Gandhi University Meerpur
Undergraduate Programs
Course: CC-M1

Session: 2024-25			
Part A-Introduction			
Subject	Physics		
Semester	1 st		
Name of the Course	Elementary Mechanics		
Course Code	24L4.5-PHY-103		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	CC-M		
Level of the Course (As per Annexure-I)	100-199		
Pre-requisite for the course(if any)	Physics as main subject at level 4 (i.e. 10+2 or equivalent) and Physics not as major subject in 1 st Sem		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the dynamics of system of particles, Determination of moment of inertia using Theorems of parallel and perpendicular axis. Application of both translational and rotational dynamics motions simultaneously in analyzing rolling with slipping. 2. Differentiate between elastic and plastic bodies. Elastic constants, determination and their physical significance. Torque and its significance in rotatory motion. 3. Familiar about the special theory of relativity and its applications. Michelson's Morley experiment and its findings. 4. Analyze the two body Central Force problem and its applications. 5. Learn to present observations, results, analysis and different concepts related to experiments of Mechanics.		
Credits	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3

Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35		Time: 3hrs
Part B-Contents of the Course		
<u>Instructions for Paper-Setter</u>		
1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20 % numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.		
Unit	Topics	Contact Hours
I	Fundamentals of Dynamics: Rigid body, Moment of Inertia, Radius of Gyration, Theorems of perpendicular and parallel axis (with proof), Moment of Inertia of ring, Disc, Angular Disc, Solid cylinder.	3
II	Elasticity: Deforming force, Elastic limit, stress, strain and their types, Hooks law, Module of elasticity Relation between shear angle and angle of twist, Poisson's ratio and its limiting value. Torque required for twisting cylinder.	4
III	Special Theory of Relativity: Michelson's Morley experiment and its outcomes, Postulates of special theory of relativity, Lorentz Transformations, Lorentz contraction, Time dilation, Relativistic transformation of velocity, relativistic addition of velocities, variation of mass-energy equivalence.	4
IV	Gravitation and central force motion: Law of gravitation, Potential and field due to spherical shell and solid sphere. Motion of a particle under central force field, Normal coordinates and normal modes, Normal modes of vibration for given spring mass system, possible angular frequencies of oscillation of two identical simple pendulums of length (l) and small bob of mass (m) joined together with spring of spring constant (k).	4

	<u>Practicum</u> 1. Measurement of length (or diameter) using Vernier caliper, screw gauge and travelling microscope. 2. To study the random error in observations. 3. To determine the area of window using a sextant. 4. Moment of Inertia of a Fly Wheel. 5. Moment of Inertia of irregular body using a Torsion Pendulum. 6. Young's Modulus by Bending of Beam. 7. Young's modulus by Koenig's method. 8. Modulus of rigidity of material of wire by Maxwell's Needle. 9. Elastic constant by Searle's method. 10. To determine the value of 'g' by using Bar pendulum. Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.	15
--	---	----

Suggested Evaluation Methods		
Internal Assessment: ➤ Theory (10 Marks) • Class Participation: 04 Marks • Seminar/presentation/assignment/quiz/class test etc.: Nil • Mid-Term Exam: 6 Marks ➤ Practicum (5 Marks) • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 5 Marks • Mid-Term Exam: Nil	End Term Examination :20 Marks	
	15 Marks	
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. Mechanics "Berkeley Physics Course Vol.I", Charles Kittel, TataMcGraw-Hill 2. Mechanics, D.S. Mathur, S.Chand and Company Limited, 2000 3. Elements of Properties of Matter, D.S.Mathur, S.Chand & Com. Pt.Ltd., NewDelhi 4. Physics, Resnick, Halliday & Walker, Wiley 5. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A.Serway, 2010, Cengage Learning 6. An introduction to mechanics, D.Kleppner, R.J. Kolenkow, 1973, McGraw-Hill. 7. Properties of Matter, R. Murgeshan, S.Chand & Com. Pt. Ltd., NewDelhi 8. Classical Mechanics, J.C.Upadhyaya, Himalaya Publishing House 9. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, NewDelhi 10. Advanced Level Practical Physics, M.Nelkon and Ogborn, Henemann Education Books Ltd., New Delhi 11. Practical Physics, S.S.Srivastava and M.K.Gupta, Atma Ram & Sons, Delhi 12. Practical Physics, S.L.Gupta and V.Kumar, Pragati Prakashan Meerut 13. Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar 14. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, Asia Publishing House.		

Indira Gandhi University Meerpur

Undergraduate Programs

Course: MDC-1

Session: 2024-25			
Part A-Introduction			
Subject	Physics		
Semester	1 st		
Name of the Course	Physics Fundamentals–I		
Course Code	24L4.5-PHY-104		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MDC		
Level of the course(As per Annexure-I	100-199		
Pre-requisite for the course(if any)	Not studied Physics subject at level 4 (i.e.10+2 or equivalent)		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Have knowledge about the nature, scope and impact of physics on technological development of the society. 2. Understand and describe motion of an object in one dimension. 3. Understand and describe the laws of motion and their applications in daily life. 4. Understand and appreciate the importance of laws of conservation of energy and momentum in daily life. 5. Learn to present observations, results, analysis and different concepts related to experiments of Physics Fundamentals –I		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Max. Marks: 75 Internal Assessment Marks: 20 End Term Exam Marks: 55		Time:3hrs	

Part B-Contents of the Course

Instructions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20 % numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Physics-Nature, scope & excitement, Major discoveries in physics, major contribution by Indian Physicists, Fundamental physical constants, Physics in relation to other sciences, impact of physics on society and on latest development in science & technology. System of Measuring Units-Need for measurement, measuring process, concept of mass, length, time; Fundamental and derive units, system of units, concepts of error, types of error (only definition), Accuracy and precision in measurement, least count and applications of measuring instruments -Vernier caliper, Screw Gauge	8
II	Motion of objects in one dimension- position of the object, origin/reference point, frame of reference, definitions and examples of motion in one, two and three dimension, Scalar and Vector quantities, description of motion along a straight line- distance and displacement, uniform motion and non-uniform motion, average and instantaneous speed, average and instantaneous velocity, acceleration; graphical analysis of straight line motion- distance- time graph, velocity-time graph, equation of motions and their applications.	8
III	Causes of motion- concept of force, Newton's 1st law of motion, inertia and mass; Newton's 2 nd law of motion, momentum and force; 3 rd law of motion, daily life applications of Newton's laws of motion. Universal law of gravitation and its importance, acceleration due to gravity	7

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Essential University Physics, Vol.-1&2 by Richard Wolfson, Pearson Education, Patparganj, Delhi, India.
2. Concept of Physics by H.C. Verma, Bharti Bhawan, Ansari Road, Daryaganj, New Delhi, India.
3. Modern Physics(2nd edition), by S.L. Kakani and Shubhra Kakani, Viva Books, New Delhi.
4. Physics for Scientists and Engineers with Modern Physics, 7th edition, by Raymond A. Serway and John W. Jewett, Jr., Thomson Higher Education 10 Davis Drive Belmont, CA 94002-3098 USA.
5. Physics For You, Fifth Edition, by Keith Johnson, OUP Oxford; 5th edition (23 June 2016).
6. B.Sc Practical Physics, C.L. Arora, R Chand & Co. New Delhi
7. B.Sc Practical Physics, Harnam Singh and Dr.P.S.Hemne, S Chand & Company Ltd.

Indira Gandhi University Meerpur
Undergraduate Programs
Course: CC-2/MCC-3

Session: 2024-25	
Part A-Introduction	
Subject	Physics
Semester	2 nd
Name of the Course	Electricity, Magnetism and EM Theory
Course Code	24L4.5-PHY-201
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	CC/MCC
Level of the Course (As per Annexure-I)	100-199
Pre-requisite for the course (if any)	Appeared or passed the 1 st sem (B.Sc. Physical Science/equivalent)
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Explain and differentiate the vector and scalar formalisms of electrostatics. Also be able to apply Gauss's Divergence & Stokes theorem to solve various problems in electrostatics. 2. Describe the magnetic materials & important properties of magnetic field. Understand the properties and theories of dia-, para- & ferromagnetic materials. 3. Derive Maxwell equations and their physical significance and familiar about the propagation of electromagnetic waves i.e. boundary conditions at the interface between different media. The students will also be able to have basic idea about the propagation of electromagnetic waves in free space and in medium. 4. 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. 5. Learn to present observations, results, analysis and different concepts related to experiments of Electricity and Magnetism.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time:3hrs	
Part B- Contents of the Course			
<u>Instructions for Paper-Setter</u>			
1.Nine questions will be set in total. 2. Question no. 1will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of scientific(non-programmable) calculator is allowed.			
Unit	Topics		Contact Hours
I	Vector Background and Electric Field: 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, Stoke’s theorem. Conservative nature of Electrostatic Field, Electrostatic Potential, Potential as line integral of field, potential difference Derivation of electric field E from potential as gradient. Derivation of Laplace and Poisson equations. Electric flux, Gauss’s Law, Differential form of Gauss’s law and applications of Gauss’s law. Mechanical force of charged surface, Energy per unit volume.		11
II	Magnetic Field: Biot-Savart law and its simple applications: straight wire and circular loop, 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, Magnetic Properties of Matter: Force on a dipole in an external field, 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,		12

	Electronic theory of dia and paramagnetism, Domain theory of ferromagnetism (Langevin's theory), Cycle of Magnetization- B-H curve and hysteresis loop: Energy dissipation, Hysteresis loss and importance of Hysteresis Curve.	
III	Time varying electromagnetic fields: Electromagnetic induction, Faraday's laws of induction and Lenz's Law, Self-inductance, Mutual inductance, Energy stored in a Magnetic field, Derivation of Maxwell's equations, Displacement current, Maxwell's equations in differential and integral form and their physical significance. Electromagnetic Waves: Electromagnetic waves, Transverse nature of electromagnetic wave, energy transported by electromagnetic waves, Poynting vector, Poynting's theorem. Propagation of Plane electromagnetic waves in free space & Dielectrics.	11
IV	DC current Circuits: 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. Alternating Current Circuits: 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.	11

Indira Gandhi University Meerpur**Undergraduate Programs****Course: CC-M2**

Session: 2024-25			
Part A-Introduction			
Subject	Physics		
Semester	2 nd		
Name of the Course	Elementary Electricity, Magnetism & EM Theory		
Course Code	24L4.5-PHY-202		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	CC-M		
Level of the Course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Physics not as major subject in 2 nd sem		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Explain and differentiate the vector and scalar formalisms of electrostatics. Also be able to apply Gauss's Divergence & Stokes theorem to solve various problems in electrostatics. 2. Describe the magnetic materials & important properties of magnetic field. Understand the properties and theories of dia-, para- & ferromagnetic materials. 3. Derive Maxwell equations and their physical significance and familiar boundary conditions at the interface between different media. The students will also be able to have basic idea about the propagation of electromagnetic waves. 4. 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. 5. Learn to present observations, results, analysis and different concepts related to experiments of Electricity and Magnetism.		
Credits	Theory	Practical	Total

	1	1	2
Contact Hours	1	2	3
Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35	Time: 3hrs		
Part B-Contents of the Course			
<u>Instructions for Paper-Setter</u>			
1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts, and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of a scientific (non-programmable) calculator is allowed.			
Unit	Topics		Contact Hours
I	Vector background and electric field: 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, Stoke’s theorem.		4
II	Magnetic field and magnetic properties : Magnetic induction, Magnetic flux, Solenoidal nature of vector field of induction, properties of B (i) $\nabla \cdot B=0$ (ii) $\nabla \times B = \mu_0 J$, Magnetic Materials, types, Hysteresis curve and Importance of Hysteresis Curve.		3
III	Time varying electromagnetic fields and electromagnetic waves : Electromagnetic induction, Faraday’s laws of induction and Lenz’s Law, Derivation of Maxwell’s equations and their physical significance. Boundary conditions at interface between two different media, Propagation of electromagnetic wave (Basic idea, no derivation), Poynting vector and Poynting theorem.		4
IV	D.C. and A.C. circuits: D.C. Network theorems: Thevenin’s theorem, Norton theorem, Superposition theorem, Analysis of LCR Series and parallel resonant circuits.		4

Indira Gandhi University Meerpur

Undergraduate Programs

Course: DSEC-1

Session: 2024-25			
Part A-Introduction			
Subject	Physics		
Semester	2 nd		
Name of the Course	Computational Physics		
Course Code	24L4.5-PHY-203		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	DSEC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Appeared or passed the 1 st sem (B.Sc. Physical Science/equivalent)		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the programming language and its use in various applications. 2. Develop Python programs to solve computational problems. 3. Select a suitable programming to solve differential equations. 4. Find the integral value of a function using appropriate method. 5. Understand how to develop a programme for a particular problem and it will improve logical thinking that helps to solve scientific problems using Python language.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 hrs	

Part B-Contents of the Course

Instructions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts, and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of a scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Introduction to Programming using Python: Structure of a Python Program, Functions, Interpreter shell, Indentation. Identifiers and keywords, Literals, Strings, Basic operators (Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment Operator, bitwise operator). Standard libraries in Python, notion of class, object and method.	11
II	Creating Python Programs: Identifiers and keywords; Literals, numbers, and strings; Operators; Expressions; Input/output statements; Defining functions; Control structures (conditional statements, loop control statements, break, continue and pass, exit function), default arguments. Mutable and immutable objects. Testing and debugging a program.	12
III	Differentiation: Taylor series method, Newton's forward and backward difference formula, Sterling's formula. Numerical solutions of partial differential equations using Taylors's series method.	11
IV	Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Gaussian Quadrature, Legendre– Gauss Quadrature, Numerical double integration.	11

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Sheetal Taneja, Naveen Kumar, Python Programming “A Modular Approach” Pearson India.
2. E. Balaguruswamy, Introduction to Computing and Problem Solving using Python, 2nd edition, McGraw Hill Education, 2018
3. RC Desai, Fortran Programming and Numerical Methods, Tata McGraw Hill, New Delhi.
4. Suresh Chandra, Computer Applications in Physics, Narosa Publishing House
5. ML DeJong, Introduction to Computational Physics, Addison-Wesley Publishing Company.
6. RC Verma, PK Ahluwalia and KC Sharma, Computational Physics: An Introduction, New Age International Publisher.
7. SS Sastry, Introductory methods of numerical Analysis, Prentice Hall of India Pvt. Ltd.
8. V Rajaraman, Computer Oriented Numerical Method, Prentice Hall of India Pvt. Ltd.
9. C Balachandra Rao and CK Santha, Numerical Methods, University Press
10. KE Atkinson, An introduction to numerical analysis, John Wiley and Sons.

Indira Gandhi University Meerpur
Undergraduate Programs
Course: MDC-2

Session: 2024-25			
PartA-Introduction			
Subject	Physics		
Semester	2 nd		
Name of the Course	Physics Fundamentals-II		
Course Code	24L4.5-PHY-204		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MDC		
Level of the Course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Not studied Physics subject at level 14 (i.e.10+2orequivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Have basic knowledge about nature of light, the associated phenomena and their importance in daily life. 2. Understand and describe the working of important optical instruments through the learning of image formation by mirrors and lenses. 3. Have basic knowledge about electric current, electric circuit, electric components, and practical utility of heating and magnetic effects of electric current. 4. Grasp an introductory idea about the generation of X- rays, α, β and γ rays through an understanding of composition of atom & nucleus. 5. Understand the observations, results, analysis and different concepts related to experiments of light &optics.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4

Max. Marks: 75 Internal Assessment Marks: 20 End Term Exam Marks: 55	Time: 3hrs
---	-------------------

Part B-Contents of the Course

Instructions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts, and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, select in gone question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Light and optics-Nature and properties of light, its speed, frequency and wavelength; Reflection of light-types of reflection and their importance in daily life, laws of reflection, multiple reflection by mirrors and their applications. Refraction of light- laws of refraction, refractive index, refraction of light through prism(dispersion of light), formation Rainbow, twinkling of stars, advance Sunrise and delayed Sunset; Scattering of light and blue colour of the sky; apparent depth, total internal reflection and its important applications.	7
II	Image formation through reflection-images formed by plane mirrors, multiple images formed by two flat mirrors and optical illusions; images formed by parabolic mirrors and spherical mirrors- Concave and convex mirrors, ray diagrams, mirror equation and magnification; applications of plane and curved mirrors in daily life. Image formation through hhre fraction- images by convex and concave lenses, ray diagrams and lens equation. Optical instruments-Camera, eye, telescope and microscope.	8

III	Electricity- electric charge, types of charges, unit of charge, frictional electricity, electricity by conduction and electric current, units of electric current, measurement of current, conductors and insulators; resistance, resistivity and Ohm's law, electric potential and potential difference, emf; Electric circuit- resistor, capacitor, battery, ammeter and voltmeter; Series and parallel combinations of resistors, electrical wiring in houses and electrical safety (fuse, hot wire, neutral, ground and short circuit), electric power and electric power transmission; Heating effect of current and its practical applications. Magnetic effect of electric current- Magnetic field and field lines, bar magnet, magnetic field and direction of field due to a current-through straight conductor and through a circular loop; solenoid, electromagnet.	8
IV	Structure of an atom- Rutherford's model of an atom, Bohr's model of an atom and composition of the atom-electron, proton and neutron, orbits or shells (energy levels in an atom), distribution of electrons in different shells of the atom, atomic number and atomic mass of an atom, core shell and outer shell, valence of an atom, excitation and ionization of the atom, meaning of atomic transitions; Discovery of X-rays, Generation of X-rays, their characteristics, applications and harmful effects; Composition of nucleus, meaning of nuclear transitions and properties of α-, β- and γ-rays.	7
	<u>Practicum</u> 1. To find the focal length of a convex mirror using a convex lens. 2. To find the value of v for different values of u in the case of a concave mirror and to find the focal length. 3. To find the focal length of a concave lens using a convex lens. 4. To determine the refractive index of a glass slab. 5. To find the refractive index of a liquid using a convex lens and plane mirror 6. To determine the resistivity of different wires by plotting a graph for potential difference versus current. 7. To verify Ohm's law for metallic conductor and to determine its resistance.	30

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: CC-3/MCC-4

Session: 2024-25			
Part A-Introduction			
Subject	Physics		
Semester	3 rd		
Name of the Course	Thermo dynamics & Statistical Physics		
Course Code	24L5.0-PHY-301		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the Course(As per Annexure-I)	100-199		
Pre-requisite for the course(if any)	Appeared or passed the 2 nd sem (B.Sc. Physical Science/ equivalent)		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand and describe the basic concepts and laws of thermodynamics. 2. Apply the laws of thermo dynamics to develop Maxwell's thermodynamic relations be able to understand their physical interpretations. 3. Appreciate cellular nature of phase space and have better knowledge of classical statistics which would result in greater insight into solutions of various complex problems. 4. Have better understanding of quantum statistics and are in a position to extend the treatment to the analysis of complex problems. 5. Learn to present observations, results, analysis and different concepts of experiments related to Thermodynamics & Statistical Physics.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3hrs
Part B-Contents of the Course		
<u>Instructions for Paper-Setter</u> 1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, select in gone question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.		
Unit	Topics	Contact Hours
I	THERMODYNAMICS-I Thermodynamic-systems, variables and equation of state, thermal equilibrium, Zeroth law of thermodynamics; Concept of heat, work and its sign (work done- by the system on the system) & its path dependence, First law of thermodynamics- its significance and limitations, internal energy as a state function, different types of process-isochoric process, isobaric process, adiabatic process, isothermal process, cyclic process, Reversible and irreversible process, First law and cyclic process; Second law of thermodynamics and its significance, Carnot theorem; Absolute scale of temperature, Absolute Zero and magnitude of each division on work scale and perfect gas scale, Joule's free expansion, Joule Thomson effect, Joule-Thomson (Porous plug) experiment, conclusions and explanation, analytical treatment of Joule Thomson effect, Entropy, calculations of entropy of reversible and irreversible process, T-S diagram, entropy of a perfect gas, Nernst heat law (third law of thermodynamics); Liquefaction of gases, (oxygen, air, hydrogen and helium) solidification of helium below 4K, Cooling by adiabatic demagnetization	11

II	THERMODYNAMICS-II Derivation of Clausius-Clapeyron and Clausius latent heat equations and their significance, specific heat of saturated vapours, phase diagram and triple point of a substance, development of Maxwell thermo dynamical relations, Thermo dynamical functions: Internal energy (U), Helmholtz function (F), Enthalpy (H), Gibbs function (G) and the relations between them, derivation of Maxwell thermodynamical relations from thermodynamical functions, Application of Maxwell relations: relations between two specific heats of gas, Derivation of Clausius- Clapeyron and Clausius equation, variation of intrinsic energy with volume for (i) perfect gas (ii) Vander wall gas (iii) solids and liquids, derivation of Stefan's law, adiabatic compression and expansion of gas & deduction of theory of Joule Thomson effect.	11
III	Statistical Physics-I Distribution of N (for N= 2, 3, 4) distinguishable and indistinguishable particles in two boxes of equal size, microstates and macro states, thermo dynamical probability, constraints and accessible states, statistical fluctuations, general distribution of distinguishable particles in compartments of different sizes, β -parameter, entropy and probability; Concept of phase space, division of phase space into cells, postulates of statistical mechanics; Classical and quantum statistics, basic approach to these statistics, Maxwell-Boltzmann statistics applied to an ideal gas in equilibrium-energy distribution law, Maxwell's distribution of speed & velocity (derivation required), most probable speed, average and r.m.s. speed, mean energy for Maxwellian distribution.	12
IV	Statistical Physics-II Dulong and Petit Law, derivation of Dulong and Petit law from classical physics; Need of Quantum statistics- classical versus quantum statistics, Bose-Einstein energy distribution Law, Application of B. E. Statistics to Planck's radiation law, degeneracy and B. E. condensation; Fermi-Dirac energy distribution Law, F.D. gas and degeneracy, Fermi energy and Fermi temperature; F. D. energy distribution Law for electron gas in metals, zero point energy, average speed (at 0 K) of electron gas	11

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Thermal Physics and Statistical Mechanics, S.K. Roy, New Age International Publishers, New Delhi
2. Thermodynamics and statistical Physics, J.K.Sharma and K.K.Sarkar, Himalaya Publishing House, Bombay
3. Introduction to Thermo dynamics and its Applications, Stowe Keith, University Press (India) Pvt. Ltd, Hyderabad
4. Introductory Thermo dynamics, Pierre Infelta, Brown Walker Press, Boca Ratan, Florida
5. Fundamentals of Thermo dynamics, J.K. Johnson, University of Pittsburgh 2009
6. Thermo dynamics and Its Applications, Jefferson Tester, Michael Modell, 3rd Edition
7. Thermo dynamics, Statistical Thermodynamics & Kinetics, Thomas Engel, Philip Reid, 2nd Edition
8. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
9. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
10. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
11. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: MCC-2

Session: 2024-25			
Part A-Introduction			
Subject	Physics		
Semester	3 rd		
Name of the Course	Mathematical Physics		
Course Code	24L4.5-PHY-102		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MCC		
Level of the Course(As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Appeared or passed the 2 nd sem (B.Sc. Physical Science/ equivalent)		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Learn the Fourier analysis of periodic functions and their applications in physical problems. Learn the beta, gamma and the error functions and their applications in doing integrations. 2. Acquire knowledge of methods to solve partial differential equations with the examples of important partial differential equations in Physics. 3. Write given function in terms of sine and cosine terms in Fourier series and also to get knowledge in Fourier transforms 4. Learn about beta gamma function, their properties, solve Legendre equations find generating function for Legendre Polynomial, Hermite equation, study or the orthogonal properties of Hermite Polynomials, recurrence relations of complex numbers and their properties such as analyticity, poles and residues. 5. Learn about the method to solve the mathematical problem using Fortran		
Credits	Theory	Practical	Total
	3	1	4

Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time:3 hrs	
Part B-Contents of the Course			
<u>Instructions for Paper-Setter</u>			
1.Nine questions will be set in total.			
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.			
3. Four more questions are to be attempted, select in gone question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.			
4. 20% numerical problems are to be set.			
5. Use of scientific (non-programmable) calculator is allowed.			
Unit	Topics		Contact Hours
I	Theory of Errors: Systematic and Random errors, Propagation of errors, Normal law of errors, Standard and Probable error, Least square fit, error on slope and intercept of fitted line. Matrices: Normal Matrices, Orthogonal Matrices, Hermitian Matrices, Unitary Matrices, Symmetric and Anti-symmetric Matrices, Conjugate of a Matrix, Anti-hermition Matrices, Trace of Matrix, Eigen values and eigen vectors of Matrices, Diagonalization of Matrices.		11
II	Method of expansion of a function: Taylor’s expansion, Power series, Laurent’s theorem. Partial and ordinary differential equations, Partial Differential equations, First order differential equations, Method of separation of variables, Singular points, Vibrations of an elastic string, One dimensional Heat Flow, Heat conduction equation for a 3-dimensional rectangular configuration and apply it to the cooling of a brick (assuming constant initial temperature distribution), vibrations of rectangular and circular membrane, Method of Frobenius, Diffusion equation, Laplace’s equation in problems of rectangular , cylindrical and spherical symmetry, Inhomogeneous partial differential equation-Green’s function.		12

III	Fourier series and Integrals: Introduction, Evaluation of coefficients of Fourier series, cosine series, sine series, Dirichlet's theorem, representation of Even and odd functions, Extension of interval, complex form of Fourier series, Properties of Fourier series: Convergence, Integration, Differentiation, Parseval's theorem, Physical applications of Fourier series analysis: square wave, Half wave rectifier, Full wave rectifier, saw tooth wave, triangular wave, Fourier Integrals, deduction of expressions for the Fourier Transform and its inverse.	11
IV	Beta and Gamma Functions: Definition of gamma function, beta function, other forms of beta function, Relationship between beta and gamma function, Legendre's equation, Legendre's Polynomial, Legendre's function of second kind, General solution of Legendre's equation, Generating function of Legendre's polynomial, orthogonality of Legendre's polynomials, Deduction of Rodrigue's formula for the Legendre's Polynomials, Hermite Polynomial, Hermite differential equation, Generating function of Hermite Polynomial, deduction of recursion relation for H_n of 1st kind and 2nd	11

	<u>Practicum</u> Review of FORTRAN Programming fundamentals: FORTRAN Preliminaries: Integer and floating point arithmetic expression, built in functions, executable and non-executable statements, input and output statements, Formats, IF, DO and GO TO statements, Dimension arrays, statement function and function subprogram. To print out all natural (even/odd) 1. Compute the product of two matrices of different dimensions using DO loop 2. Numerical integration by Simpson1/3rule 3. Fitting of a straight line using Least-Squares method 4. Using array variable, find out the average and standard deviation 5. Write a program to evaluate the function $Y=1/[C(1+e\cos\theta)]$ and $V=\sqrt{[CMG(e^2 + e\cos\theta + 1)]}$ $e = 1.1$, $C = 3.0(E+08)$, $M=5.893(E+24)$, $G=6.67(E-11)$ for varying value of θ from 0 to π. 6. To find maximum, minimum and range of a given set of numbers using computer. 7. To evaluate sum off in ite series. 8. Find the root sofa quadratic equation. 9. To find integration of a definite integral by trapezoidal rule. 10. To find the area of a triangle, sphere and cylinder. 11. Given values for a, b, c, d and a set of values for the variable x evaluate the function defined by. $f(x) = ax^2 + bx + c \text{ if } x < d$ $f(x) = 0 \text{ if } x = d$ $f(x) = ax^2 + bx - c \text{ if } x > d$ For each value of x and print the value of x and f(x). Write a program for an arbitrary number of x values. Note: Teachers will discuss the fundamentals of FORTRAN Programming to the students. Thereafter student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.	30
--	---	----

[illegible]

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: MCC-5

Session: 2024-25			
Part A-Introduction			
Subject	Physics		
Semester	3 rd		
Name of the Course	Classical Mechanics		
Course Code	24L5.0-PHY-303		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MCC		
Level of the Course(As per Annexure-I)	100-199		
Pre-requisite for the course(if any)	Appeared or passed the 2 nd sem (B.Sc. Physical Science/ equivalent)		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Learn the concept of conservation of energy, momentum, angular momentum and apply them to understand the basic problems in physics. 2. Understand the importance of Lagrangian & Hamiltonian dynamics and to find the Lagrangian and Hamiltonian for various simple mechanical systems such as Linear Harmonic oscillator, Simple pendulum, Atwood's machine 3. Describe and understand the concepts of central force motion, Kepler's laws of planetary motion and scattering in central force field 4. Differentiate between inertial and Non-inertial frame of references and describe how fictitious forces arise in a non-inertial frame and to understand the importance of these forces 5. Learn to present observations, results, analysis and different concepts related to experiments of Classical Mechanics.		
Credits	Theory	Practical	Total
	3	1	4

Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 hrs	
Part B-Contents of the Course			
<u>Instructions for Paper-Setter</u>			
1.Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, select in gone question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.			
Unit	Topics		Contact Hours
I	INTRODUCTORY IDEAS OF CLASSICAL MECHANICS Newton’s Laws of Motion, Limitation of Newton’s programme; Space-time reference system; Introduction to different coordinate systems-Cartesian, cylindrical and spherical coordinate systems. Mechanics of single particle- Conservation Laws of linear momentum, Angular momentum and mechanical energy, First integrals of motion; Mechanics of as system of particles- Concept of external and internal forces, concept of centre of mass and centre of mass frame of reference, Conservation laws of linear momentum, Angular momentum and mechanical energy, relation between angular momentum and angular momentum about the Centre of Mass.		11
II	LAGRANGIAN AND HAMILTONIAN DYNAMICS Degrees of freedom; Constraints - Their classification, properties and examples; Generalized coordinates, Transformation equations, Generalized Displacement, Velocity, Acceleration, Momentum, Force and Potential; Principle of Virtual Work & D’Alembert’s Principle, Lagrange’s equations of motion from D’Alembert’s Principle; Cyclic or ignorable coordinates; Integrals of motion; Concept of symmetry-Homogeneity and isotropy. Hamilton’s Function and Hamilton’s equations of motion, Properties of Hamiltonian and Hamilton’s equations of motion; Formation of (i)		12

	Lagrangian and Lagrange's equations of motion (ii) Hamiltonian and Hamilton's equation of motion for linear harmonic oscillator, Atwood's machine, simple pendulum & compound pendulum.	
III	MOTION UNDER CENTRAL FORCE Definition and properties of the central force, two-body central force problem- reduction to equivalent one-body problem (Lagrangian and Lagrange's equations of motion); differential equation for an orbit, general features of the orbit, stability of the orbits under central force and conditions for closure. Inverse square law- Kepler's law of planetary motion and their derivation; Scattering in central force field- Scattering cross-section, scattering angle, impact parameter and derivation of Rutherford scattering cross-section.	11
IV	ROTATING FRAMES AND RELATIVE COORDINATE SYSTEMS Inertial and non-inertial frame of references; inertial forces in rotating frame (rotating coordinate systems) – Coriolis force and derivation of Coriolis force from Lagrangian formulation, the electromagnetic analogy of the inertial forces; effect of Coriolis force- on projectile motion (a) the projectile dropped from a height (h) with initial velocity zero (b) the projectile is sent vertically up with velocity v_0 to reach a height h above the ground and if returns to the ground, river flow on the surface of earth, formation of cyclones, trade and tropical winds, Coriolis force effect in atomic nuclei, Coriolis phenomenon in the planetary atmospheres; Foucault pendulum, Precession of charged particles in a magnetic field, methods of handling the situations with two rotations separated by a time varying translation.	11

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Classical Mechanics by H. Goldstein(2nd Edition)
2. Mechanics, D .S.Mathur ,S.Chand & Com. Pt. Ltd., New Delhi
3. Classical Mechanics by J. C.Upadhyaya, Himalya Publishing House, Mumbai.
4. ClassicalMechanicsbyS.L.Gupta,V.Kumar&H.V.Sharma,PragatiPrakashan,Meerut.
5. Classical Mechanics by N. C. Rana & P. S. Joag, Tata McGraw-Hill Publishing company Limited, New Delhi
6. B.Sc .Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
7. Advanced Level Practical Physics, M. Nelkon and Ogborn, Henemann Education Books Ltd., New Delhi
8. Practical Physics, S.S. Srivastava and M.K.Gupta, Atma Ram & Sons, Delhi
9. Practical Physics, S.L.Gupta and V.Kumar, Pragati PrakashanMeerut
10. Modern Approach to Practical Physics,R.K. Singla, Modern Publishers, Jalandhar
11. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop,Asia Publishing House.

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: MDC-3

Session: 2024-25			
Part A-Introduction			
Subject	Physics		
Semester	3 rd		
Name of the Course	Physics Fundamentals-III		
Course Code	24L5.0-PHY-304		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MDC		
Level of the Course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Not studied Physics subject at level4 (i.e. 10+2or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Have introductory idea about the importance of semiconductors and basic semiconductor devices. 2. Have the basic knowledge about the lasers and optical fibers and their importance in scientific and technological fields. 3. Understand importance of radio isotopes, Nuclear fission and fusion reactions and their hazardous aspects also. 4. Have the basic knowledge about the importance of some scientifically and technologically advanced materials. 5. Learn to present observations, results, analysis and different concepts related to experiments of Fundamentals of modern Physics in this course.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Max. Marks:75 InternalAssessmentMarks:20 End Term Exam Marks: 55		Time:3hrs	

Part B-Contents of the Course		
<u>Instructions for Paper-Setter</u> 1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, select in gone question out of two-question set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.		
Unit	Topics	Contact Hours
I	Basics of semiconductor and semiconductor devices-Atomic structure and energy levels, energy bands (basic idea), definition of conductor, semiconductor and insulators (on the basis of energy gap), Intrinsic semiconductors, extrinsic semiconductors-p-type and n-type semiconductor), P-N junction diode-depletion layer, forward biasing and reverse biasing, V-I characteristics; Principle, working and applications of-Zener diode, Photodiode, Solar cell and Light emitting diode (LED); Basic idea of transistors, semiconductors in computers-integrated circuits	8
II	Basics of Laser systems - introduction to LASER, important properties of laser light, Principle of laser- Light amplification, population inversion and pumping; Working of laser- schematic diagram for functioning of laser, three level and four level Laser systems; applications of Lasers in different fields of science and technology. Basics of fiber optics- introduction to optical fibers, total internal reflection and the optical fibers, structure and types of optical fiber (basic idea), advantages and disadvantages of optical fibers, optical fiber communication system (basic idea), applications of optical fibers.	8
III	Introduction to nuclear physics- the atomic nucleus and the nucleons, atomic number, mass number, isotopes, isobars and isotones; nuclear binding energy, natural radioactivity and radioactive decay- α , β , and γ - decay; Laws of radioactivity, decay constant, relative activity, half life, average life, radioisotopes, carbon dating and other applications of radioactive isotopes;	7

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Concept of Modern Physics by Arthur Beiser, McGraw-Hill Education.
2. Modern Physics(2nd edition), by S.L. Kakani and Shubhra Kakani, VivaBooks, New Delhi.
3. Semiconductor Devices-Physics and Technology by S.M. Sze, Wiley(1985)
4. Laser and Non-linear optics by B.B. Laud., Wiley Eastern Limited (1985)
5. Semiconductor Electronics by A.K. Sharma, New Age International Publisher(1996)
6. Kenneth S. Krane, Introductory Nuclear Physics, Wiley, New York, 1988
7. Radiation detection and measurement : G.F. Knoll(Wiley, New York)(2000)
8. Verma and Srivastava: Crystallography for Solid State Physics
9. Rajnikant; Solid State Physics, Wiley India, 2011.
10. J.C. Anderson, K.D. Leaver, R.D. Rawlings and J.M. Alexander, Materials Science, 4th Edition (Chapman Hall, London, 1990).
11. V. Raghavan, Materials Science and Engineering, 3rd Ed. (Prentice-Hall India, New Delhi, 1993).
12. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn 4th Edition, reprinted 1985, Heinemann Educational Publishers
13. Basic Electronics and Linear circuits by D.C. Kulshreshtha, N.N. Bhargava and S.C. Gupta.
14. Nuclear Physics, D.C. Tayal.
15. Nanomaterials and Nanotechnology, Sunder Singh

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: CC-4/MCC-6

Session: 2024-25	
Part A-Introduction	
Subject	Physics
Semester	4 th
Name of the Course	Waves and Optics
Course Code	24L5.0-PHY-401
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	CC/MCC
Level of the Course (As per Annexure-I)	100-199
Pre-requisite for the course (if any)	Appeared or passed the 3 rd sem (B.Sc. Physical Science/ equivalent)
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Have understanding of Interference - by Division of Wave front, by Division of Amplitude and Interference due to transmitted light & reflected light. 2. Learn about Huygens-Fresnel's theory, diffraction at a straight edge and at a circular aperture, diffraction due to a narrow slit and due to a narrow wire. Understand and explain the Fraunhofer diffraction, dispersive power of grating, Rayleigh's criterion and resolving power of telescope & grating. 3. Understand the theories and laws of polarization along with understanding of the production and detection of (i) Plane polarized light(ii)Circularly polarized light and (iii)Elliptically polarized light. 4. Understand and appreciate the applications of Lasers in developing LED, Holography, in materials processing, in Medicine, Industry and Military. Have the idea of optical fibres, their properties and principle of propagation of electromagnetic waves through optical fibres. 5. Understand various optical phenomena, principles, workings and applications optical instruments through Experiments.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3hrs	
Part B-Contents of the Course			
<u>Instructions for Paper-Setter</u>			
1.Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, select in gone question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of Scientific (non-programmable) calculator is allowed.			
Unit	Topics		Contact Hours
I	INTERFERENCE Interference by Division of Wave front: Young’s double slit experiment, Coherence, Conditions of interference, Fresnel's biprism and its applications to determine the wavelength of sodium light and thickness of a mica sheet, phase change on reflection. Interference by Division of Amplitude: 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		11
II	DIFFRACTION Fresnel’s diffraction: Huygens-Fresnel’s theory, Fresnel’s assumptions, rectilinear propagation of light, diffraction at a straight edge, rectangular slit and diffraction at a circular aperture. Diffraction due to a narrow slit, diffraction due to a narrow wire. Fraunhoffer diffraction: Single slit diffraction, double slit diffraction, plane transmission grating spectrum, dispersive power of grating, limit of resolution, Rayleigh's criterion, resolving power of telescope and a grating.		11

III	POLARIZATION Polarization: Polarisation 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).	11
IV	Lasers: Basic concept of absorption and emission of radiations, amplification and population inversion; Main components of lasers: (i) Active Medium (ii) Pumping (iii) Optical Resonator; Properties of laser beam: Monochromaticity, Directionality, Intensity, Coherence (Spatial & Temporal coherence); Metastable state, Excitation mechanism and Types of Lasers (He-Ne Laser & Ruby Laser), Applications of Lasers. Fibre optics: 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.	12

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Principles of Optics, M.Bornand E.Wolf, Pergamaman Press
2. Optics by Ajoy Ghatak, 2008, Tata McGrawHill
3. Fundamentals of Optics, Jenkinsand White, McGrawHill Book Co.Ltd.,New Delhi
4. Optics, K.D.Muller,UniversityScience Books, Milllally California
5. An Introductionto Interferometry,Tolansky, JohnWiley & Sons, New Delhi
6. Polarized Light Production and Use, Shurcliff, Harward UniversityPress, Cambridge, M A (USA)
7. Lasers and Non-Linear Optics, B.B. Laud, NewAge International(P) Ltd., Publishers, New Delhi
8. Lasers, Principles, Types and Applications, K.R. Nambiar, New Age International(P) Ltd., Publishers, New Delhi
9. Laser,Theory & Applications by K.Thyagarajan and A.K.Ghatak,Macmillan India limited
10. A textbook of optics by N. Subrahmanyamand Brijlal,S. Chand & Company
11. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher,NewDelhi
12. Advanced Level Practical Physics,M.Nelkon and Ogborn,Henemann Education Books Ltd., New Delhi
13. Practical Physics,S.S.Srivastava and M.K.Gupta, Atma Ram & Sons,Delhi
14. Practical Physics, S.L.Gupta and V.Kumar, Pragati Prakashan Meerut
15. Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar
16. Advanced Practical Physics for students, B.L.Flint and H.T. Worsnop, Asia Publishing House
17. Waves and Optics, S.P. Taneja.

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: MCC-7

Session: 2024-25	
Part A-Introduction	
Subject	Physics
Semester	4 th
Name of the Course	Introductory Quantum Mechanics
Course Code	24L5.0-PHY-402
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MCC
Level of the Course (Asper Annexure-I)	100-199
Pre-requisite for the course (if any)	Appeared or passed the 3 rd sem (B.Sc. Physical Science(H)/ equivalent)
Course Learning Outcomes (CLO):	After completing this course, he learner will be able to: 1. Know main aspects of the inadequacies of classical mechanics and understand historical development of quantum mechanics and understand the theory of quantum measurements, wave packets and uncertainty principle. 2. Understand the central concepts of quantum mechanics: wave functions, Interpretation of Wave Function, momentum and energy operator, expectation values, the Schrodinger equation, time dependent and time independent cases, probability density, the normalization techniques, Eigen functions, Eigen values and their significance. 3. Understanding the behavior of quantum particle encountering the (i) barrier & ii) potential. 4. Solve Schrodinger equation for ground state energy and wave functions of various simple quantum mechanical one dimensional and three dimensional potentials. 5. Learn to present observations, results, analysis and different concepts related to experiments of Elements of Quantum Mechanics.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 hrs	
Part B-Contents of the Course			
<u>Instructions for Paper-Setter</u>			
1.Nine questions will be set in total.			
2. Question no. 1will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.			
3. Four more questions are to be attempted, select in gone question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.			
4. 20% numerical problems are to be set.			
5. Use of scientific (non-programmable) calculator is allowed.			
Unit	Topics		Contact Hours
I	THE ORIGIN QUANTUM PHYSICS Inadequacies in Classical Physics, Overview of quantum physics, boundary between classical and quantum phenomena, Blackbody Radiation, Planck’s Quantum Theory, Photons, Photoelectric effect, Compton effect (theory and result), Frank-Hertz experiment, de-Broglie hypothesis, Davisson and Germer experiment, wave packet, phase velocity, group velocity and their relation, Heisenberg's uncertainty principle, Time energy and angular momentum, position uncertainty. Uncertainty principle from de Broglie wave. (Wave particle duality). Gamma Ray Microscope, Electron diffraction from as it		12
II	THE SCHRODINGER WAVE EQUATION-I Time dependent and time independent Schrodinger equation, dynamical evolution of a quantum state; properties of Wave Function, Interpretation of Wave Function, Condition for physical acceptability of Wave Functions. Eigen values and Eigen functions, Mathematical consideration of Schrodinger equation: Normalization, Orthogonality, Observables, Stationary states, Position, Linear momentum & Energy operators; commutator of position and linear momentum operators; Postulates of		11

	quantum mechanics, Probability current density, Expectation values of position and linear momentum, Ehrenfest's theorem.	
III	THE SCHRODINGER WAVE EQUATION-II Solution of time dependent Schrodinger equation, Proof of Uncertainty principle (1D wave packet), Gaussian wave packet, Spread of Gaussian wave packet, Fourier analysis and Parseval's formula (main results only), Fourier integral theorem from Parseval's formula, General forms of Fourier transform, Kronecker delta and Dirac delta functions, Coordinate and momentum representations, Schrodinger equation in momentum representation, Significance of momentum wave functions, Box and Dirac delta normalization, Momentum wave functions for a free particle.	12
IV	One-Dimensional Problems 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.	10

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: MCC-8

Session: 2024-25	
Part A-Introduction	
Subject	Physics
Semester	4 th
Name of the Course	Atomic spectroscopy
Course Code	24L5.0-PHY-403
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MCC
Level of the Course (As per Annexure-I)	100-199
Pre-requisite for the course(if any)	Appeared or passed the 3 rd sem (B.Sc. Physical Science(H)/equivalent)
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Acquire knowledge about the historical background and developments of atomic spectroscopy through the study of spectral series in Hydrogen atom, effect of nuclear motion on line spectra (correction of finite nuclear mass), short comings of Bohr's theory, Wilson Sommerfeld quantization rule, Sommerfeld extension of Bohr's model, Sommerfeld relativistic correction, Short comings of Bohr-Sommerfeld theory and finally Vector atom model. 2. Understand and explain the vector atom model, various coupling schemes and atomic spectra of one and two electron atoms. 3. Understand the LS & JJ coupling. 4. Explain the influence on the spectra of atoms in the presence of external applied electric and magnetic field i.e. Zeeman effect, Paschen-Back effect, Stark effect. 5. Learn to present observations, results, analysis and different concepts related to experiments of Elements of Atomic and Molecular Physics.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3hrs	
Part B-Contents of the Course			
<u>Instructions for Paper-Setter</u>			
1.Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, select in gone question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.			
Unit	Topics		Contact Hours
I	Historical background of atomic spectroscopy: 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 online spectra (correction of finite nuclear mass), variation in Rydberg constant due to finite mass, short comings of Bohr’s theory, Vector atom model; space quantization, electron spin, coupling of orbital and spin angular momentum, spectroscopic terms and their notation, quantum numbers associated with vector atom model, transition probability and selection rules.		11

II	Vector atom model (single valance electron): Orbital magnetic dipole moment (Bohr megnaton), behavior of magnetic dipole in external magnetic field; Larmor's precession and Larmor's theorem. Penetrating and Non-penetrating orbits, Penetrating orbits on the classical model; Quantum defect, spin orbit interaction energy of the single valance electron. Hydrogen fine spectra, Main features of Alkali Spectra and their theoretical interpretation, term series and limits, Rydeburg-Ritze combination principle, Absorption spectra of Alkali atoms observed doublet fine structure in the spectra of alkali metals and its Interpretation, Intensity rules for doublets ,comparison of Alkali spectra and Hydrogen spectrum	12
III	Vector atom model (two valance electron): Essential features of spectra of Alkaline-earth elements, Vector model for two valance electron atom: application of spectra. Coupling Schemes; LS or Russell – Saunders Coupling Scheme and JJ coupling scheme, Interaction energy in L-S coupling(sp, pd configuration), Lande interval rule, Pauli principal and periodic classification of the elements. Interaction energy in JJ Coupling (sp, pd configuration), equivalent and non-equivalent electrons, Two valance electron system-spectral terms of non-equivalent and equivalent electrons, comparison of spectral terms in L-S And J-J coupling. Hyperfine structure of spectral lines and its origin; isotope effect, nuclear spin.	12
IV	Atom in external field: 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.	10

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Concept of Modern Physics (1987), A. Beiser, McGraw-Hill Co Ltd. New Delhi
2. Atomic Physics (2007), J.B. Rajab, S Chand & Co, New Delhi
3. Atomic Physics Vol II (1991), J. H. Fewkes and J. Yarwood, Oxford University Press
4. Physics of Atoms and Molecules 2nd Ed (2009), B. H. Bransden and C. J. Joachain, Pearson Education, New Delhi
5. Fundamentals of Molecular Spectroscopy, Colin N. Banwell and Elaine M. McCash, McGraw Hill Co Ltd., New Delhi
6. Atomic and Nuclear Physics Vol I (1996) S. N. Ghoshal, S. Chand & Com., New Delhi
7. Atomic and Nuclear Physics (1982), K. Gopalkrishnan, McMillan India, New Delhi
8. Elements of Spectroscopy S. L. Gupta, V. Kumar and R. C. Sharma, Pragati Prakashan, Meerut.
9. Geeta Sanon, BSc Practical Physics, 1st Edn. (2007), R. Chand & Co.
10. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.
11. Indu Prakash and Ramakrishna, A Textbook of Practical Physics, Kitab Mahal, New Delhi.
12. D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.
13. Nelson and Jon Ogborn, Practical Physics.
14. Atomic and Molecular Spectroscopy, Rajkumar

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: DSE-1

Session: 2024-25			
Part A-Introduction			
Subject	Physics		
Semester	4 th		
Name of the Course	Laser Physics & Fiber Optics		
Course Code	24L5.0-PHY-404		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the Course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Appeared or passed the 3 rd sem (B.Sc. Physical Science(H)/ equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the basic principle of laser, Einstein's coefficients and their physical significance. Line broadening and its reasons. 2. 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. 3. Understand about optical fibres and its classification, basic principle involved in propagation of light through optical fibre and its application in communication. 4. Have the idea of Fibre materials, Fibre Cables and Fabrication Techniques. 5. Understand how and why to use of laser source in performing experiments in laboratory and have the idea how the signal that carries information transmitted through the optical fibre.		
Credits	Theory	Practical	Total
	3	1	4

Contact Hours	3	2	5
---------------	---	---	---

Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70	Time: 3 hrs
--	--------------------

Part B-Contents of the Course

Instructions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, select in gone question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific(non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Introduction to Laser: The Einstein Coefficients, Absorption and Emission cross-sections; Light amplification by an atomic system; Threshold condition; Origin of Line Shape function: Lorentzian and Gaussian shape functions; Line Broadening mechanisms - Homogeneous broadening: Natural Broadening, Collision broadening; Inhomogeneous broadening: Doppler Broadening	11
II	Laser Rate Equations: Two Level laser system, Three Level laser system, Four Level Laser Systems (Threshold Population, threshold pump rate, Laser power output with suitable examples), Variation of laser power around threshold; Optimum output coupling. Cavity modes: Number of modes in 1D, 2D and 3D cavities, Mode locking, Q switched lasers and methods of Q-switching	12
III	Optical fibres: Introduction; step index fibre, numerical aperture, pulse dispersion in step index fibre, graded index, material dispersion. Comparison of step and graded index fibres Propagation of light in optical Fibres : Basic structure and optical path of an optical fibre, Modes of propagation, meridional and skew rays, number of modes and cut off parameters of fibres, Single mode propagation. Disadvantage of monomode and graded index multimode fibre	11

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- 1.Laser and Optical Engineering P.Das, Narosa Publication.
- 2.Lasers and Nonlinear Optics-B.B. Land.
- 3.Optical Electronics-A Ghatak and K.Thyagarayan.
- 4.Principles of Lasers, O.Svelto,Plenum(1989)
- 5.Laser Physics,L.V.Tarasov, Mir (1983)
- 6.Quantum Electronics,A.Yavir, JohnWiley(1992)
- 7.Laser: Theory & Applications, A.Ghatak & K.Tayagrajan, MacmillanIndia
- 8.Optical fibre communication(second edition)-GerdKeiser, McGrawHill,Inc.NewYork.
- 9.Optical fibres and fibre optic communication systems- S.Sarkar.
10. Lasers:Principle,Types and applications-K.R.Nambiar New Age International Publishers.
- 11.Optical fibres and Laser: Principles and Applications, De Annuradha.

Indira Gandhi University Indira
Gandhi Undergraduate Programs
Course: DSE-1

Session: 2024-25			
Part A-Introduction			
Subject	Physics		
Semester	4 th		
Name of the Course	Physics of Nano materials		
Course Code	24L5.0-PHY-405		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the Course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Appeared or passed the 3 rd sem (B.Sc. Physical Science(H)/equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the properties of Nano materials/nanostructures 2. Understand the basic Physics of methods for preparation of Nano materials/nanostructures. 3. Understand the basic Physics of Characterization & Instrumentation Technique for Nanomaterials/nanostructures. 4. Understand the application and advantages of Nanomaterials 5. Understand the analysis and plotting of experimental data using various techniques.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks: 70		Time:3hrs	

Part B-Contents of the Course

Instructions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, select in gone question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Definition, Length scale, Historical background & developments, Richard Feynman Statement, Moore's law, Vision and objective of Nano-technology, Top down and Bottom up approach, Surface to Volume Ratio, Quantum confinement, Size effect in nano system, Quantum dots, Nano wires, Different Allotropes of carbon, Introduction to CNTs, Structure of CNTs, Types of CNTs- SWNTs, MWNTs, Bucky balls (C60), Graphene, Semiconductor Nano particles–types and properties.	10
II	Synthesis methods for Nano materials/Nanostructures: Bottom up and top down approaches for synthesis of nanomaterials, Synthesis of zero-dimensional nanostructures (Nanoparticles): Sol-Gel Process, Epitaxial core-shell nanoparticles, Ball milling, Synthesis of One-dimensional nanostructures (Nanowires, Nanorods, Nanotubes): Electrochemical deposition, Lithography, Synthesis of Two- dimensional nanostructures (Thin Films & Quantum wells): Molecular beam epitaxy (MBE), MOCVD, Cluster beam evaporation, Ion beam deposition.	12
III	Characterization & Instrumentation Technique for Nanomaterials/Nanostructures: X -ray Diffraction (XRD): Basic principle and idea of instrumentation, Determination of crystallite/particle size and strain in nanomaterials using Debye Scherer's formula and Williamson–Hall's plot, UV Visible spectroscopy: Basic principle and idea of instrumentation, optical energy band gap, Tauc plot, surface plasmon peaks Photoluminescence (PL) spectroscopy: Basic principle and idea of instrumentation, Shift in PL peaks with particle Size, Determination of alloy	13

	composition in thin films of compound semiconductors, Estimation for width of quantum wells, Raman spectroscopy: Basic principle and idea of instrumentation, Variations in Raman spectra of nanomaterials with particle size, Study of Raman spectra of carbon nanotubes and Graphene.	
IV	Applications of Nanomaterials: Importance of nano-scale and technology, Applications of Nanotechnology in different field: Automobiles, Electronics and Devices, Nano-biotechnology, Materials, Medicine, Food, Textiles and Fabrics, Sporting Equipment and Goods, Chemical and Bio sensor, Enhancing Water Quality, Space Science, Improving Air Quality, IT sector, Environmental Remediation, agriculture; Advantages of Nano materials	10

	<u>Practicum</u> 1. To analyze the crystal structure of simple cubic, FCC and associated defects using XRD data. 2. To study the crystallite by W-H analysis of XRD data. 3. To study wavelength used by using standard FCC/BCC lattice in XRD. 4. To analyze the structural of different carbonaceous material (Quantum dot, CNT, grapheme, amorphous, graphite)using RAMAN spectroscopy data. 5. To study the RAMAN spectra of Poly carbon ate monomer structure. 6. To study the band gap/energy gap of different materials using UV-visible spectroscopy data. 7. To study the Transmission spectra using UV-visible spectroscopy data. 8. To study the Absorption spectra using UV-visible spectroscopy data. 9. To study the band transition in different luminescent materials using PL spectroscopy data. 10. To study the e mission and absorption spectra of a material using PL spectroscopy data. Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.	30

Indira Gandhi University Meerpur

Undergraduate Programs

Course: CC-5/MCC-9

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	5 th		
Name of the Course	Modern Physics		
Course Code	24L5.5-PHY-501		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 4 th sem (B. Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the need for Quantum Mechanics, Heisenberg's uncertainty principle, time dependent and time independent Schrodinger equation and its applications. 2. Familiar about the crystalline state, basis, crystal lattices, Reciprocal lattice to sc, bcc and fcc lattices. 3. Analyze the Hydrogen atom problem based on Sommerfeld theory, Vector Atom Model, L-S&J-J coupling. 4. Familiar about various Nuclear Models, Magic Numbers, Classification of fundamental particles and Strange particles.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs
Part B-Contents of the Course		
<u>Instructions for Paper- Setter</u> - Nine questions will be set in total. - Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. - Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 20% numerical problems are to be set. - Use of scientific (non-programmable) calculator is allowed.		
Unit	Topics	Contact Hours
I	Introductory Quantum Mechanics: Need of Quantum Mechanics, Planck's quantum hypothesis and radiation formula, quantization of EM radiation and photoelectric effect, Compton effect, de- Broglie hypothesis, de-Broglie wave, wave packet, phase and group velocities, Time-dependent and time- independent Schrodinger equations, Properties of wave function, Probability current density, linear momentum and energy operators, expectation values of position and linear momentum, particle confined in a one-dimensional infinite box: energy eigen functions and eigenvalues. Heisenberg's Uncertainty Principle and its applications	11
II	Solid State Physics: Crystalline state, crystal lattice, basis, lattice translation vectors, primitive and non-primitive unit cells, symmetry operations, Bravais lattices in two and three dimensions, Miller Indices, crystallographic planes, interplanar spacing, simple crystal structures: NaCl, CsCl, HCP, Zinc blende, Diamond, diffraction of waves by crystals, Bragg's law, Idea of Reciprocal Lattice: Reciprocal lattice to sc, bcc and fcc lattices.	11
III	Atomic and Molecular Physics: Sommerfeld theory (qualitative), Relativistic correction, Fine structure of $H\alpha$ line, Lamb shift, Larmor's theorem (qualitative), Vector Atom Model, electron spin, space quantization, spin-orbit Interaction energy, LS and JJ coupling, Spectral terms for equivalent and non-equivalent electrons, Anomalous Zeeman effect, Lande's g-factor, splitting of D1 and D2 lines in weak magnetic field.	11
IV	Nuclear and Particle Physics: Composition of nucleus, stability of nucleus, nuclear properties, nuclear size, spin, parity, magnetic moment, quadrupole moment, Nuclear Models, Liquid Drop Model and Semi-empirical Mass formula, Nuclear shell model and magic numbers (qualitative idea only), classification of fundamental particles, Quark and Lepton quantum numbers, Hadrons, Baryons and Mesons.	12

	Practicum 1. To determine the Planck’s constant using photocell. 2. To determine e/m by Thomson method. 3. To determine the ionization potential of mercury. 4. To study quantization of energy using Frank Hertz experiment. 5. To determine the wavelength of laser source using diffraction of double slits. 6. To determine diameter of wire using laser source. 7. To study the variation of resistivity with temperature of given semiconductor crystal using four probe method. 8. To find the unknown capacitance of a capacitor using De-Sauty’s Bridge. 9. To determine the average diameter of lycopodium powder particles. Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.	30
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory (20 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➤ Practicum (10 Marks) • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil	End Term Examination : 50 Marks : 20 Marks	
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill 2. Modern Physics, R.A. Serway, C.J. Moses, and C. A. Moyer, 2005, Pearson publishing 3. Quantum Mechanics: Theory and Applications by Ajoy Ghatak and S. Lokanathan (2019), (Extensively revised6th Edition), Laxmi Publications, New Delhi 4. Quantum Mechanics by Ishwar Singh Tyagi, Pearson publication 5. Introduction to solid state physics by C. Kittel, Wiley India 6. Solid state physics by H C Gupta, Vikas publishing house Ltd, New Delhi 7. Solid state physics by Puri & Babber, S. Chand & company, New Delhi 8. Concepts of Nuclear Physics by B L Cohen, Tata McGraw Hill Publication, 1974. 9. Nuclear Physics by D.C. Tayal, Himalaya publishing house 10. Atomic and Nuclear Physics by N. Subrahmanyam, S. Chand & company 11. Atomic & Molecular spectra by Raj Kumar, Kedar Nath Ram Nath, Meerut 12. Introduction to elementary particles by D. Griffiths 13. Elements of Spectroscopy S. L. Gupta, V. Kumar and R. C. Sharma, Pragati Prakashan, Meerut.		

14. Atomic and Nuclear Physics by S.N. Ghoshal, VolII (1996), S. Chand & Com., New Delhi
15. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
16. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House

Indira Gandhi University Meerpur
Undergraduate Programs
Course: MCC-10

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	5 th		
Name of the Course	Nuclear Physics		
Course Code	24L5.5-PHY-502		
CourseType: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (ifany)	Appeared or passed the 4 th sem (B. Sc Physical Science or equivalent)		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the Nuclear structure and general properties of nuclei. 2. Familiar about the different types of nuclear radiation decay and their energetic. 3. Understand the principle, construction, working and applications of different nuclear accelerators and Nuclear radiation detector. 4. Acquire knowledge of different types of nuclear reaction, conservation laws and energetic of nuclear reaction..		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	
Part B-Contents of the Course			

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Nuclear structure and general Properties of Nuclei: Constituents of Nucleus; Nuclear composition (p-e and p-n hypotheses), Nuclear properties; Nuclear size, spin, parity, statistics, magnetic dipole moment, Electric quadruple moment (shape concept). Nuclear mass and its determination by Bain-Bridge, Bain-Bridge and Jordan mass spectrograph. Nuclear charge and its determination by Moseley Law.	10
II	Natural radioactivity (Law of disintegration, half-life, activity etc), radioactive series, artificial radioactivity, application of radioactivity in radioactive dating, medicine, food and agriculture etc., Nuclear Radiation decay Processes: (a) α -decay: Basics of α -decay process and quantum mechanical explanation of α -decay. Energetics of α -decay, (b) β -decay: β^- -decay, β^+ -decay, electron capture decay, β -energy spectrum, end point energy; Origin of continuous beta spectrum (neutrino hypothesis) and energetics of beta-decay. (c) γ -decay; γ -rays emission and energetics of γ -rays.	12
III	Nuclear Accelerators: Linear accelerators: Principle, construction, theory, working and types. Tandem accelerator; Principle, construction, working, advantages and limitations. Cyclotron: Principle, construction, theory, working and its limitations. Betatron: condition, Principle, construction, theory, working. Nuclear Radiation Detectors: Gas filled detectors; Ionization chamber, proportional counter, G.M. Counter (detailed study), Basic principle of organic and inorganic Scintillation detectors for γ and electron radiation.	12
IV	Nuclear Reactions: Nuclear reactions, Elastic and Inelastic scattering, Nuclear disintegration, photonuclear reaction, radiative capture, direct reaction, heavy ion reactions and spallation reactions, conservation laws, Q-value and reaction threshold. Nuclear Reactors: Nuclear Reactors, General aspects of reactor design. Nuclear fission and fusion reactors, (Principle, construction, working and applications).	11

Indira Gandhi University Meerpur

Undergraduate Programs

Course: DSE-2

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	5 th		
Name of the Course	Environmental Physics		
Course Code	24L5.5-PHY-503		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 4 th sem (B. Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Exhibit the knowledge of Basic atmospheric physics and Atmospheric thermodynamics. 2. Learn about the Environmental physics, Human environment, Air regulation in buildings, Thermal conduction effects. 3. Understand the Scope of Environmental Physics. 4. Learn about the Transport of Heat, Mass and Momentum and Radiant Energy.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> 1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus.			

This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.		
Unit	Topics	Contact Hours
I	Basic atmospheric physics: Introduction to the Atmosphere, Composition and Structure: Description of Air, Stratification of Mass, Thermal and Dynamical Structure, Trace Constituent. Atmospheric thermodynamics: Air (excluding and including water), Water paths, Ideal gas law, Atmospheric composition, Hydrostatic balance, Constant vertical gradient of temperature, Conservation of energy (dry case, moist case),	12
II	Environmental physics: Definition, Physics in the environment: Human environment, Built environment, Urban environment, Global environment, Biological environment. Human environment: Introduction, Laws of Thermodynamics, Energy and metabolism, Thermodynamics laws and the human body, Second Law of Thermodynamics and the Gibbs free energy, Conduction, Convection, Radiation.	13
III	Scope of Environmental Physics: Properties of Gases and Liquids- Gases and Water Vapor, Hydrostatic Equation, First Law of Thermodynamics, and Specific Heats, Latent Heat, Potential Temperature, Water Vapor and its Specification, Vapor Pressure, Dew-Point Temperature, Saturation Vapor Pressure Deficit, Mixing Ratio, Specific and Absolute Humidity, Virtual Temperature, Relative Humidity.	10
IV	Transport of Heat, Mass, and Momentum: Transfer Equation, Molecular Transfer Processes, Momentum and Viscosity, Heat and Thermal Conductivity, Mass Transfer and Diffusivity, Diffusion Coefficients, Diffusion of Particles. Transport of Radiant Energy: Origin and Nature of Radiation- Absorption and Emission of Radiation, Full or Black Body Radiation, Wien's Law, Stefan's Law, Planck's Law, Quantum Unit, Radiative Exchange.	10
	Practicum: 1. Verification of ideal gas laws. 2. Measurement of solar radiation and Estimation of solar constant. 3. Measurement of humidity (wet-bulb dry-bulb method), air temperature. 4. Determination of thermal conductivity and U-value of metal rods and building material. 5. Measurement of latent heat of water using calorimetric and electrical methods. 6. Verification of Stefan-Boltzmann law.	30

Indira Gandhi University Meerpur
Undergraduate Programs
Course: DSE-2

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	5 th		
Name of the Course	Non-Linear Dynamics		
Course Code	24L5.5--PHY-504		
CourseType: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (ifany)	Appeared or passed the 4 th sem (B.Sc. Physical Science or equivalent)		
CourseLearningOutcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the concept of dynamical systems. 2. Learn the concept of integrability and non-integrability of dynamical systems. 3. Understand the nonlinear Schrodinger equations, solitons and their solutions. 4. Learn the basic concepts of fluids, flow phenomenon and their dynamics.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	
Part B-Contents of the Course			
<u>Instructions for Paper- Setter</u> 1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, selecting one question out of two questions set			

from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.		
Unit	Topics	Contact Hours
I	Introduction to nonlinear dynamics and chaos. Dynamical view of physical systems. Role of computers in nonlinear science. Dynamical systems: definition and classification. Linear and nonlinear systems. Deterministic systems. Degrees of freedom. State space and phase space. Attractors and their types. Stability of solutions of ordinary differential equations. Linear stability analysis.	10
II	Concept of integrability in dynamical systems. Integrable versus non-integrable systems. Symmetries and invariants. First integrals of motion and their physical meaning. Direct methods for finding first integrals. Two-dimensional flows and phase-plane analysis. Linearization near fixed points. Limit cycles and qualitative behavior of trajectories. Poincaré–Bendixson theorem (statement and implications).	12
III	Linear and nonlinear partial differential equations. Diffusive versus dispersive systems. Physical origin of nonlinearity and dispersion. Soliton theory: concept of solitons and relation to integrability. Korteweg–de Vries (KdV) equation and solitary wave solutions. Conservation laws (qualitative). Nonlinear Schrödinger Equation (NLSE): physical origin and applications.	11
IV	Deterministic chaos and sensitivity to initial conditions (butterfly effect). Routes to chaos (overview). Lorenz equations and strange attractor (qualitative features). Lyapunov exponent (concept only). Discrete dynamical systems: one-dimensional maps. Fixed points and stability. Fluid flow as a dynamical system. Laminar and turbulent flows. Reynolds number and flow instability. Transition to turbulence as a manifestation of nonlinear dynamics and chaos.	12
	Practical 1. Stability analysis of the inverted pendulum using linearization about equilibrium points and phase-plane methods. 2. Reynolds experiment: Study of flow patterns in a circular pipe, identifying laminar, transitional, and turbulent regimes, and determination of the Reynolds number. 3. Breakdown of linearity in pendulum motion: Investigation of large-amplitude oscillations and deviation from simple harmonic motion. 4. Fixed-point analysis of Newton’s law of cooling: Experimental study of the cooling (or heating) of an object in an ambient environment and verification of the stability of the equilibrium temperature. 5. Determination of the damping coefficient of a damped harmonic	30

	oscillator through time-domain analysis. 6. Phase-portrait analysis and chaotic behavior using Chua's circuit, including identification of strange attractors. 7. Numerical solution of first-order dynamical systems using standard integration techniques (Euler and Runge–Kutta methods). 8. Numerical study of phase portraits and fixed points of damped and weakly nonlinear harmonic oscillators. 9. Numerical investigation of bifurcations, including pitchfork and Hopf bifurcations, using normal-form models. 10. Numerical study of deterministic chaos using the logistic map, including bifurcation diagrams and sensitivity to initial conditions. Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.	
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory (20 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➤ Practicum (10 Marks) • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil		End Term Examination : 50 Marks : 20 Marks

Part C-Learning Resources	
Recommended Books/e-resources/LMS: 1. Nonlinear Dynamics: Integrability, Chaos and Pattern, M. Lakshmanan & S. Rajasekar, Springer 2. Nonlinear Dynamics and Chaos, Steven H. Strogatz, Levant Books, Kolkata, 2007 3. Understanding Nonlinear Dynamics, Daniel Kaplan and Leon Glass, Springer. 4. An Introduction to Fluid Dynamics, G. K. Batchelor, Cambridge Univ. Press, 2002 5. Classical and Quantum Mechanics of Noncentral Potentials: A survey of two-dimensional systems, R. S. Kaushal, Narosa Publishing House, New Delhi, 1998 6. Elementary Fluid Mechanics, Tsutomu Kambe (World Scientific, 2007)	

Indira Gandhi University Meerpur
Undergraduate Programs
Course: DSE-3

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	5 th		
Name of the Course	Instrumentation and Analytical Methods		
Course Code	24L5.5-PHY-505		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 4 th sem (B. Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Have knowledge about the errors in measurements. 2. Understand the basic instrumentation of electrical and electronic measurements. 3. Understand the principles and working of basic analytical instruments – CRO, frequency signal generator and pulse generators, 4. Have awareness about the spectroscopic instruments.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time: 3hrs	
Part B-Contents of the Course			
Instructions for Paper- Setter			
1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus.			

- This question may have 4 parts and the answer should be in brief but not in Yes/No.
- Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
 - 20% numerical problems are to be set.
 - Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Basics of Measurement: Least count of an instrument, instrument's accuracy, precision, sensitivity, resolution, significant figures, Errors in measurement-Gross errors and systematic errors, absolute errors and relative errors; Measurement error combinations-Sum of errors, difference of errors, product of errors, quotient of quantities and quantity raised to a power. Statistical analysis of errors: Arithmetic Mean value, deviation, standard deviation of mean, least square fitting, normal distribution, covariance and correlation, Binomial distribution, Poisson distribution and Chi square test.	13
II	Electrical instrumentation: AC bridges-Measurements of inductance by Maxwell's bridge, Measurement of capacitance and high resistance by De Sauty's bridge, measurement of mutual inductance by Carry Foster bridge Signal generators: Block diagram, explanation of low frequency signal generator, pulse generator and function generator	10
III	Display devices: Cathode Ray Oscilloscope: Block diagram of general purpose oscilloscope and its basic operation, Construction of CRT, electron gun, Electrostatic focusing and deflection, screen for CRT, Dual trace oscilloscopes, Front panel controls, Measurement of voltage, frequency and phase; Pulse measurements-Pulse amplitude, pulse width and space width.	10
IV	Spectroscopic Instrumentation: UV-visible spectrophotometer: Beer-Lambert law, absorptivity, UV and Visible absorption, Instrumentation, essential parts of spectrophotometer (double beam spectrophotometer), grating and prisms, radiant energy sources, filters, photosensitive detectors, photomultiplier tubes, relation between absorption in visible and UV region and molecular structure, applications of UV-visible spectroscopy.	12

Practicum	30
1. To determine the value of an unknown inductance using Maxwell's Bridge. 2. To measure the value of an unknown capacitance using De Sauty's Bridge. 3. To measure high resistance using De Sauty's Bridge. 4. To determine the mutual inductance between two coils using a Carey Foster Bridge 5. Measurement of Mutual Inductance Using Carey Foster Bridge. 6. To study the block diagram and operation of: (i) Low Frequency Signal Generator (ii) Pulse Generator and (iii) Function Generator 7. To verify Beer–Lambert law using a UV–Visible spectrophotometer. 8. To determine the molar absorptivity (ϵ) of a given solution using UV–Visible spectrophotometer. 9. To generate sine, square and triangular waveforms, analyze the effect of load on waveform shape and amplitude. 10. To measure voltage, frequency, and phase difference of a waveform using a CRO. Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.	
Suggested Evaluation Methods	

[illegible]

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Theory of errors in Physical measurements by J C Pal, New Central Book Agency-2010.
2. Measurement, Instrumentation and Experimental Design in Physics and Engineering by Michael Sayer and Abhai Mansingh, PHI Learning Private Limited, Delhi, 2015.
3. Electronic Instrumentation and Measurements by David A. Bell, PHI Learning Private Limited, Delhi, 2nd edition 2010.
4. Handbook of Analytical Instruments by R.S. Khandpur, Tata McGraw-Hill, 3rd edition 2006.
5. Measurement and instrumentation Principles by Alan S Morris, Elsevier-2006.
6. Polymer characterization. Physical techniques- D. Campbell and J.R. White, Chapman and Hall.

Indira Gandhi University Meerpur
Undergraduate Programs
Course: DSE-3

Session: 2024-25			
Part A – Introduction			
Subject	Physics		
Semester	5 th		
Name of the Course	Renewable Energy and Energy Harvesting		
Course Code	24L5.5-PHY-506		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 4 th sem (B. Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the significance of renewable energy in addressing global energy challenges 2. Differentiate between various renewable energy sources and their applications 3. Analyze the environmental, social and economic implications of renewable energy adoption 4. Explain the mechanisms of renewable energy conversions.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> 1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus.			

This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.		
Unit	Topics	Contact Hours
I	Introduction to Renewable Energy: Overview of renewable energy sources, Importance of renewable energy in sustainable development, Comparison between renewable and non-renewable energy sources, Basic principles of energy conversion in renewable energy systems, Environmental and economic benefits of renewable energy	10
II	Solar Energy Harvesting: Principles of solar energy conversion, Photovoltaic effect and solar cell technology, Types of solar panels and their efficiency, Solar thermal energy systems: principles and applications, Challenges and advancements in solar energy technology	10
III	Wind Energy Conversion and Geothermal Energy: Wind energy resources and distribution, Aerodynamics of wind turbine blades, Types of wind turbines and their applications, Power generation from wind energy, Wind energy integration into the electrical grid, Geothermal Energy and its sources, Geothermal power plants, its types and operation, Applications of geothermal heat pumps.	12
IV	Biomass and Hydroelectric Energy: Biomass as a renewable energy source, Biomass conversion technologies: combustion, gasification, and anaerobic digestion, Hydroelectric power generation: principles and types of hydroelectric plants, Environmental and social impacts of biomass and hydroelectric energy, Future trends and innovations in biomass and hydroelectric energy.	13
	Practicum 1. Study of I-V & P-V characteristics of a Solar cell. 2. To compare the efficiencies of the different types of solar cells (viz. Monocrystalline, Polycrystalline and Amorphous Si) of given illumination and area of cell. 3. Determination of Performance Parameters of Flat Plate Solar Collector in Forced Circulation Mode. 4. Determination of parameters of Parabolic Trough Collector. 5. To study and optimize the angle of inclination of blades for the wind energy conversion. 6. To study and optimize the number, shape and size of the blades for wind energy conversion. 7. Study of the composition of gases during the anaerobic digestion of different biomasses. 8. Study of the I-V characteristics of the Micro-Fuel cell based on anaerobic digestion of compost.	30

Indira Gandhi University Meerpur
Undergraduate Programs
Course: CC-6/MCC-11

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	6 th		
Name of the Course	Electronics		
Course Code	24L5.5-PHY-601		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 5 th sem (B. Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the operation of p-n junction, use of diode as Rectifier, voltage multiplier circuits, Zener Diode, Photo diode, solar cell, clipping and clamping circuits. 2. Familiar about Bipolar Junction Transistor, use of transistor as Amplifier in CB, CE and CC configurations. 3. Understand the concept of feedback in amplifiers, its types and effect of negative feedback on characteristics of amplifiers. 4. Analyze the operation of oscillators, classification of oscillators as LC oscillators, RC oscillators and crystal oscillators.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Semi-Conductor Diodes: Semiconductors: Intrinsic and Extrinsic, P-N Junction diode and its V-I characteristics, Ideal Diode, Zener and Avalanche Breakdown, Zener Diode and its application as Voltage regulator, Photo-Diode, Light Emitting Diode, Solar Cell. P-N Junction as Half Wave and Full Wave Rectifiers: Efficiency and Ripple Factor, Comparison of Rectifiers, Clipping and Clamping circuits.	10
II	The Bipolar Transistor: The Bipolar Junction Transistor, Transistor Action and Working (PNP and NPN transistor), Transistor Circuit configurations: Common Base (CB), Common Emitter (CE) and Common Collector (CC) configurations, Current Amplification Factors (α , β and γ) and Relationship between them, Comparison of characteristics of Transistor in different configurations. Amplifiers: CB, CC and CE amplifiers, Transistor Biasing: selection of operating point, Load line analysis and operating point. Methods of Transistor biasing and stabilization (Fixed Base Bias, Bias with emitter resistor and voltage divider circuit).	12
III	Multistage Transistor amplifiers: RC Coupled amplifier (two-stage, concept of bandwidth, no derivation), Classification of amplifiers: Class A, B, AB and C amplifiers. Feedback in Amplifiers: Principle, Types of feedback, voltage gain, Advantages of negative feedback: Stabilization of gain, reduction in frequency distortion, reduction in non-linear distortions, reduction in noise, Effect of negative feedback on Input impedance, output impedance and bandwidth, Emitter follower circuit.	12
IV	Oscillators: Oscillations: Damped and Undamped Oscillations, Oscillatory circuit, Principle of Oscillation, Condition for self-sustained oscillation: Barkhausen Criteria for sustained oscillations, Essentials of Transistor oscillator, Selection of an Oscillator, Classification of oscillators, LC oscillators: Tuned collector, Tuned Base, Hartley Oscillator, Colpitt's Oscillator, RC oscillators: Phase Shift and Wein Bridge Oscillator.	11

Indira Gandhi University Meerpur
Undergraduate Programs
Course: MCC-12

Session: 2024-25	
Part A - Introduction	
Subject	Physics
Semester	6 th
Name of the Course	Solid State Physics-I
Course Code	24L5.5-PHY-602
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC
Level of the course (As per Annexure-I)	300-399
Pre-requisite for the course (if any)	Appeared or passed the 5 th sem (B. Sc Physical Science or equivalent)
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Have a brief idea about crystalline and amorphous materials, unit cell, primitive cell, miller indices, Bravais lattices and crystal structures. 2. Acquire knowledge about X-ray diffraction, Bragg's Law, experimental X-ray diffraction methods and reciprocal lattice. 3. Understand about different types of bonding such as Vander wall's, Ionic, Covalent, hydrogen and Metallic bonding in crystals. 4. Understand the concept of free electron gas model, density of states in one, two and three dimensions, Fermi energy, heat capacity of electron gas, Electrical conductivity and Ohm's law.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Crystal Structure-I: Crystalline and glassy forms, liquid crystals, crystal structure, periodicity, lattice and basis, crystal translational vectors and axes. Unit cell and Primitive Cell, Wigner Seitz primitive Cell, symmetry operations for two-dimensional crystal, Bravais lattices in two and three dimensions. Crystal planes and Miller indices, Interplanar spacing, Crystal structures of Zinc Sulphide, Sodium Chloride and Diamond.	10
II	Crystal Structure-II: X-ray diffraction, Bragg's Law and experimental X-ray diffraction methods. K-space and reciprocal lattice and its physical significance, reciprocal lattice vectors, reciprocal lattice to a simple cubic lattice, bcc and fcc lattices. Bonding in Crystals: Vander Waal's bonding, Ionic bonding, Covalent bonding, example of hydrogen molecule, hydrogen bonding, Metallic bonding.	11
III	Electronic Properties of Metallic Solids: Free electron gas model, Energy levels and density of states in one, two and three dimensions, Fermi momentum, Fermi energy, Fermi temperature, Effect of temperature, heat capacity of electron gas (explicit calculation), Experimental heat capacity of metals, Electrical conductivity and Ohm's law, Motion in magnetic fields and Hall effect, Thermal conductivity of metals and Wiedmann-Franz law.	12
IV	Dielectric Properties of Materials: Polarization, Local electric field at an atom, Depolarization field, Electric susceptibility, Polarizability, Clausius Mosotti equation, Classical theory of polarizability, Normal and Anomalous dispersion, Ferroelectric properties of Materials: Classification of crystals, piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains.	12

	Practicum 1. To determine Hall coefficient and mobility of a given semiconductor. 2. To measure the resistivity of a semiconductor (Ge) with temperature (up to 150° C) by four probe method. 3. To determine conductivity of given semiconductor crystal using four probe method. 4. To measure the magnetic susceptibility of Solids. 5. To measure the Coupling Coefficient of a piezoelectric crystal. 6. To measure the dielectric constant of a dielectric material with frequency. 7. To study the PE Hysteresis loop of a Ferroelectric crystal. 8. To determine the dielectric constant of paper. 9. To find the polarizability of a dielectric substance. 10. To determine the dielectric constant by charging and discharging of parallel plate capacitor. Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.	30
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory (20 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.:05 Marks • Mid-Term Exam: 10 Marks ➤ Practicum (10 Marks) • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 Marks • Mid-Term Exam: Nil	End Term Examination : 50 Marks : 20 Marks	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
1. Solid State Physics by S. O. Pillai, New Age International Publisher, New Delhi. 2. Introduction to Solid State Physics by C. Kittel, Wiley India Pvt. Ltd. 3. Solid State Physics by R. K. Puri, V.K. Babbar, S. Chand & Co. New Delhi. 4. The Physics of Solids by Richard Turton, Oxford University Press. 5. Solid State Physics by Ashcroft and Mermin, Saunders college publishing. 6. Elements of Solid State Physics by M.N. Ruden, J. Wilson, Willey Blackwell Publishing.		

7. Solid State Physics by A.J. Dekker, Luxmi PublicaionsSolid State Physics: Essential Concepts by D.W.Snoke
8. Essentials of Solid State physics by S.P.Kuila, New Central Book Agency.
9. Introductory Solid State Physics By H.P.Myres, CRC Press.
10. Solid State Physics by Vimal Kumar Jain, Springer Nature Switzerland Ag.
11. Fundamentals of Solid State physics by Saxena, Gupta, Pragati Prakashan Meerut.
12. Advanced practical Book for students, B. L. Flint and H. T. Wornsop, 1971, Asia Publishing House.
13. A text book of practical physics, I. Prakash & Ramakrishna, 11th edition., 2011 Kitab Mahal.
14. Elements of Solid-State Physics, J. P. Srivastava, 2nd Ed., 2006, Prentice Hall of India.
15. B.Sc Practical Physics, C. L. Arora, R Chand & Co. New Delhi

Indira Gandhi University Meerpur
Undergraduate Programs
Course: DSE-4

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	6 th		
Name of the Course	Condensed Matter Physics-I		
Course Code	24L5.5-PHY-603		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 5 th sem (B. Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand many-electron effects in solids by analyzing electron–electron interactions, and collective excitations such as plasmons. 2. understand the physics of low-dimensional and mesoscopic systems, including quantum confinement, 3. Apply classical and quantum theories of transport phenomena to describe electrical, thermal, and magneto-transport properties of solids. 4. Describe emergent quantum phases of matter using concepts of broken symmetry and order parameters, and explain the fundamental properties of superconductivity.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time: 3hrs	

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Many-Electron Effects and Collective Phenomena in Solids Independent electron approximation and its limitations; electron–electron interaction in solids; screening and dielectric response; concept of quasiparticles; Fermi liquid theory: basic postulates and physical interpretation; collective excitations in solids with special reference to plasmons; correlation effects in transition metal systems; concept of metal–insulator transition.	12
II	Low-Dimensional and Mesoscopic Systems Concept of reduced dimensionality, quantum confinement effects, physical realization of two-dimensional electron gas, quantum wells, quantum wires and quantum dots, energy quantization in confined systems, density of states in one-, two- and three-dimensional systems, mesoscopic length scales, phase coherence and quantum interference, ballistic and diffusive transport regimes.	11
III	Transport Phenomena in Condensed Matter Classical and quantum transport in solids; electrical conductivity beyond the Drude model; quantum corrections to conductivity and weak localization; size-dependent transport effects in thin films and nanostructures; classical and quantum Hall effects (qualitative treatment); magnetoresistance; thermal transport in solids; introduction to thermoelectric effects such as Seebeck and Peltier effects.	11
IV	Emergent Quantum Phases of Matter Concept of broken symmetry and order parameter in solids; emergence of collective behaviour of electrons leading to new quantum phases; phenomenological introduction to superconductivity, including its basic properties and significance; Bose–Einstein condensation in solids and simple examples of condensed matter systems; charge density waves and spin density waves, their origin and effects on material properties	11

<u>Practicum</u> 1. Measurement of Electrical Conductivity of a Copper Metal Using Four-Probe Method. 2. To study the variation of electrical resistivity of a semiconductor with temperature and to determine its energy band gap using Four-Probe method. 3. To determine the carrier concentration and mobility of charge carriers in a given semiconductor using the Hall effect. 4. To study change in resistance under applied magnetic field and Plot magnetoresistance vs magnetic field strength 5. To determine the Seebeck coefficient of a Cu or Cu-Ni alloy material. 6. To study thickness dependence of electrical resistivity of a thin film. 7. Study of I–V Characteristics of a Tunnel Diode. 8. To study the resistance–temperature characteristics of a thermistor and to determine its temperature coefficient of resistance (TCR). 9. To study the variation of electrical resistance of a thin film sample with applied magnetic field and to determine its magnetoresistance. 10. To determine the electrical conductivity of an electrolyte solution and study its variation with concentration. Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.	30
Suggested Evaluation Methods	
Internal Assessment: ➤ Theory (20 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➤ Practicum (10 Marks) • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil	End Term Examination : 50 Marks : 20 Marks
Part C-Learning Resources	

Recommended Books/e-resources/LMS:

1. Solid State Physics – *Ashcroft & Mermin.*
2. A Quantum Approach to Condensed Matter Physics -*Cambridge.*
3. Many–Body Quantum Theory in Condensed Matter Physics -*Bruus & Flensberg.*
4. Many-Body Techniques in Condensed Matter Physics -*Merino & Levy Yeyati.*
5. Physics of Nanostructured Solid State Devices-*Bandyopadhyay.*
6. Mesoscopic Electron Transport-*Springer/Edited volume.*
7. Quantum Transport in Mesoscopic Systems -*Mello.*
8. Transport Phenomena in Strongly Correlated Fermi Liquids-*Kontani.*
9. Topological Phases in Condensed Matter Physics-*Basu.*
10. Advanced Quantum Condensed Matter Physics -*Cambridge.*
11. Principles of Condensed Matter Physics -*Chaikin & Lubensky.*

Indira Gandhi University Meerpur
Undergraduate Programs
Course: DSE-4

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	6 th		
Name of the Course	Material Science		
Course Code	24L5.5 -PHY-604		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 5 th sem (B. Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the relationship between atomic structure, microstructure, and properties of materials. 2. Explain the role of crystal imperfections and defects in determining material behavior. 3. Analyze phase equilibria and transformations in engineering and functional materials. 4. Understand mechanical, thermal, and functional properties of materials used in technology.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Atomic Structure and Crystal Imperfections Atomic bonding in solids: ionic, covalent, metallic and van der Waals bonding, cohesive energy and bond energy, crystal imperfections and defects, point defects: vacancies, interstitials and substitutional impurities, line defects: edge and screw dislocations, surface defects and grain boundaries, role of defects in diffusion and mechanical behavior of materials.	12
II	Phase Equilibria and Phase Transformations Concept of phases and phase equilibrium, Gibbs phase rule, unary and binary phase diagrams, Solubility limit, eutectic and peritectic systems, lever rule and its applications, phase transformations in solids, Basic Concepts, The Kinetics of Phase Transformations, Metastable Versus Equilibrium States, nucleation and growth processes.	10
III	Mechanical and Thermal Properties of Materials Concepts of Stress and strain, elastic and plastic deformation, Hooke's law, yield strength, tensile strength and ductility, creep and fatigue, fracture: brittle and ductile fracture, hardness and wear, Compressive, Shear, and Torsional Deformation, Hardness, thermal properties: thermal expansion, thermal conductivity, heat capacity, Thermal stresses, influence of microstructure on mechanical and thermal behavior.	11
IV	Functional and Advanced Engineering Materials Dielectric materials: Polarization, dielectric constant and losses, Applications in capacitors and insulation, Difference between structural and functional materials, piezoelectric material: working principle and applications in sensors and actuators, Magnetostrictive materials – basics and uses, ferroelectric materials, magnetic materials for technological applications, shape memory alloys: Nitinol – properties, phase transformation and applications.	12

9. V. Raghavan, Materials Science and Engineering, Prentice Hall.
10. B. D. Cullity, Elements of Materials Science, Addison-Wesley.
11. M. F. Ashby, Materials Selection in Mechanical Design, Elsevier.
12. NPTEL Courses on Materials Science and Engineering.

Indira Gandhi University Meerpur

Undergraduate Programs

Course: DSE-5

Session: 2024-25	
Part A - Introduction	
Subject	Physics
Semester	6 th
Name of the Course	Nuclear and Particle Physics
Course Code	24 L5.5-PHY-605
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	DSE
Level of the course (As per Annexure-I)	300-399
Pre-requisite for the course (if any)	Appeared or passed the 5 th sem (B.Sc Physical Science or equivalent)

Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand and differentiate isotopes, isobars, isotones and mirror nuclei, and explain nuclear binding energy. 2. Explain the nature of nuclear forces, and the qualitative ideas of spin dependence and charge independence of nuclear forces. 3. Analyze the interaction of α , β and γ radiations with matter, including energy loss. 4. Describe elementary particles, antimatter and relativistic concepts.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	
Part B-Contents of the Course			

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Isotope, Isobar, Isotone, Mirror nuclei, Binding energy, deuteron and its binding energy, Average binding energy and its variation with mass number, main features of binding energy versus mass number curve, systematic of nuclear binding energy, nuclear stability, stability region, Fermi-gas model, Liquid drop model, semi-empirical mass formula, spin dependency and charge independency of the nuclear forces (qualitative idea)	11
II	Nuclear Radiation Interaction: Interaction of heavy charged particles (α -particles); Energy loss of heavy charged particle (idea of Bethe formula, no derivation), Range and straggling of α -particles. Geiger-Nuttall law. Interaction of light charged particle (β -particle), Energy loss of β -particles (ionization), Range of electrons, absorption of β -particles. Interaction of γ -Ray; Passage of γ -radiations through matter (Photoelectric, Compton and	13

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Introductory Nuclear Physics by K. S. Krane.
2. Nuclear & Particle Physics by Rajesh Verma.
3. Introduction to Elementary Particles by David J. Griffiths.
4. Introduction to Nuclear and Particle Physics (Springer, D'Auria).
5. Introduction to Nuclear and Particle Physics by Das & Ferbel.
6. Radiation Detection and Measurement by G. F. Knoll

Indira Gandhi University Meerpur
Undergraduate Programs
Course: DSE-5

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	6 th		
Name of the Course	Modern Characterization Techniques		
Course Code	24L5.5-PHY-606		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 5 th sem (B.Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Students will be able to perform and interpret two-probe, four-probe, and van der Pauw resistivity measurements. 2. Understand and apply cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and galvanostatic charge–discharge (GCD). 3. Get idea to apply Bragg’s law and interpret XRD patterns to determine crystal structure, phase composition, crystallite size (Debye–Scherrer). 4. Understand and use advanced microscopy techniques for material characterization.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70	Time:3hrs
Part B-Contents of the Course	

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Two-probe and four-probe method, van der Pauw method, resistivity and Hall mobility, Capacitance-Voltage (C-V) measurements, Parameters derived from diode I-V characteristics, Cyclic Voltammetry, Electrochemical Impedance Spectroscopy (EIS), and Galvanostatic Charge-Discharge (GCD).	12
II	X-ray diffraction, Bragg's law and crystal structure analysis, Analysis of the peak position and intensities, effect of stress, strain, and temperature on the x-ray peaks, FWHM, line broadening, crystallite size, texture, Debye Scherrer formula, determination of the crystal structure and phase percentage from the x-ray spectra.	12
III	Ryleigh criteria of resolution, de Broglie wavelength, Optical Microscopy principle, fluorescence microscopy, Scanning Electron Microscopy (principle, working, etc.), Transmission Electron Microscopy (principle, working, etc.), Phase contrast.	10
IV	Interaction of the light with materials (viz. absorption, reflection, transmission), UV-Vis spectroscopy, band gap determination, Infrared spectroscopy, FTIR spectroscopy: Basic concept, instrumentation, different modes of operation and applications	11

Indira Gandhi University Meerpur
Undergraduate Programs
Course: CC-H1

Session: 2024-25	
Part A - Introduction	
Subject	Physics
Semester	7 th
Name of the Course	Advanced Mathematical Physics
Course Code	24L6.0-PHY-701
CourseType: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	CC
Level of the course (As per Annexure-I)	400-499
Pre-requisite for the course (if any)	Appeared or passed the 6 th Sem (B.Sc. Physical Science with Physics as major subject)
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Learn basics of group theory and prepare group multiplication tables and to understand reducible and irreducible group representations and construct character table of symmetry groups of equilateral triangles, rectangle and square. 2. Find the Fourier series expansion and develop Fourier integrals and learn properties of Fourier and Laplace transforms and evaluate the Fourier and Laplace transforms of functions and derivatives. 3. Obtain explicit expressions of Bessel and Legendre polynomials by solving the concerned differential equations. Find explicit expressions of Hermite, Laguerre, Bessel and Legendre polynomials using the corresponding generating functions and derive various recurrence relations among these special functions. 4. Derive Cauchy integral theorem and Cauchy integral formula and find Taylor and Laurent series expansion of functions of complex variable. One can understand the calculus of residue and evaluate some typical definite integral using the method of contour integration.

Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	
Part B-Contents of the Course			
<u>Instructions for Paper- Setter</u>			
1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4-7 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.			
Unit	Topics		Contact Hours
I	Group Theory: Fundamentals of Group theory: Definition of a group and illustrative examples, Group multiplication table, rearrangement theorem, cyclic groups, sub-groups and cosets, permutation groups, conjugate elements and class structure, normal divisors and factor groups, isomorphism and homomorphism, class multiplication.		12
II	Fourier Series and Integral Transforms: Fourier series, General properties, Advantages and applications, Gibbs phenomenon, Development of the Fourier integral, Inversion theorem, Fourier transform, Fourier transform of derivatives, Momentum representation, Laplace transform, Laplace transform of derivative, Properties of Laplace transforms, Faltung's theorem, Inverse Laplace transformation.		15
III	Special Functions: Bessel Functions: Bessel functions of the first kind $J_n(x)$, Generating function, Recurrence relations, Expansion of $J_n(x)$ when n is half an odd integer, Integral representation; Legendre Polynomials $P_n(x)$: Generating function, Recurrence relations and special properties, Rodrigues' formula, Orthogonality of $P_n(x)$; Associated Legendre polynomials, Spherical harmonics, Addition theorem for spherical harmonics, Hermite and Laguerre Polynomials: generating function & recurrence relations only.		17

IV	Functions of a complex variable and calculus of residues: Complex algebra, Functions of a complex variable, Cauchy's integral theorem, Cauchy's integral formula; Taylor and Laurent expansions; Singularities; Cauchy's residue theorem, Cauchy principle value, Singular points and evaluation of residues, Jordan's Lemma; Evaluation of definite integrals of the type: $\int_0^{2\pi} f(\sin \theta, \cos \theta) d\theta$; $\int_{-\infty}^{\infty} f(x)dx$; $\int_{-\infty}^{\infty} f(x)e^{iax}dx$ using Cauchy's residue theorem.	16
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory (30 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15 Marks		End Term Examination : 70 Marks
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. Group Theory and Quantum Mechanics by M. Tinkam. 2. Mathematical Methods for Physicists (4th edition) by G. Arfken. 3. Mathematical Methods for Physicists (6th edition) by Arfken and Weber. 4. Mathematical Physics for Physicists & Engineers by L. Pipes. 5. Introduction to Mathematical Physics by C. Harper		

Indira Gandhi University Meerpur
Undergraduate Programs
Course: CC-H2

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	7 th		
Name of the Course	Statistical Mechanics		
Course Code	24L6.0-PHY-702		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)	Appeared or passed the 6 th Sem (B.Sc. Physical Science with Physics as major subject)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Apply probability theory and statistical concepts to describe microstates, macrostates, phase space, entropy, and equilibrium in physical systems. 2. Use statistical ensembles and partition functions to derive thermodynamic properties and understand fluctuations and response functions. 3. Explain quantum statistics (MB, BE, FD) and apply them to systems such as ideal gases, photons, electrons in metals, and Bose–Einstein condensation. 4. Analyze interacting systems and phase transitions, including virial expansion, van der Waals gas, critical behavior, and Ising models.		
Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4

Max. Marks:100
Internal Assessment Marks:30
End Term Exam Marks:70

Time:3hrs

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4-7 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Review of probability theory: random variables, probability distributions, mean, variance, and central limit theorem. Concept of microstates and macrostates. Phase space and classical dynamics. Liouville's theorem and incompressibility of phase space. Ergodic hypothesis. Postulates of statistical mechanics. Equal a priori probability. Entropy: Boltzmann and Gibbs formulations and their equivalence. Microcanonical ensemble and its connection with thermodynamics. Boltzmann equation (qualitative).	14
II	Canonical and grand canonical ensembles. Partition functions and their physical significance. Thermodynamic quantities derived from partition functions. Equivalence of ensembles in the thermodynamic limit. Ideal classical gas: entropy and Gibbs paradox. Maxwell-Boltzmann velocity distribution. Harmonic oscillators. Equipartition theorem. Paramagnetism as an application of the canonical ensemble. Kinetic theory of dilute gases in equilibrium: Maxwell velocity distribution, mean free path (qualitative), effusion and transport concepts.	16
III	Indistinguishability and quantum statistics. Identical particles and symmetry requirements. Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics. Density of states. Bose-Einstein statistics: Bose-Einstein condensation. Thermodynamic properties of ideal Bose gas. Photon statistics and blackbody radiation. Liquid helium (qualitative discussion). Fermi-Dirac statistics: energy and pressure of an ideal Fermi gas. Electrons in metals.	15
IV	Interacting classical systems. Cluster expansion and virial equation of state. Physical interpretation of virial coefficients. van der Waals gas and critical behavior. Phase transitions of first and second order. Order parameter and symmetry breaking. Ising model: one-dimensional Ising model (exact result), mean-field theory (Bragg-Williams approximation), qualitative discussion of the two-dimensional Ising model. One-dimensional random walk. Brownian motion. Langevin equation.	15

Suggested Evaluation Methods	
Internal Assessment: ➤ Theory (30 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15 Marks	End Term Examination : 70 Marks
Part C-Learning Resources	
Recommended Books/e-resources/LMS: 1. An Introduction to Thermal Physics — <i>Daniel V. Schroeder</i> 2. Statistical Physics — <i>F. Mandl</i> 3. Statistical Mechanics — <i>R.K. Pathria & Paul D. Beale</i> 4. Statistical Mechanics — <i>K. Huang</i> 5. Statistical Mechanics — <i>James Sethna</i> 6. Kinetic Theory of Gases and Transport Phenomena — <i>J. C. Maxwell & S. Chapman / D. Morrell</i> 7. Statistical Mechanics: A Set of Lectures — <i>R. P. Feynman</i> 8. Phase Transitions and Critical Phenomena — <i>H. E. Stanley</i> 9. Introduction to Modern Statistical Mechanics — <i>David Chandler</i> 10. Nonequilibrium Statistical Mechanics — <i>Robert Zwanzig</i>	

Indira Gandhi University Meerpur
Undergraduate Programs
Course: CC-H3

Session: 2024-25	
Part A - Introduction	
Subject	Physics
Semester	7 th
Name of the Course	Quantum Mechanics
Course Code	24L6.0-PHY-703
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC
Level of the course (As per Annexure-I)	400-499
Pre-requisite for the course (if any)	Appeared or passed the 6 th Sem (B.Sc. Physical Science with Physics as major subject)
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Realize the basic quantum-mechanical view point, and learn its wave mechanical and matrix formulations for a non-relativistic situation. 2. Construct matrices for observables and wave functions in different representations, and apply the matrix theory for calculating eigenvalues and eigenfunctions of linear harmonic oscillator. 3. Calculate the eigenvalues and eigenfunctions for the orbital and general angular momenta, along with the matrix representation of angular momentum. 4. Perform quantum-mechanical addition of two general angular momenta, and calculate Clebsch-Gordan coefficients for some simple situations.

Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4-7 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Schrödinger formulation of Quantum Mechanics: Recapitulation of basic concepts: Why quantum mechanics? Two-slit experiment with <i>em</i> radiation and matter particles, Quantum-mechanical view point, The Schrödinger wave equation, Expectation values, Ehrenfest theorem; Interpretative postulates of quantum mechanics: Dynamical variables as Hermitian operators, Eigenvalues and eigenfunctions, Expansion in eigenfunctions; Illustration of postulates for energy and momentum: Orthonormality of eigenfunctions, Reality of eigenvalues, Closure property, Probability function and expectation value, Co-ordinate and momentum representations of wave function, Uncertainty principle for two arbitrary observables; Problems: A charged particle in a uniform static magnetic field (eigenfunctions and Landau levels); The Hydrogen atom (reduced mass, radial wave functions and energy eigenvalues).	16
II	Matrix formulation of Quantum Mechanics: Preliminaries: Hermitian and unitary matrices, Transformation and diagonalization of matrices, Matrices of infinite rank; Representation of observables and wave functions as matrices, Transformation theory, choice of basis, change of basis, unitary transformations, Hilbert space representation; Dirac's ket and bra notations; Time-development of quantum system: Schrödinger, Heisenberg and Interaction pictures, Link with classical equations of motion, Quantization of a classical systems; Application to motion of a particle in an em field.	14
III	Quantum theory of Angular Momentum: Orbital angular momentum operator $\mathbf{L}$, Cartesian and spherical polar co-ordinate representation, Commutation relations, Orbital angular momentum and spatial rotations, Eigenvalues and eigenfunctions of $\mathbf{L}^2$ and L_z , Spherical harmonics; General angular momentum $\mathbf{J}$: Eigenvalues and eigenfunctions of $\mathbf{J}^2$ and J_z , Matrix representation of angular momentum operators, Spin angular momentum, Wave function including spin (Spinor); Spin one-half: Spin eigenfunctions, Pauli spin matrices; Addition of two angular momenta, Clebsch-Gordan coefficients and their calculation for $j_1 = j_2 = 1/2$, $j_1 = 1$, $j_2 = 1/2$ and $j_1 = j_2 = 1$; The Wigner-Eckart theorem.	15

IV	Many-particle systems and identical particles: Many-particle Schrödinger wave equation, Stationary-state solutions; Systems of identical particles, Physical meaning of identity, Principle of indistinguishability, Exchange and transposition operators, Totally symmetric and anti-symmetric wave functions, Time-invariance of symmetry, Construction of symmetric and anti-symmetric wave functions, Connection among spin, symmetry and statistics of identical particles, Fermions and bosons; Spin and total wave functions for a system of two spin $\frac{1}{2}$ particles, Pauli exclusion principle and Slater determinant; Application to the electronic system of the helium atom (<i>para</i> - and <i>ortho</i> -helium); Limit of distinguishability of identical particles.	15
Suggested Evaluation Methods		
Internal Assessment: > Theory (30 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15 Marks		End Term Examination : 70 Marks
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. Quantum Mechanics (3rd edition) by L. I. Schiff 2. Quantum Mechanics (2nd edition) by B. H. Bransden and Joachain 3. Quantum Mechanics (3rd edition) by S. Gasiorowicz 4. Quantum Mechanics (3rd edition) by E. Merzbacher 5. Quantum Mechanics by John L. Powell and B. Crasemann 6. Quantum Mechanics by A. K. Ghatak and S. Loknathan 7. Introductory Quantum Mechanics (4rd edition) by Richard L. Liboff 8. Quantum Mechanics: Concepts and Applications (2nd edition) by N. Zettili		

Indira Gandhi University Meerpur
Undergraduate Programs
Course: DSE-6

Session: 2024-25	
Part A – Introduction	
Subject	Physics
Semester	7 th
Name of the Course	Molecular Physics
Course Code	24L6.0-PHY-704
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	DSE
Level of the course (As per Annexure-I)	400-499
Pre-requisite for the course (if any)	Appeared or passed the 6 th Sem (B.Sc. Physical Science with Physics as major subject)
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand molecular bonding and structure using MO theory and potential energy curves. 2. Explain rotational energy levels and microwave spectra of molecules. 3. Describe vibrational motion and interpret IR and rovibrational spectra. 4. Understand electronic and vibronic transitions in molecular spectra.

Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	
Part B-Contents of the Course			

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4-7 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Born–Oppenheimer approximation. Electronic, vibrational, and rotational motions in molecules. Molecular bonding: covalent, ionic, van der Waals and hydrogen bonding. Diatomic molecules. Bond order, bond length, dissociation energy. Homonuclear and heteronuclear molecules. Potential energy curves. Anharmonicity and dissociation. Franck–Condon principle (qualitative).	15
II	Rigid and non-rigid rotor models. Rotational energy levels of diatomic molecules. Rotational spectra and selection rules. Microwave spectroscopy. Effect of isotopic substitution. Stark effect (qualitative). Rotational spectra of polyatomic molecules (linear and symmetric tops – qualitative).	15
III	Harmonic and anharmonic oscillator models. Vibrational energy levels and selection rules. Infrared absorption spectroscopy. Anharmonic corrections. Overtone bands. P, Q, and R branches. Force constants. Normal modes of vibration in polyatomic molecules. Group frequency concept (qualitative).	15
IV	Electronic transitions in molecules. Electronic energy levels. Selection rules. Vibronic transitions. Franck–Condon factors. Band systems. Electronic spectra of diatomic molecules. Introduction to Raman spectroscopy: classical and quantum theory. Rotational and vibrational Raman spectra. Applications of molecular spectroscopy in atmospheric physics, chemistry, and biology.	15
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory (30 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15 Marks		End Term Examination : 70 Marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Fundamentals of Molecular Spectroscopy – *Prabal Kumar Mallick* (Springer)
2. Spectra of Atoms and Molecules – *Peter F. Bernath* (4th/5th edition)
3. Basic Atomic and Molecular Spectroscopy – *J. Michael Hollas*
4. Molecular Spectroscopy - *S.K. Dogra*
5. Rotational Spectroscopy of Diatomic Molecules – *Brown & Carrington*
6. Fundamental Concepts of Molecular Spectroscopy – *Abani Bhuyan*
7. Fundamentals of Quantum Chemistry: Molecular Spectroscopy and Modern Electronic Structure Computations – *M. Mueller*
8. Fundamentals of Molecular Spectroscopy – *C.N. Banwell & E.M. McCash*
9. Spectra of Diatomic Molecules – *Herzberg* (classic, deeper theory)

Indira Gandhi University Meerpur
Undergraduate Programs
Course: DSE-6

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	7 th		
Name of the Course	Sensors and Transducers		
Course Code	24L6.0-PHY-705		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	400-499		
Pre-requisite for the course (if any)	Appeared or passed the 6 th Sem (B.Sc. Physical Science with Physics as major subject)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Learn the basics of sensors and transducer 2. Explain the thermal sensors 3. Learn about the magnetic Sensors 4. Know the recent trends in sensor technologies and their applications.		
Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	
Part B-Contents of the Course			
<u>Instructions for Paper- Setter</u> 1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4-7 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.			

4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Basics of Sensors and Transducers: Definition, Principles, Classification, Parameters, Environmental Parameters, Characterization: Electrical, Mechanical and Thermal, Optical, Chemical/Biological. Resistive Potentiometer, Strain Gauge and types, Inductive Sensors: Sensitivity and Linearity of the Sensor, Ferromagnetic Plunger Type Transducers. Capacitive Sensors: Parallel Plate Capacitive Sensor, Serrated Plate Capacitive Sensor, Variable Permittivity or Variable Thickness Dielectric Capacitive Sensor.	16
II	Thermal sensors: Gas Thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Resistance Change Type Thermometric Sensors: RTD - materials, construction, types, working principle, Thermistor: materials, construction, types, working principle, Thermo emf sensors: Thermocouple – Principle and types, Radiation sensors: Principle and types.	15
III	Magnetic Sensors: Principles and working: Yoke Coil Sensors, Coaxial Type Sensors, Force and Displacement Sensors; Magnetoresistive Sensors: Anisotropic Magnetoresistive Sensing, Semiconductor Magnetoresistors, Active Semiconductor Magnetic Sensors, Hall Effect and Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers.	15
IV	Recent Trends in Sensor Technologies: Film Sensors, Semiconductor IC technology-Standard Methods, Microelectromechanical Systems and Nano-sensors. Sensors Applications: On-board Automobile Sensors, Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing, Medical Diagnostic Sensors, Sensors for Environmental Monitoring.	14
Suggested Evaluation Methods		
Internal Assessment: > Theory (30 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15 Marks		End Term Examination : 70 Marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Sensors and Transducers, D Patranabis, PHI, 2nd Edition.
2. Measurement Systems: Application and Design, E. A. Doebelin, McGraw Hill, New York
3. Instrumentation- Devices and Systems, Rangan, Sarma, and Mani, Tata-McGraw Hill, 2nd edition.
4. Electronic Instrumentation, H.S Kalsi, McGraw Hill, 4th edition.
5. A course in Electrical & Electronic Measurement and Instrumentation, A.K. Sawhney, Dhanpat Rai and Company Private Limited.
6. Transducers and Instrumentation, D.V.S. Murthy, 2nd Edition, Prentice Hall of India Private Limited, New Delhi, 2010.
7. Transducer Engineering, S. Renganathan, Allied Publishers, 2005
8. Instrumentation Measurements and Analysis, Nakra & Choudhary, Tata McGraw-Hill, 2nd edition.

Indira Gandhi University Meerpur
Undergraduate Programs
Course: PC-H1

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	7 th		
Name of the Course	Practicum Course		
Course Code	24L6.0-PHY-706		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	PC		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)	Appeared or passed the 6 th Sem (B.Sc. Physical Science with Physics as major subject)		
Course Learning Outcomes (CLO):	After successful completion of the course on Physics a student will be able to: 1. Determine molecular parameters (bond length, bond order, vibrational/rotational constants) from diatomic molecule spectra. 2. Analyze spectroscopic data to study molecular bonding, energy levels, and potential energy curves. 3. Explain the basic principles, classification, and operational parameters of sensors and transducers, including electrical, mechanical, thermal, optical, and chemical/biological types. 4. Describe the working principles of resistive, inductive, capacitive, and electromagnetic transducers and differentiate between various sensor types.		
Credits	Theory	Practical	Total
	-	4	4

Contact Hours	-	8	8
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time: 4hrs	
Part B-Contents of the Course			
<u>Instructions for Practical examiners</u>			
1. Student will perform at least 08 experiments. 2. The examiner will assign one practical at the time of end term examination.			
	<u>Practicum</u> 1. To identify the functional groups present in organic compounds by analyzing their infrared (IR) absorption spectra. 2. To identify and study the normal modes of vibration in molecules such as CO ₂ / NH ₃ /CH ₄ using infrared (IR) spectroscopy and molecular symmetry analysis. 3. To verify Beer-Lambert law and determine molar absorptivity. 4. To observe the shift in O-H stretching frequency in alcohols or carboxylic acids due to hydrogen bonding using infrared (IR) spectroscopy. 5. To determine the rotational temperature of a diatomic or linear molecule by analyzing the intensity distribution of its rotational Raman lines. 6. To measure strain on a metallic beam using a strain gauge and Wheatstone bridge. 7. To study the characteristics of parallel plate and variable thickness dielectric capacitive sensors and plot capacitance vs displacement/pressure. 8. To measure the output voltage of a Hall effect sensor in the presence of a magnetic field. 9. To measure displacement caused by thermal expansion using a bimetallic strip or diaphragm sensor. 10. To measure (a) phase difference, (b) deflection sensitivities and (c) frequency of an unknown ac signal using CRO.	120	
Suggested Evaluation Methods			
Internal Assessment: ➤ Practicum (30 Marks) • Class Participation: 05 Marks • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: 15 Marks			End Term Examination : 70 Marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Sawhney, A. K. (2018). Transducers and Instrumentation (2nd ed.). New Delhi, India: Dhanpat Rai & Co.
2. Patranabis, D. (2012). Sensors and Transducers (2nd ed.). New Delhi, India: PHI Learning Private Limited.
3. Doebelin, E. O. (2004). Measurement Systems: Application and Design (5th ed.). New Delhi, India: McGraw-Hill Education.
4. Helfrick, A. D., & Cooper, W. D. (2018). Modern Electronic Instrumentation and Measurement Techniques (4th ed.). Upper Saddle River, NJ, USA: Pearson Education.
5. Bentley, J. P. (2005). Principles of Measurement Systems (4th ed.). Harlow, England: Pearson Education.
6. Liu, C. (2012). Foundations of MEMS (2nd ed.). Upper Saddle River, NJ, USA: Pearson Education.

Indira Gandhi University Meerpur
Undergraduate Programs
Course: CC-HM1

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	7 th		
Name of the Course	Basics of Laser Physics and Fiber Optics		
Course Code	24L6.0-PHY-707		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-M		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)	Appeared or passed the 6 th sem with physics as major subject		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the basic principle of laser, Einstein's coefficients and their physical significance. Line broadening and its reasons 2. 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 3. Understand about optical fibres and its classification, basic principle involved in propagation of light through optical fibre and its application in communication 4. Have the idea of Fibre materials, Fibre Cables and Fabrication Techniques.		
Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4-7 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Introduction to Laser: Spontaneous and Stimulated Absorption and Emission of radiation, Main features of a laser: Directionality, high intensity, high degree of coherence, spatial and temporal coherence, Einstein's coefficients and possibility of amplification, Kinetic of optical absorption, Population inversion: A necessary condition for light amplification, resonant cavity and laser pumping, Threshold condition for laser emission, Line Broadening mechanisms: Homogeneous broadening (Natural Broadening, Collision broadening); Inhomogeneous broadening (Doppler Broadening).	15
II	Lasers: Principle, Construction & working of He-Ne Laser, Ruby Laser, Semiconductor junction Laser, N ₂ -Laser, CO ₂ laser. Laser Applications: Spatial Frequency Filtering, Holography, Laser induced Fusion, Lasers in Isotope Separation. Application of Laser Technology in material processing (Drilling, Cutting, Welding), Medicine, Industry and Military.	15
III	Optical fibres: Introduction; Basic structure and classification of optical fibres, Single mode and monomode optical fibres, Propagation of light in optical Fibres, Numerical Aperture, acceptance angle, meridional and skew rays, number of modes and cut off parameters of fibres, pulse dispersion in step index fibres and graded index fibres, material dispersion. Advantages and disadvantages of fibres, Application of optical fibres.	15
IV	Fibre Materials & Fabrication Techniques: Glass fibre, plastic fibre, losses of fibres; bending losses, intrinsic fibre losses, scattering losses and absorption losses. Fibre Cables: Fibre cable construction, Strength member, cable tensile loading, Minimum bend radius, Losses incurred during installation of cables or during subscriber service, testing of cables, cable selection criteria.	15

Suggested Evaluation Methods

Internal Assessment: ➤ Theory (30 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15 Marks	End Term Examination : 70 Marks
Part C-Learning Resources	
Recommended Books/e-resources/LMS 1. Laser and Optical Engineering P.Das, Narosa Publication. 2. Lasers and Nonlinear Optics - B.B. Land. 3. Optical Electronics - A Ghatak and K. Thyagarayan. 4. Principles of Lasers, O. Svelto, Plenum (1989) 5. Laser Physics, L.V. Tarasov, Mir (1983) 6. Laser: Theory & Applications, A. Ghatak & K. Tayagrajan, Macmillan India 7. Optical fibre communication (second edition) - Gerd Keiser, McGraw Hill, Inc. New York. 8. Optical fibres and fibre optic communication systems - S.Sarkar.	

Indira Gandhi University Meerpur
Undergraduate Programs
Course: CC-H4

Session: 2024-25	
Part A - Introduction	
Subject	Physics
Semester	8 th
Name of the Course	Electrodynamics and Plasma Physics
Course Code	24L6.0-PHY-801
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC
Level of the course (As per Annexure-I)	400-499
Pre-requisite for the course (if any)	Appeared or passed the 7 th Sem (B.Sc. Physical Science with Physics as major subject)
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand EM wave propagation, skin effect, and quasi-static fields. 2. Explain electromagnetic potentials, gauges, and retarded fields. 3. Describe basic plasma properties and collective behavior. 4. Understand plasma waves and dielectric response. 5. Apply charged-particle motion and basic MHD concepts in plasmas.

Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	
Part B-Contents of the Course			
<u>Instructions for Paper- Setter</u> 1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4-7 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.			
Unit	Topics		Contact Hours
I	Maxwell stress tensor, Propagation of the em wave in different mediums, skin depth, equation of the quasi-static field, depth of penetration of a magnetic field into a conductor, the skin effect, complex resistance, capacitance in a quasi-steady current circuit, excitation of currents by acceleration.		15
II	Concept of electromagnetic potentials (scalar and vector potentials), Potential formulation of the Maxwell equations, Gauge transformation (Lorentz and Coulomb gauge), Physical observables and gauge invariance, Retarded scalar and vector potentials, Jefimenko's equation, Aharonov–Bohm Effect (Conceptual)		15
III	Definition, classification, and parameters of plasma, Debye shielding, quasi-neutrality, collective behaviour, Debye length, Debye sphere, Saha equation, plasma frequency, Plasma oscillations, plasma number, langmuir waves, Collisional and collisionless plasmas, Plasma sheath and double layers, Wave propagation in plasmas, Plasma currents and conductivity, Plasma dielectric response, plasma confinement		15
IV	Motion of charged particles in non-uniform electric and magnetic fields, Magnetized plasma: Cyclotron motion, Larmor radius, Longitudinal plasma oscillations, Ion acoustic waves, Dispersion relation, Magnetohydrodynamics (MHD): Basic assumptions, single fluid plasma model, MHD equation (qualitative), frozen-in magnetic concept.		15

Suggested Evaluation Methods	
Internal Assessment: ➤ Theory (30 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15 Marks	End Term Examination : 70 Marks
Part C-Learning Resources	
Recommended Books/e-resources/LMS: 1. Introduction to Electrodynamics by D J Griffith 2. Electrodynamics of continuous media by L. D. Landau and E. M. Lifshitz 3. Plasma Physics: An Introduction by Richard Fitzpatrick 4. Introduction to Plasma Physics and Controlled Fusion by Francis F. Chen 5. Plasma Physics by Alexander Piel	

Indira Gandhi University Meerpur
Undergraduate Programs
Course: CC-H5

Session: 2024-25	
Part A - Introduction	
Subject	Physics
Semester	8 th
Name of the Course	Advanced Quantum Mechanics
Course Code	24L6.0-PHY-802
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC
Level of the course (As per Annexure-I)	400-499
Pre-requisite for the course (if any)	Appeared or passed the 7 th Sem (B.Sc. Physical Science with Physics as major subject)
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the formalism and postulates of quantum mechanics. 2. Analyze quantum dynamics and measurement principles. 3. Apply approximation methods to simple quantum systems. 4. Explain angular momentum and spin in quantum mechanics.

Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	

Part B-Contents of the Course		
<u>Instructions for Paper- Setter</u> 6. Nine questions will be set in total. 7. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4-7 parts and the answer should be in brief but not in Yes/No. 8. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 9. 20% numerical problems are to be set. 10. Use of scientific (non-programmable) calculator is allowed.		
Unit	Topics	Contact Hours
I	Review of basic postulates of quantum mechanics, Hilbert space, state vectors, and operators, Dirac bra-ket notation, Commutators and uncertainty relations, Eigenvalue problems and expectation values, Time evolution of quantum states, Schrödinger, Heisenberg, and Interaction pictures (introductory)	15
II	Time-independent perturbation theory (non-degenerate and degenerate cases), Applications: Stark effect, Zeeman effect (qualitative and simple calculations), Variational method and its applications, WKB approximation and its validity	15
III	Angular momentum operators and commutation relations, Eigen values and eigenfunctions of L^2 and L_z , Ladder operators, Spin angular momentum and Pauli spin matrices, Addition of angular momenta, Clebsch–Gordan coefficients (basic properties and simple examples)	15
IV	Klein–Gordon equation and its limitations, Dirac equation: formulation and physical interpretation, Spin and relativistic corrections (qualitative), Probability current and continuity equation, Introduction to quantum scattering theory, Partial wave analysis (qualitative), Born approximation (introductory).	15

Suggested Evaluation Methods	
Internal Assessment: ➤ Theory (30 Marks) - Class Participation: 05 Marks - Seminar/presentation/assignment/quiz/class test etc.: 10 Marks - Mid-Term Exam: 15 Marks	End Term Examination : 70 Marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. D.J. Griffiths – Introduction to Quantum Mechanics
2. J.J. Sakurai – Modern Quantum Mechanics (selected UG-friendly sections)
3. A. Ghatak & S. Lokanathan – Quantum Mechanics: Theory and Applications
4. Eugen Merzbacher – Quantum Mechanics (reference)
5. Quantum Mechanics (3rd edition) by L. I. Schiff
6. Quantum Mechanics (2nd edition) by B. H. Bransden and Joachain
7. Introduction to Quantum Mechanics (2nd edition) by David J. Griffiths
8. Quantum Mechanics by A. K. Ghatak and S. Loknathan
9. A Textbook of Quantum Mechanics by P. M. Mathews and K. Venkatesan
10. Quantum Mechanics by John L. Powell and B. Crasemann
11. Quantum Mechanics: Concepts and Applications (2nd edition) by N. Zettili

Indira Gandhi University Meerpur
Undergraduate Programs
Course: CC-H6
 (Not applicable to degree with research)

Session: 2024-25	
Part A - Introduction	
Subject	Physics
Semester	8 th
Name of the Course	Digital Electronics
Course Code	24L6.0-PHY-803
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC
Level of the course (As per Annexure-I)	400-499
Pre-requisite for the course (if any)	Appeared or passed the 7 th Sem (B.Sc. Physical Science with Physics as major subject)
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand number systems, Boolean algebra, and basic logic gates. 2. Design and analyze combinational circuits using K-maps and standard building blocks. 3. Explain and implement sequential circuits using flip-flops, counters, and shift registers. 4. Understand basic memory elements and their applications in digital systems.

Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	

Part B-Contents of the Course		
<u>Instructions for Paper- Setter</u> - Nine questions will be set in total. - Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4-7 parts and the answer should be in brief but not in Yes/No. - Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 20% numerical problems are to be set. - Use of scientific (non-programmable) calculator is allowed.		
Unit	Topics	Contact Hours
I	Number Systems and Logic Gates: Number systems: binary, octal, decimal, hexadecimal, Conversion between systems, Binary arithmetic: addition, subtraction, multiplication, division, Boolean algebra: basic laws and simplification, Logic gates: AND, OR, NOT, NAND, NOR, XOR, XNOR, Truth tables and logic expressions, De Morgan's theorems and simplification using Boolean algebra.	15
II	Combinational Logic Circuits: Simplification techniques: Karnaugh Map (K-map) up to 4 variables, Adders and subtractors (half & full), Multiplexers and demultiplexers, Encoders and decoders, Comparators.	15
III	Sequential Logic and Memory: Latches and flip-flops (SR, JK, D, T), Truth tables and characteristic equations, Edge triggering and timing diagrams, Counters: asynchronous and synchronous, Shift registers, Basic memory elements: RAM, ROM, and EEPROM (conceptual), Applications of sequential circuits.	15
IV	Digital ICs, A/D & D/A Conversion and Digital Systems: TTL and CMOS logic families (basic comparison), Noise margins, fan-in, fan-out (basic concepts), ADC and DAC: types and working principles, Digital display systems: seven-segment display, Introduction to microcontrollers (basic concepts).	15
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory (30 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15 Marks		End Term Examination : 70 Marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Digital Design (6th Edition) by *M. Morris Mano & Michael D. Ciletti*
2. Digital Electronics by (Publisher: McGraw-Hill/Indian edition)
3. Mastering Digital Logic Design: A Complete Guide with Concepts & Circuits (*S. Suganthi, P. Gangalakshmi, D. Usha*)
4. Digital Logic Design Using Verilog: Coding and RTL Synthesis (*Vaibbhav Taraate*)

Indira Gandhi University Meerpur
Undergraduate Programs
Course: DSE-7

Session: 2024-25	
Part A - Introduction	
Subject	Physics
Semester	8 th
Name of the Course	Solid State Physics-II
Course Code	24L6.0-PHY-804
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE
Level of the course (As per Annexure-I)	400-499
Pre-requisite for the course (if any)	Appeared or passed the 7 th Sem (B.Sc. Physical Science with Physics as major subject)
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Analyze the structure of a crystalline solid in terms of lattice, basis and unit cell, and of a non-crystalline solid on the basis of pair-distribution function. 2. Calculate the dispersion of lattice waves for crystals with mono- and diatomic basis, and understand the principle underlying its experimental measurement using neutron scattering. 3. Learn the Bloch's theorem, its application to the KP model, solve the one-electron Schrödinger equation for a periodic potential to see the emergence of energy bands. 4. Grasp important characteristics of superconductors, along with qualitative aspects of the BCS theory of superconductivity.

Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4-7 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Crystal structure: Recapitulation of basic concepts: Bravais lattice and Primitive vectors; Primitive, Conventional and Wigner-Seitz unit cells; Crystal structures and lattices with basis; Symmetry operations and fundamental types of lattices; Index system for crystal planes. Determination of crystal structure by diffraction: Reciprocal lattice and Brillouin zones (examples of <i>sc</i> , <i>bcc</i> and <i>fcc</i> lattices); Bragg and Laue formulations of X-ray diffraction by a crystal and their equivalence; Laue equations; Ewald construction; Brillouin interpretation; Crystal and atomic structure factors; Structure factor of the <i>bcc</i> and <i>fcc</i> lattices, Examples of NaCl and diamond; Experimental methods of structure analysis: Types of probe beam, The Laue, rotating crystal and powder methods.	15
II	Lattice dynamics and thermal properties: Binding in solids: Crystals of inert gases, Lennard-Jones potential; Qualitative idea of Ionic, Covalent and Metallic bonding. Classical theory of lattice vibration (in harmonic approximation): Vibrations of crystals with monatomic basis- Dispersion relation, First Brillouin zone, Group velocity; Two atoms per primitive basis- dispersion of acoustical and optical modes. Quantization of lattice waves: Phonons, Phonon momentum, Inelastic scattering of neutrons by phonons. Thermal properties: Lattice (phonon) heat capacity; Normal modes.	15
III	Electronic properties of solids: Failure of the free electron gas model; Band theory of solids: Nearly free electron model, Energy gap; Periodic potential and Bloch's theorem; Kronig-Penney model; Wave equation of electron in a periodic potential, Solution of the central equation, Approximate solution at and near a zone boundary; Periodic, extended and reduced zone schemes of energy band representation; Number of orbitals in a band; Classification into metals, semiconductors and insulators. Calculation of energy bands: Tight binding method and its application to <i>sc</i> and <i>bcc</i> structures; Wigner-Seitz method.	15

IV	Superconductivity: Experimental survey: Superconductivity and its occurrence, Destruction of superconductivity by magnetic fields, Meissner effect, Type I and type II superconductors, Entropy, Free energy, Heat capacity, Energy gap, Theoretical survey: Thermodynamics of the superconducting transition, London equation, Coherence length; Microscopic theory: Qualitative features of the BCS theory, BCS ground state wave function; Quantitative predictions of the BCS theory, critical temperature, energy gap, critical field, specific heat; DC and AC Josephson effects; High T _c superconductors (introduction only).	15
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory (30 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15 Marks		End Term Examination : 70 Marks
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. Introduction to Solid State Physics (7th edition) by Charles Kittel 2. Solid State Physics by Neil W. Ashcroft and N. David Mermin 3. Solid State Physics: An Introduction to Theory and Experiment by H. Ibach and H. Luth 4. Principles of the Theory of Solids (2nd edition) by J. M. Ziman 5. Condensed Matter Physics by Michael P. Marder 6. Applied Solid State Physics by Rajnikant		

Indira Gandhi University Meerpur
Undergraduate Programs
Course: DSE-7

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	8 th		
Name of the Course	Condensed Matter Physics-II		
Course Code	24L6.0-PHY-805		
CourseType: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)	Appeared or passed the 7 th Sem (B.Sc. Physical Science with Physics as major subject)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Use second quantization and Green's functions for interacting electrons. 2. Explain correlated electron models (Hubbard, t-J) and Mott transitions. 3. Understand topological phases using Berry curvature and invariants. 4. Describe superconductivity and magnetism including unconventional pairing.		
Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4

Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70	Time:3hrs
Part B-Contents of the Course	

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4-7 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Advanced Many-Body Theory and Electron Correlations: Second quantization formalism; creation and annihilation operators; interacting electron systems in second quantization; Hartree–Fock approximation and exchange effects; diagrammatic perturbation theory; Green’s functions (time-ordered, retarded and advanced); spectral functions and physical interpretation; Dyson equation and self-energy; random phase approximation (RPA) and collective modes; limitations of Fermi liquid theory.	16
II	Strongly Correlated Electron Systems: Hubbard model and its limits (weak and strong coupling); t – J model; Mott–Hubbard metal–insulator transition; superexchange interaction; correlation effects in transition metal oxides; role of electron correlations in magnetism; heavy fermion systems and Kondo effect; quantum criticality and scaling near quantum phase transition.	15
III	Topological and Low-Dimensional Quantum Matter: Berry phase and Berry curvature in solids; topological invariants (Chern number, Z_2 invariant); quantum Hall effect revisited from a topological perspective; topological insulators and bulk–boundary correspondence; edge and surface states; topological semimetals (Dirac and Weyl semimetals); role of symmetry and dimensionality.	15
IV	Superconductivity, Magnetism and Nonequilibrium Phenomena: Microscopic theory of superconductivity (BCS theory); Cooper pairing and energy gap; Ginzburg–Landau theory and coherence length; type-I and type-II superconductors; flux quantization and vortices; unconventional superconductivity (d-wave, p-wave); magnetism in solids: itinerant vs localized moments; spin waves and magnons; nonequilibrium condensed matter systems.	14

Suggested Evaluation Methods	
Internal Assessment: ➤ Theory (30 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15 Marks	End Term Examination : 70 Marks
Part C-Learning Resources	
Recommended Books/e-resources/LMS: 1. A Course in Quantum Many-Body Theory: From Conventional Fermi Liquids to Strongly Correlated Systems -M. Fabrizio 2. Quantum Many-Body Physics: A Perspective on Strong Correlations -Y. Kuramoto. 3. Strongly Correlated Systems: Theoretical Methods -Avella & Mancini. 4. Electronic Structure of Strongly Correlated Materials -Anisimov & Izyumov. 5. Topological Phases in Condensed Matter Physics -S. Basu. 6. Topological Insulators and Topological Superconductors -B. A. Bernevig & T. L. Hughes. 7. Field Theories of Condensed Matter Physics -E. Fradkin.	

Indira Gandhi University Meerpur
Undergraduate Programs
Course: PC-H2
(Not applicable to degree with research)

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	8 th		
Name of the Course	Practicum Course		
Course Code	24L6.0-PHY-806		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	PC		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)	Appeared or passed the 7 th Sem (B.Sc. Physical Science with Physics as major subject)		
Course Learning Outcomes (CLO):	After successful completion of the course on Physics Laboratory-I (general physics), a student will be able to: 1. Measure the width of a narrow slit using diffraction phenomenon and ionization potential of mercury. Also calculate the Planck's constant using a suitable light source and half life of Indium. 2. Measure the mass absorption coefficient of β-rays in Aluminum and the band gap of a semiconductor and set Michelson and Fabry-Parot interferometers for various practical measurements. 3. Determine the strength of α-source and verify nuclear statistics using SSNTD. Also verify the energy quantization using the Frank-Hertz Experiment. 4. Demonstrate different harmonics present in complex signals using Fourier Analysis and understand the underlying dynamics mimicked by the Feigenbaum and the Chua' circuits.		
Credits	Theory	Practical	Total
	-	4	4
Contact Hours	-	8	8

Max. Marks:100
Internal Assessment Marks:30
End Term Exam Marks:70

Time: 4hrs

Part B-Contents of the Course

Instructions for Practical Examiners

1. Student will perform at least 08 experiments.
2. The examiner will allot one practical at the time of end term examination.

Practicum

120

1. To measure the width of a narrow slit using the diffraction phenomenon.
2. To determine the ionization potential of mercury.
3. To determine the value of Planck's constant using photocell/LED
4. To study absorption of β -rays in Aluminum.
5. Michelson interferometer experiment
6. Fabry-Parot interferometer experiment.
7. To determine the half-life of Indium.
8. To determine the strength of an α -source using SSNTD.
9. To study nuclear statistics using SSNTD
10. Demonstration of energy quantization using the Frank-Hertz Experiment.
11. Fourier analysis of complex signals.
12. To determine band-gap of a semiconductor material.
13. To study nonlinear dynamics using Feigenbaum circuit.
14. To study nonlinear dynamics using Chua' circuit.

Suggested Evaluation Methods

Internal Assessment:

➤ **Practicum (30 Marks)**

- Class Participation: **05 Marks**
- Seminar/Demonstration/Viva-voce/Lab records etc.: **10 Marks**
- Mid-Term Exam: **15 Marks**

End Term Examination : 70 Marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Quantum Mechanics: Concepts and Applications (2nd edition) by N. Zettili
2. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
3. Phototubes, John F. Ryder
4. Nuclear Radiation Detectors, S.S. Kapoor and V.S. Ramamurti
5. Radiation detection and measurements, G.F. Knoll
6. Solid State Nuclear Track Detectors, S.A. Durrani
7. Techniques for Nuclear and Particle Physics Experiments, W.R. Leo

Indira Gandhi University Meerpur
Undergraduate Programs
Course: CC-HM2

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	8 th		
Name of the Course	Nanoscience and Nanomaterials		
Course Code	24L6.0-PHY-808		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	CC- M		
Level of the course (As per Annexure-I	400-499		
Pre-requisite for the course (ifany)	Appeared or passed the 7 th sem (B.Sc. Physical Science (H)/ equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Able to understand the Vision and objective of Nano- technology, Nanoparticles, Nanowires and Nanotubes, Nanolayers/Nanocoatings, Nanoporous Materials; Properties of Nanomaterials and Significance of Nanoscience. 2. Describe the Inorganic Natural Nanomaterials, Natural Nanomaterials from Animal Kingdom and Cell Walls. 3. Understand the basic Physics of methods for preparation of Nanomaterials/nanostructures. 4. Learn the application and advantages of Nanomaterials		
Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70		Time:3hrs	

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4-7 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Introduction: Nanometers, Micrometers, Millimeters, Moore's Law, Nanoscale Elements in Traditional Technologies, Esaki's Quantum Tunneling Diode, Quantum Dots of Many Colors, Accelerometers in Car, Nanopore Filters, Historical Perspective, Vision and objective of Nanotechnology, Nanomaterials: Nanoparticles, Nanowires and Nanotubes, Nanolayers/Nanocoatings, Nanoporous Materials; Properties of Nanomaterials, Significance of Nanoscience, Top down and Bottom up approach, Surface to Volume Ratio, Quantum confinement, Size effect in nano system.	15
II	Natural Nanomaterials: Nanomaterials All around Us, Aesthetic and Practical Value of Natural Nanomaterials, Learning from Natural Nanomaterials, the Nano Perspective. Inorganic Natural Nanomaterials: Minerals, Clays, Natural Carbon Nanoparticles, Nanoparticles from Space, Different Allotropes of carbon, Introduction to CNTs, Structure of CNTs, Types of CNTs- SWNTs, MWNTs, Bucky balls (C60), Graphene.	15
III	Synthesis methods for Nanomaterials/Nanostructures: Bottom up and top-down approaches for synthesis of nanomaterials, Synthesis of zero-dimensional nanostructures (Nanoparticles): Sol-Gel Process, Epitaxial core-shell nanoparticles, Ball milling, Synthesis of One-dimensional nanostructures (Nanowires, Nanorods, Nanotubes): Electrochemical deposition, Lithography, Synthesis of Two-dimensional nanostructures (Thin Films & Quantum wells): Molecular beam epitaxy (MBE), MOCVD.	15

IV	Applications of Nanomaterials: Importance of nano-scale and technology, Applications of Nanotechnology in different field: Automobiles, Electronics and Devices, Nano-biotechnology, Materials, Medicine, Food, Textiles and Fabrics, Sporting Equipment and Goods, Chemical and Bio sensor, biotechnology, Enhancing Water Quality, Space Science, Air Quality Improvement, IT sector, Environmental Remediation, Agriculture.	15
----	--	----

Suggested Evaluation Methods

Internal Assessment: ➤ Theory (30 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15 Marks	End Term Examination : 70Marks
Part C-Learning Resources	
Recommended Books/e-resources/LMS: 1. Nanotechnologies: The Physics of Nanomaterials Volume I, David S. Schmool. 2. Introduction to Nanoscience, Gabor L Hornyak and Joydeep Dutta 3. Nanophysics and Nanotechnology, Edward L Wolf 4. Essentials in Nano-science and nanotechnology, Narendra Kumar, Sunit Kumbhat 5. Nanostructures & Nanomaterials: Synthesis, Properties & Applications by Guozhong Cao 6. Nanotechnology: Principles and Practices, Sulabha K Kulkarni 7. Introduction to Nano: Basics to Nanoscience and Nanotechnology, Amretashis Sengupta and Chandan Kumar Sarkar.	

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: VAC-3

Session: 2024-25			
Part A-Introduction			
Subject	Physics		
Semester	3 rd (Scheme-C)		
Name of the Course	Exploring the Journey of Indian Space Satellites		
Course Code	24L5.0-VAC-PHY-301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	VAC		
Level of the Course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Learn about the Concept, ideas and theories of Satellite and Orbits. 2. Elementary understanding of Satellite Systems and their Applications. 3. Get the idea of Indian Communications satellites and their applications and Classification of Satellites. 4. Get knowledge about Milestones in India’s Space Programme.		
Credits	Theory	Practical	Total
	2	NA	2
Contact Hours	2	NA	2
Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35		Time: 3hrs	

Part B-Contents of the Course

Instructions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Concept of 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 set-up.	7
II	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	8
III	Space Centers and institutes, Genesis of India'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	8
IV	Launch vehicle technology, Milestones in India's Space Programme.	7

Suggested Evaluation Methods

Internal Assessment:

➤ Theory (15 Marks)

- Class Participation: **5 Marks**
- Seminar/presentation/assignment/quiz/class test etc.: **5 Marks**
- Mid-Term Exam: **5 Marks**

End Term Examination : 35 Marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. <https://www.indiascience.in/videos/isro-indias-space-journey-e-2>
2. <https://www.indiascience.in/videos/isro-indias-space-journey-part-2-e-1>
3. <https://www.insightsonindia.com/science-technology/space-technology/milestones-in-India's-space-programme/>
4. <https://www.clearias.com/indian-space-program/>
5. SCIENCE366: A Chronicle of Science and Technology, BasuBiman
6. Science and technology, Praveen Chandra Mishra, Chronicle Books

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: VAC-4/VAC-3

Session:2024-25			
Part A-Introduction			
Subject	Physics		
Semester	4 th (for scheme-C :VAC-4) and (Schemes A, B & D :VAC-3)		
Name of the Course	Physics in Everyday Life		
Course Code	24L5.0-VAC-PHY-401		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	VAC		
Level of the Course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Elementary understanding of the mechanical concepts and application in daily life related to Force, weight, work, energy, power. 2. Get the idea of working of refrigerator, air conditioner, Bernoulli principle, pressure cooker in various engines. 3. Learn about the daily life activities related to sound and optics. 4. Basic understanding of some electrical and electronic appliances		
Credits	Theory	Practical	Total
	2	NA	2
Contact Hours	2	NA	2
Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35		Time: 3hrs	
Part B-Contents of the Course			
Instructions for Paper-Setter			
1. Nine questions will be set in total.			

2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.		
Unit	Topics	Contact Hours
I	MECHANICS Every day activities related to Force, weight, work, energy, power and centrifuge; washing machine.	7
II	HEAT Variation of boiling point with pressure, pressure cooker, cooling by expansion, refrigerator, air conditioner, Bernoulli principle – Bunsen burner, aero plane	8
III	SOUND AND OPTICS Sound waves, Doppler Effect, power of lens, long sight and short sight, microscope, telescope, binocular camera, video camera.	8
IV	ELECTRICAL AND ELECTRONIC APPLIANCES Working of the tube light and fan, kilowatt hour, fuse and heating elements, microwave oven, electric heater, photoelectric effect.	7
Suggested Evaluation Methods		
Internal Assessment: Theory (15 Marks) - Class Participation: 5 Marks - Seminar/presentation/assignment/quiz/class test etc.: 5 Marks - Mid-Term Exam: 5 Marks		End Term Examination : 35 Marks
Part C-Learning Resources		
Recommended Books/e-resources/LMS: R. Murugesan, Allied Physics I & II, S. Chand & Co, New Delhi (2006). - D.S. Mathur, Elements of properties of matter and acoustics, S. Chand & Company Ltd., New Delhi (2010) R. Murugesan, Properties of matter and acoustics, S. Chand & Co, New Delhi (2012) - Brijal & Dr. N. Subramanyan and P.S. Hemne, Heat and Thermodynamics, S. Chand & Co, New Delhi, (2004) R. Murugesan, Electricity, S. Chand & Co, New Delhi (2010) R. Murugesan and Kiruthiga Sivaprasath, Modern Physics, S. Chand & Co, New Delhi (2016) N. Subramaniyam, Brijlal and M.N. Avadhanulu, A textbook of Optics S. Chand & Co, New Delhi (2012)		

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: VOC-1/VOC-2

Session:2024-25			
Part A-Introduction			
Subject	Physics		
Semester	3 rd (for Scheme-B:VOC-1) / 5 th (for Scheme- A,C, D:VOC-2)		
Name of the Course	Refrigeration and Air Conditioning (RAC)		
Course Code	24L5.0-VOC-PHY-301, 24L5.5-VOC-PHY-501		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	VOC		
Level of the Course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Learn about the factors contributing to food spoilage, causes of food spoilage, methods of food preservation 2. Learn about the Commercial Application so fair-conditioning 3. Understand the principles of ice production, different methods of ice manufacturing 4. Learn about the Industrial Applications of air-conditioning		
Credits	Theory	Practical	Total
	4	NA	4
Contact Hours	4	NA	4
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3hrs	
Part B-Contents of the Course			
Instructions for Paper-Setter			
1. Nine questions will be set in total.			

2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted. Select any one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.		
Unit	Topics	Contact Hours
I	Food Preservation: Introduction, factors contributing to food spoilage, causes of food spoilage, methods of food preservation, freezing method of food preservation, preservation of food with direct contact of liquid N ₂ , freeze drying, preservation of different products, cold storage and commercial cabinets	17
II	Commercial Applications: Introduction, air-conditioning of houses, offices, hotels and restaurants, air-conditioning of departmental stores, air-conditioning of theatres and auditoriums, hospitals and medical applications	13
III	Ice-Manufacturing: Introduction, principles of ice production, different methods of ice manufacturing, treatment of water for making ice, brines, freezing tanks, ice cans, quality of ice	13
IV	Industrial Applications: Introduction, importance of RH in different industries, ice-cream manufacturing, refrigeration for breweries, selection of refrigerant for breweries, use of liquid N ₂ for fabric, quality, air conditioning in textile and photographic industries	17
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory (30 Marks) • Class Participation: 5 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15		End Term Examination : 70 Marks
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1.Refrigeration and Air Conditioning, Sadhu Singh, Khanna Publishing House 2.Refrigeration and Air Conditioning by C.P.Arora, McGraw Hill education (India)(P) limited, New Delhi 3.Principles of Refrigeration by Roy J. Dossat, Pearson education, New Delhi 4.Refrigeration and Air Conditioning by Manohar Prasad, Newage International(P)limited, New Delhi 5.Course in Refrigeration and Air Conditioning by S.C. Arora and S.Domkundwar, Dhanpatrai and sons, Delhi		

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: VOC-1/VOC-2

Session:2024-25			
Part A-Introduction			
Subject	Physics		
Semester	4 th (for Scheme-A, C &D: VOC-1), (for Scheme- B: VOC-2)		
Name of the Course	Maintenance of Laboratory Instruments		
Course Code	24L5.0-VOC-PHY-401		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	VOC		
Level of the Course(As per Annexure-I	100-199		
Pre-requisite for the course(if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the SOP related to Physics Laboratory. 2. Understand the Maintenance of Electronics experiment 3. Understand the Maintenance of mechanics experiments 4. Understand the Maintenance of optics experiments		
Credits	Theory	Practical	Total
	4	NA	4
Contact Hours	4	NA	4
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3hrs	
Part B-Contents of the Course			
<u>Instructions for Paper-Setter</u> 1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, select in gone question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.			

Unit	Topics	Contact Hours
I	Standard Operating Procedure for Maintenance of Lab Equipment, safety rules and policies, culture of laboratory safety, responsibility and accountability for laboratory safety, special safety considerations in Physics Lab, other factors that influence laboratory safety programs,	16
II	Equipment Maintenance Documentation, Maintenance of Electronics experiment, Symbols, Terminal identification & List applications of various semiconductor devices- Diodes, Transistors, SCR, UJT etc. Introduction to voltage regulator, List types of regulators, CRO, GM Counter.	16
III	Maintenance of mechanics experiments, Basic Terms related to experiments of Mechanics,	14
IV	Maintenance of optics experiments, Basic Terms related to experiments of optics. Circuit designing and testing.	14
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory (30 Marks) • Class Participation: 5 Marks • Seminar/presentation/assignment/quiz/class test etc.: 10 Marks • Mid-Term Exam: 15		End Term Examination :70 Marks
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, NewDelhi 2. Advanced Level Practical Physics, M. Nelkon and Ogborn, Henemann Education Books Ltd., New Delhi 3. Practical Physics, S.S. Srivastava and M.K.Gupta, AtmaRam & Sons, Delhi 4. Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut 5. Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar 6. Advanced Practical Physics for students, B.L.Flint and H.T. Worsnop, Asia Publishing House		

Indira Gandhi University Indira Gandhi
Undergraduate Programs
Course: VOC-3

Session:2024-25			
Part A-Introduction			
Subject	Physics		
Semester	6th		
Name of the Course	Solar Panel Installation		
Course Code	24L5.5-VOC-PHY- 601		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	VOC		
Level of the Course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the basics of solar energy and solar panels 2. Learn about the SPV Panels system sand their Installation 3. Get the knowledge about the testing method sand techniques SPV. 4. Learn about Maintenance and Troubleshooting process of SPV.		
Credits	Theory	Practical	Total
	4	NA	4
Contact Hours	4	NA	4
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3hrs	
Part B-Contents of the Course			
<u>Instructions for Paper-Setter</u>			
1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, select in gone question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.			

Unit	Topics	Contact Hours
I	Introduction to solar energy and solar panels Solar Energy and its potential, harnessing solar energy, need for Solar energy to electrical energy conversion, Solar photovoltaic (SPV) system, SPV panels and their types, ratings and specifications. Advantages and disadvantages of SPV panels, basics of load calculation and SPV requirement	16
II	SPV Panels systems and their Installation Solar panel to SPV systems: OFF grid and ON grid solar systems, Areas of applications of SPV systems, components of solar systems; solar panel, inverter (Stand alone and grid tied) , Battery Energy system (BES), Charge controller, Tools and equipments: Digital Multimeter Clamp Meter Hydrometer, Sun pathfinder Thermography Camera, drills and fasteners, sealants, pliers and strippers, Pyranometer, Personal Protective Equipments (PPE), Battery maintenance kit Battery water filler etc. Installation: Site selection criteria, steps and procedure for solar panel array installation, different mounting structures, installation of AC and DC distribution boxes, earthing and grounding pits, optimal cable sizing and cable laying.	17
III	Testing and Inspection Testing methods and techniques, testing of SPV open circuit and load voltage, Battery SOC testing, testing of protective systems and earth resistance, Inspection of connected systems and running a test,	14
IV	Maintenance and Trouble shooting Scheduled and unscheduled maintenance, checking dust accumulation, Module Shading Module Mismatch, Physical Integrity, standard trouble shooting procedure.	13
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory(30 Marks) - Class Participation: 5 Marks - Seminar/presentation/assignment/quiz/class test etc.: 10 Marks - Mid-Term Exam: 15		End Term Examination : 70 Marks
Part C-Learning Resources		
Recommended Books/e-resources/LMS: - Solar Photo voltaic technology PHI 2013, Chetan Singh Solanki - Solar Electrical Handbook 2021, Michael Box well - Hand book for rooftop solar panel installation in Asia, 2014 Asian Development Bank (ADB)		