

INDIRA GANDHI UNIVERSITY

Meerpur-Rewari, Haryana (122502)

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

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



SCHEME OF EXAMINATION & SYLLABI

in accordance with National Education Policy-2020

for

Postgraduate Programme

in

M.Sc. (Computer Science)

(Effective from Academic Session: 2026-27)

**DEPARTMENT OF COMPUTER SCIENCE
FACULTY OF ENGINEERING & TECHNOLOGY**

www.igu.ac.in

VISION AND MISSION OF THE UNIVERSITY

VISION

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

MISSION

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

VISION AND MISSION OF THE DEPARTMENT

VISION

To train students to be highly effective instructors, researchers, and contributors to IT companies globally. Be regarded as a prestigious centre of scholarly achievement worldwide.

MISSION

1. To advance research and education in IT domain.
2. To create skilled employees for businesses and industries based on latest IT technologies like artificial intelligence, data science and IoT etc.
3. To offer learning environments that are centered on the needs of the students in order to help them develop as people as a whole.

ABOUT THE PROGRAMME

The M.Sc.(Computer Science) is a two-year postgraduate programme designed to provide students with advanced theoretical knowledge and practical expertise in the field of Computer Science. The programme aims to develop highly skilled professionals capable of addressing complex computational problems, conducting research, and contributing to technological innovation in academia, industry, and government sectors.

The curriculum covers advanced areas of Computer Science including Algorithms, Data Structures, Artificial Intelligence, Machine Learning, Data Science, Cloud Computing, Cyber Security, Software Engineering, Database Management Systems, Computer Networks, and Emerging Technologies. The programme emphasizes analytical thinking, problem-solving abilities, research aptitude, and the application of modern computing tools and techniques.

The programme seeks to:

- *Provide in-depth knowledge of advanced concepts, theories, and practices in Computer Science.
- *Develop the ability to design, implement, and evaluate efficient computing solutions for real-world problems.
- *Enhance research skills through project work, seminars, and dissertation-based learning.
- *Foster innovation, critical thinking, and interdisciplinary approaches to technological challenges.
- *Prepare students for careers in software development, data analytics, cybersecurity, cloud computing, research, and academia.
- *Equip students with professional, ethical, and entrepreneurial competencies required in the rapidly evolving digital world.
- *Encourage lifelong learning and adaptability to emerging technologies and global technological trends.

The programme integrates classroom instruction, laboratory work, project-based learning, internships, and research activities to ensure a balanced development of theoretical understanding and practical competence. Graduates of the programme will be well-prepared for advanced professional careers, doctoral studies, research positions, and leadership roles in the computing industry.

INTAKE IN THE PROGRAMME

As per Institution

MINIMUM ELIGIBILITY CRITERIA

BCA/ B. Voc. (Software Development /IT / Web Development)/ B.Sc. (Hons.)/ B.Sc./B.Sc. (Computer Science)/ B.E./ B. Tech. / B.A with Mathematics with at least 50% marks (47.5% marks for SC/ST/ Blind/ Visually and Differently Abled candidates of Haryana only) in aggregate or any other examination recognized as equivalent thereto by I.G.U., Meerpur

*The eligibility of the NEP Courses will be decided and changed as per the DC/BoS/AC of IGU

PASSING CRITERIA

40% Marks (In Theory and Practical separately)

ELIGIBILITY FOR EXAMINATION

75% Attendance in every subject

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1	To have fundamental as well as advanced knowledge of the Information Technologies.
PEO2	To provide the professional services to IT industries, Research organization, in the domain of super specialization.
PEO3	To opt for higher education, disciplinary & multi-disciplinary research and to be a life-long learner.

PROGRAMME LEARNING OBJECTIVES (PLOs)

PLO1	Demonstrate the deep understanding and advanced knowledge in the core areas of Computer Science subject and understanding of recent developments and issues, including concepts, theories, principles, methods, and techniques in different areas of Computer Science.
PLO2	Attain the capabilities of critical thinking, logical reasoning, investigating problems, analysis, problem-solving, and application of computer science methods/techniques, in intra/inter-disciplinary areas of Computer Science, enabling to develop skills to solve problems having applications in other disciplines and/or in the real world and to formulate, synthesize, and articulate issues for analyzing, designing, and implementing of project/research proposals, testing hypotheses, and drawing inferences based on the analysis.
PLO3	Effectively communicate the attained skills in different areas of Computer Science in a precise, well-structured, and unambiguous mathematical language through effective oral and/or written expressions to the society at large.
PLO4	Capability of applying knowledge to solve scientific and other problems.
PLO5	Capable to learn and work effectively as an individual, and as a member or leader in diverse teams, multidisciplinary settings.
PLO6	Ability of critical thinking, analytical reasoning and research based knowledge including design of experiments, analysis and interpretation of data to provide conclusions.
PLO7	Ability to use and learn techniques, skills and modern tools for scientific practices.
PLO8	Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices.

PLO9	Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout life.
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Scheme of Examination for Postgraduate Programme

Subject	M.Sc. (Computer Science)
Total number of Semesters	04
Total Marks	2800
Total Credit	104
Framework	2
Scheme	R

Curriculum Framework - PG

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

Semester	Course Type	Course Code	Nomenclature of the Course	Theory (Th)/ Practical (P)	Credit	Contact hours per week (L+T+P=Total)	Internal Assessment Marks (Th+P=Total)	End Term Examination Marks (Th+P=Total)	Total Marks	Exam Hours Theory, Practical
1	CC-1	26L6.0-CSC-101	Data Structures and Algorithms	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	CC-2	26L6.0-CSC-102	Database Design Concepts	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	CC-3	26L6.0-CSC-103	Distributed Operating System	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	CC-4	26L6.0-CSC-104	Computer Organization and Architecture	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	PC-1 (pick any one)	26L6.0-CSC-105	Practical -1 (Data Structures, C++)	0T / 4P	4	0+0+8=8	0+30=30	0+70=70	100	3 Hours
	PC-2 (pick any one)	26L6.0-CSC-106	Practical -2 (Database Design Concepts, Microsoft Azure)	0T / 4P	4	0+0+8=8	0+30=30	0+70=70	100	3 Hours
	SEMINAR	26L6.0-CSC-107	Seminar	2T / 0P	2	2+0+0=2	0	50	50	2 Hours
	Total				26	34	180	470	650	
2	CC-5	26L6.0-CSC-201	Object Oriented Programming with Java	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	CC-6	26L6.0-CSC-202	Computer Graphics & Multimedia	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	CC-7	26L6.0-CSC-203	Computer Networks	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	CC-8	26L6.0-CSC-204	Theory of Computation	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	PC-3 (pick any one)	26L6.0-CSC-205	Practical -3 (JAVA, Tableau Data Visualization)	0T / 4P	4	0+0+8=8	0+30=30	0+70=70	100	3 Hours
	PC-4 (pick any one)	26L6.0-CSC-206	Practical -4 (Computer Graphics, MongoDB)	0T / 4P	4	0+0+8=8	0+30=30	0+70=70	100	3 Hours
	CHM	26L6.0-CHM-201	Constitutional, Human and Moral Values, and IPR	2T / 0P	2	2+0+0=2	15+0=15	35+0=35	50	2 Hours
	Total				26	34	195	455	650	

Curriculum Framework - PG

Semester	Course Type	Course Code	Nomenclature of the Course	Theory (Th)/ Practical (P)	Credit	Contact hours per week (L+T+P=Total)	Internal Assessment Marks (Th+P=Total)	End Term Examination Marks (Th+P=Total)	Total Marks	Exam Hours Theory, Practical
3	CC-9	26L6.5-CSC-301	Artificial Intelligence	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	CC-10	26L6.5-CSC-302	Data Mining and Warehouse	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	DEC-1 (pick any one)	26L6.5-CSC-303	Scripting Technology	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
		26L6.5-CSC-304	Mobile Computing							
		26L6.5-CSC-305	May be offered through MOOC/ Swayam Portal							
	DEC-2 (pick any one)	26L6.5-CSC-306	Network Security & Cryptography	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
		26L6.5-CSC-307	Internet of Things (IoT)							
		26L6.5-CSC-308	May be offered through MOOC/ Swayam Portal							
	PC-5 (pick any one)	26L6.5-CSC-309	Practical-5 (Artificial Intelligence, TensorFlow)	0T / 4P	4	0+0+8=8	0+30=30	0+70=70	100	3 Hours
	PC-6 (pick any one)	26L6.5-CSC-310	Practical-6 (DWM, Microsoft Power Automate)	0T / 4P	4	0+0+8=8	0+30=30	0+70=70	100	3 Hours
	OEC (*offered for the other departments)	26L6.5-OEC-311	Python Programming	2T / 0P	2	2+0+0=2	15+0=15	35+0=35	50	2 Hours
	Total				26	34	195	455	650	

Semester	Course Type	Course Code	Nomenclature of the Course	Theory (Th)/ Practical (P)	Credit	Contact hours per week (L+T+P=Total)	Internal Assessment Marks (Th+P=Total)	End Term Examination Marks (Th+P=Total)	Total Marks	Exam Hours Theory, Practical
4	CC-11	26L6.5-CSC-411	Edge Computing	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	CC-12	26L6.5-CSC-410	Wireless Technology	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	DEC-3 (pick any one)	26L6.5-CSC-401	Machine Learning & Generative AI	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
		26L6.5-CSC-402	Digital Forensics							
		26L6.5-CSC-403	Soft Computing							
		26L6.5-CSC-404	May be offered through MOOC/ Swayam Portal							
	DEC-4 (pick any one)	26L6.5-CSC-405	Network Security & Cryptography	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
		26L6.5-CSC-406	Cyber Physical System & Security							
		26L6.5-CSC-407	Biometric Security							
		26L6.5-CSC-408	May be offered through MOOC/ Swayam Portal							
	PC-7 (pick any one)	-	Any One from the Choices Given Below							
	PC-8 (pick any one)	-	Any One from the Choices Given Below							
	EEC	26L6.5-EEC-RPE-400	Research Ethics	2T / 0P	2	2+0+0=2	15+0=15	35+0=35	50	2 Hours
	Total				26	26	195	455	650	
SCHEME OF SEMESTER-4 WHEN A STUDENT OPTS FOR DISSERTATION OR PROJECT WORK										
OR										

Semester	Course Type	Course Code	Nomenclature of the Course	Theory (Th)/ Practical (P)	Credit	Contact hours per week (L+T+P=Total)	Internal Assessment Marks (Th+P=Total)	End Term Examination Marks (Th+P=Total)	Total Marks	Exam Hours Theory, Practical
4	DEC-3	26L6.5-CSC-401	Same as Semester 4 (Choices defined in Semester 4)	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	DEC-4	26L6.5-CSC-405	Same as Semester 4 (Choices defined in Semester 4)	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	DEC-5 (pick any one)	26L6.5-CSC-409	Blockchain Technology and Quantum Computing	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
		26L6.5-CSC-410	Wireless Technology							
		26L6.5-CSC-411	Edge Computing							
		26L6.5-CSC-412	May be offered through MOOC/ Swayam Portal							
	PROJECT WORK/DISSE RTATION	26L6.5-CSC-414	Dissertation	0T / 12P	12	0+0+24=24	90	210	300	0 Hours
	EEC	26L6.5-EEC-RPE- 400	Research Ethics	2T / 0P	2	2+0+0=2	15+0=15	35+0=35	50	2 Hours
Total					26	38	195	455	650	
OR										
4	CC-11	26L6.5-CSC-411	Edge Computing	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	DEC-3	26L6.5-CSC-401	Same as Semester 4 (Choices defined in Semester 4)	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	DEC-4	26L6.5-CSC-405	Same as Semester 4 (Choices defined in Semester 4)	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	PROJECT WORK/DISSE RTATION	-	Dissertation	0T / 12P	12	0+0+24=24	90	210	300	0 Hours
	EEC	26L6.5-EEC-RPE- 400	Research Ethics	2T / 0P	2	2+0+0=2	15+0=15	35+0=35	50	2 Hours
	Total				26	38	195	455	650	

Semester 1

Part A - Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	1st		
Nature of Course/Course Composition	Theory		
Name of the Course	Data structures and algorithms		
Course Code	26L6.0-CSC-101		
Course Type	CC1		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO1: Ability to analyze algorithms and algorithm correctness. CLO2: Ability to summarize searching and sorting techniques. CLO3: Ability to describe stack, queue and linked list operation. CLO4: Ability to have knowledge of tree and graphs concepts.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			

Unit	Topics	Contact Hours/ CLOs
I	Definition, Classification of data structures, Operations on data structures, Design and analysis of algorithm, Top down and bottom up approaches to Algorithm design. Frequency count, Complexity. Arrays: Address calculation using column and row major ordering. Various operations on Arrays, Vectors, Application of arrays: Matrix multiplication, sparse polynomial representation and addition.	15/ CLO1
II	Stacks and Queues: Introduction, Operations, Representation using arrays and linked list. Circular queues, Priority Queue and De Queue. Applications of stacks: Conversion from infix to postfix and prefix expressions, Evaluation of postfix expression using stacks. Linked list: Singly linked list; operations on list, Linked stacks and queues. Polynomial representation and manipulation using linked lists. Circular linked lists, doubly linked lists.	15/ CLO2
III	Binary tree traversal methods: Preorder, In order, Post ordered. Recursive Algorithms. Traversal methods. Binary tree representation of a general tree. Conversion of forest into tree. Threaded binary trees. Binary search tree: Height balanced (AVL) tree, B trees. Sorting: Selection sort, Insertion sort, Bubble sort, Quick sort, merge sort, Heap sort, Radix sort and their complexities.	15/ CLO3
IV	Searching, sorting and complexity, Hashing Schemes. Comparison of time complexity. Graph representation: Adjacency matrix, Adjacency lists, Depth first search, Breadth first search. Spanning tree: Definition, Minimal spanning tree algorithms. Shortest Path algorithms (Prim's and Kruskal's). File Structures: File Organization, Sequential Files, Indexing and Hashing, Primary indices, Secondary indices, B+ Tree index Files, B Tree index Files, Indexing and Hashing Comparisons.	15/ CLO4
	Total Contact hours	60

Evaluation Methods

Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Hubbard JR: Schaum's outline of Data Structures with C++, TMH.
- R. Sedgewick: Algorithms in C++, Pearson Education Asia.

- Y. Langsam, M. J. Augenstein and A. M. Tannenbaum: Data Structures Using C and C++, Prentice Hall of India.
- R.Kruse, C.L.Tonodo and B.Leung: Data Structures and Program Design in C, Pearson Education.
- S. Chottopadhyay, D. Ghoshdastidar & M. Chottopadhyay: Data Structures through C Language, BPB Publication.
- G.L. Heileman: Data Structures, Algorithms and Object Oriented Programming, Tata McGraw Hill.
- E. Horowitz, Sahni and D. Mehta: Fundamentals of Data Structures in C++, Galgotia Publication.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	1	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A - Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	1st		
Nature of Course/Course Composition	Theory		
Name of the Course	Database Design Concepts		
Course Code	26L6.0-CSC-102		
Course Type	CC2		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO1: To introduce the concept of Data Abstraction & Data Independence. CLO2: To describe the factors various Data base Models. CLO3: To apply the concept of Relational query Languages. CLO4: To impart knowledge of Query Processing optimization with the help of Algorithms.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics		Contact Hours/ CLOs

I	Introduction to Database, features, Applications, data base System Vs. File Processing System, Instances and Schemas. Data Models – Hierarchical, Network, Relational Model. Database Access for applications Programs – data base Users and Administrator, Data Independence, Data base System Architecture. Data base design and ER diagrams – Beyond ER Design Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Concept Design with the ER Model, and Conceptual Design for Large enterprises.	15/ CLO1
II	Relational Model: Introduction to the Relational Model, Integrity Constraint Over relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design, Introduction to Views, Destroying /altering Tables and Views. Relational Algebra and Calculus: Relational Algebra, Selection and projection set operations, renaming, Joins, Division, Examples of Algebra overviews, Query Processor, Codd's 12 Rules. Relational calculus–Tuple relational Calculus, Domain relational calculus, Expressive Power of Algebra and calculus	15/ CLO2
III	Form of Basic SQL Query – Examples of Basic SQL Queries, Introduction to Nested Queries, Correlated Nested Queries Set, Comparison Operators, NULL values, Comparison using Null values, Logical connectivity's – AND, OR and NOT. Impact on SQL Constructs, Outer Joins, Disallowing NULL values, Complex Integrity Constraints in SQL Triggers and Active Databases. Database Languages – DDL, DML, DCL and Its commands. Schema refinement, Problems Caused by redundancy, Decompositions, Problem related to decomposition, Normalization: FIRST to FIFTH Normal forms, BCNF, Lossless join Decomposition, Dependency preserving Decomposition, Schema refinement in Data base Design, Multi valued Dependencies.	15/ CLO3
IV	Overview of Transaction Management: ACID Properties, Transactions and Schedules, Concurrent Execution of transaction, Lock Based Concurrency Control, Performance Locking, Introduction to Crash recovery. Concurrency Control: Serializability, and recoverability, Introduction to Lock Management, Lock Conversions, Dealing with Deadlocks, Specialized Locking Techniques.	15/ CLO4
	Total Contact hours	60

Evaluation Methods

Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	

• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• Silberschatz, Korth: Data base System Concepts, McGraw Hill, and latest edition. • P. Radha Krishna: Database Management Systems, HITECH Publications. • C.J.Date: Introduction to Database Systems, Pearson Education. • Gupta,S.B., Aditya Mittal, Introduction to Data base Management System, University Science Press, New Delhi. • Elmasri Navrate: Data base Management System, Pearson Education.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	2	1	2	3	2	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	1	2	3	3	3	3	2	2	1
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A - Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	1st		
Nature of Course/Course Composition	Theory		
Name of the Course	Distributed operating system		
Course Code	26L6.0-CSC-103		
Course Type	CC3		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO1: Understand core concepts of distributed systems. CLO2: Classify different system types. CLO3: Analyze communication mechanisms. CLO4: Design client-server and peer to peer systems.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics		Contact Hours/ CLOs
I	Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls,		15/ CLO1

	Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Definition and Characteristics: Types (homogeneous, heterogeneous), advantages (scalability, fault tolerance), challenges (latency, security). Types of Distributed Systems: Client-server (web services, email), peer to peer (file sharing, block chain), hybrid systems. Communication: Sockets (TCP, UDP), Remote Procedure Calls (RPC), message passing (synchronous, asynchronous).	
II	Client Server Model: Concepts, architectures (thin client, thick client), examples (web applications, email). Peer to Peer Systems: Concepts, architectures (structured, unstructured), examples (BitTorrent, blockchain). Middleware: Concepts, types (message oriented, object oriented, service oriented), applications (CORBA, DCOM). Distributed Objects: Concepts, architectures (CORBA, DCOM), applications (distributed databases, remote method invocation).	15/ CLO2
III	Clock Synchronization: Logical clocks (Lamport’s timestamps), vector clocks, applications (distributed debugging, event ordering). Distributed Mutual Exclusion: Algorithms (RicartAgrawala, Maekawa’s), analysis (message complexity, fairness). Election Algorithms: Bully algorithm, Ring algorithm, applications (leader election, coordinator selection).	15/ CLO3
IV	Fault Tolerance: Concepts, techniques (replication, check pointing, rollback recovery), examples (distributed databases, cloud computing). Distributed File Systems: Concepts, architectures (NFS, AFS), examples (Google File System, Hadoop Distributed File System). Security: Threats (eavesdropping, tampering, impersonation), mechanisms (encryption, authentication, authorization), protocols (SSL/TLS, Kerberos).	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• Andrew s. Tanenbaum: distributed operating systems. • Andrew s tanenbaum distributed operating systems pearson education limited • Distributed operating systems and algorithm analysis randy chow, theodore johnson pearson • Fundamental of distributed operating system by shubhra garg, s.k. kataria & sons		

- Distributed operating systems concepts and designpradeep k. Sinha

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	2	2	3	3	3	3	2	S	2
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A - Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	1st		
Nature of Course/Course Composition	Theory		
Name of the Course	Computer organization and architecture		
Course Code	26L6.0-CSC-104		
Course Type	CC4		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO1: Understand the theory and architecture of central processing unit. CLO2: Analyze some of the design issues in terms of speed, technology, cost, performance. CLO3: Design a simple CPU with applying the theory concepts. CLO4: Use appropriate tools to design verify and test the CPU architecture.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			

Unit	Topics	Contact Hours/ CLOs
I	Functional blocks of a computer: CPU, memory, input/output subsystems, control unit. Instruction set architecture of a CPU– registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs. Data representation: signed number representation, fixed and floating-point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look ahead adder, etc. multiplication – shift and add, Booth multiplier, carry save multiplier, etc. Division restoring and no restoring techniques, floating point arithmetic.	15/ CLO1
II	Introduction to x86 architecture. CPU control unit design: hardwired and microprogrammed design approaches, Case study – design of a simple hypothetical CPU. Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics: Input/output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and no privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB	15/ CLO2
III	Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.	15/ CLO3
IV	Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• “Computer System Architecture”, 3rd Edition by M. Morris Mano, Pearson. • Computer System Architecture and Organization: by Usha, Wiley India Ltd. • “Computer Organization and Design: The Hardware/Software Interface”, 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.		

- “Computer Organization and Embedded Systems”, 6th Edition by Carl Hamacher, McGrawHill Higher Education.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	1	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of the Programme	M. Sc. Computer Science		
Semester	1st		
Nature of Course/Course Composition	Practical		
Name of the Course	Practical-1 C++		
Course Code	26L6.0-CSC-105		
Course Type	PC1		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Grasp OOP fundamentals and C++ basics (data types, variables, functions, etc.). CLO2: Design and implement classes using access specifiers, constructors, destructors and member functions. CLO3: Apply inheritance, polymorphism (overloading, overriding), and operator overloading. CLO4: Manage memory, implement object copying, and use templates and the STL.		
	Theory	Practical	Total
Credits	0	4	4
Teaching hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Duration (in Hours)	0	03	
Part B- Contents of the Course			
<u>Instructions for Examiner:</u>			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 40.			
Unit	Topics		Contact Hours/ CLOs

I	Introduction to object-oriented programming, user defined types, structures, unions, polymorphism, and encapsulation. Getting started with C++ syntax, datatype, variables, strings, functions, and default values in functions, recursion, namespaces, operators, flow control, arrays and pointers.	30/CLO1
II	Abstraction mechanism: Classes, private, public, constructors, destructors, member data, member functions, inline function, friend functions, static members, and references. Inheritance: Class hierarchy, derived classes, single inheritance, multiple, multilevel, hybrid inheritance, role of virtual base class, constructor and destructor execution, base initialization using derived class constructors. Polymorphism: Binding, Static binding, Dynamic binding, Static polymorphism: Function Overloading, Ambiguity in function overloading, Dynamic polymorphism: Base class pointer, object slicing, late binding, method overriding with virtual functions, pure virtual functions, abstract classes.	30/CLO2
III	Operator Overloading: This pointer, applications of this pointer, Operator function, member and non-member operator function, operator overloading, I/O operators. Exception handling: Try, throw, and catch, exceptions and derived classes, function exception declaration, unexpected exceptions, exception when handling exceptions, resource capture and release.	30/CLO3
IV	Dynamic memory management, new and delete operators, object copying, copy constructor, assignment operator, virtual destructor. Template: template classes, template functions. Standard Template Library: Fundamental idea about string, iterators, hashes, iostreams and other types. Namespaces: user defined namespaces, namespaces provided by library. Object Oriented Design, design and programming, role of classes.	30/CLO4
	Contact Hours	120

Evaluation Methods

Internal Assessment	MM-30	End Term Examination: 70	MM- 70
Class Participation:	5	Lab record	10
Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
Mid-Term Exam:	15	Write-up and execution of the practical	40

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- C++: The Complete Reference Schildt, McGrawHill Education (India) 3 C++ and Object Oriented Programming – Jana, PHI Learning.
- Object Oriented Programming with C++ Rajiv Sahay, Oxford

- Mastering C++ Venugopal, McGrawHill Education (India)
- Object Oriented Programming with C++ by E. Balagurusamy, McGrawHill Education (India)

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	2	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	2
CLO ₃	1	2	3	3	3	3	2	1	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	120
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	120

Part A – Introduction			
Name of the Programme	M. Sc. Computer Science		
Semester	1st		
Nature of Course/Course Composition	Practical		
Name of the Course	Practical-2 Azure Lab Syllabus		
Course Code	26L6.0-CSC-106		
Course Type	PC2		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Understand cloud computing fundamentals and Azure services. CLO2: Set up and manage Azure VMs, storage, networking, and databases. CLO3: Develop and deploy cloud applications using Azure services. CLO4: Implement CI/CD pipelines and monitor Azure resources.		
	Theory	Practical	Total
Credits	0	4	4
Teaching hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Duration (in Hours)	0	03	
Part B- Contents of the Course			
<u>Instructions for Examiner:</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 40.			
Unit	Topics		Contact Hours/ CLOs
I	Introduction to Cloud Computing and Azure: Overview of cloud computing, Introduction to Microsoft Azure, Azure services and		30/CLO1

	architecture, Setting up an Azure account. Azure Virtual Machines: Creating and configuring VMs, Managing VM instances, VM scaling and availability, VM networking. Azure Storage Solutions: Introduction to Azure Storage, Blob, File, Queue, and Table storage, Managing storage accounts, Data redundancy and replication.	
II	Azure Networking: Virtual networks, Subnets and IP addressing, Network security groups, VPN gateways and ExpressRoute. Azure App Services: Introduction to App Services, Creating and managing web apps, App Service plans, Deployment slots and scaling. Azure Databases: Azure SQL Database, Cosmos DB, Database migration, Managing and monitoring databases.	30/CLO2
III	Azure Identity and Access Management: Azure Active Directory, Role based access control (RBAC), Multifactor authentication, and Identity protection. Azure DevOps: Introduction to Azure DevOps, Continuous integration and delivery (CI/CD), Managing pipelines, Infrastructure as code (IaC).	30/CLO3
IV	Monitoring and Management: Azure Mon, Log Analytic, Application Insights, Security Center. Advanced Topics and Project Work: Advanced networking and security, Integration with other cloud services, Capstone project: Design and implement a cloud-based solution.	30/CLO4
	Contact Hours	120

Evaluation Methods

Internal Assessment	MM-30	End Term Examination: 70	MM- 70
Class Participation:	5	Lab record	10
Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
Mid-Term Exam:	15	Write-up and execution of the practical	40

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Microsoft Azure Administrator (Exam Ref AZ-104) – Jim Cheshire, Microsoft Press.
- Microsoft Azure Administrator Certification Guide (AZ-104) – Jack Lee, Packt Publishing.
- Azure for Architects: Design Solutions for the Microsoft Cloud – Ritesh Modi, Packt Publishing.
- Microsoft Azure Fundamentals Certification and Beyond (AZ-900) – Steve Miles, Packt Publishing.
- Learning DevOps: Continuously Deliver Better Software – Mikael Krief, Packt Publishing.
- Azure Strategy and Implementation Guide – Marshall Copeland, Chris Hay, and others, Microsoft Press.

- Cloud Computing: Concepts, Technology & Architecture – Thomas Erl, Ricardo Puttini, and Zaigham Mahmood, Pearson Education.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	1
CLO ₃	1	2	3	3	3	3	2	1	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	120
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	120

Semester II

Part A - Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	2nd		
Nature of Course/Course Composition	Theory		
Name of the Course	Object Oriented Programming with Java		
Course Code	26L6.0-CSC-201		
Course Type	CC5		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO1: Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs. CLO2: Read and make elementary modifications to Java programs that solve real-world problems. CLO3: Validate input in a Java program. CLO4: Identify and fix defects and common security issues in code.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
Instructions for Paper- Setter:			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics		Contact Hours/ CLOs
I	Introduction to Object-oriented Programming: Basic Concepts: Object-oriented programming (OOP) principles (encapsulation, inheritance, polymorphism, abstraction). Java Basics: Java syntax, data types, variables, operators, control structures. Classes and Objects: Class definition, object creation, constructors, methods, access modifiers.		15/ CLO1
II	Advanced Object-oriented Concepts: Inheritance: Types (single, multilevel, hierarchical), method overriding, super keyword. Polymorphism: Compile time (method overloading), runtime (method overriding), and dynamic method dispatch.		15/ CLO2

	Interfaces and Abstract Classes: Definition, implementation, differences, applications.	
III	Exception Handling and File I/O: Exception Handling: Types of exceptions, try catch block, throw, throws, finally, custom exceptions. File I/O: File handling in Java (File Reader, File Writer, Buffered Reader, and Buffered Writer), serialization and deserialization.	15/ CLO3
IV	Advanced Java Features: Collections Framework: List, Set, and Map interfaces, Array List, Linked List, Hash Set, Tree Set, Hash Map, and Tree Map. Multithreading: Thread lifecycle, creating threads (Thread class, Runnable interface), and synchronization, inter thread communication. GUI Programming: AWT, Swing, event handling, layout managers.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz /class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• The Complete Reference JAVA, TMH Publication. • Beginning JAVA, Ivor Horton, WROX Public. • JAVA 2 UNLEASHED, Tech Media Publications. • JAVA 2(1.3) API Documentations.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	1	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	1	2	3	3	3	2

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	

Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A - Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	2nd		
Nature of Course/Course Composition	Theory		
Name of the Course	Computer Graphics & Multimedia		
Course Code	26L6.0-CSC-202		
Course Type	CC6		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CO1: Have a basic understanding of the core concepts of computer graphics. CO2: Be capable of using OpenGL to create interactive computer graphics. CO3: Understand a typical graphics pipeline. CO4: Have made pictures with their computer.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	Contact Hours/ CLOs	
I	Introduction to Computer Graphics: Basic Concepts: Graphics systems, applications, graphics hardware, and software. Graphics Primitives: Points, lines, circles, ellipses, polygons, algorithms (DDA, Bresenham's). 2D Transformations: Translation, rotation, scaling, reflection, shearing, homogeneous coordinates.	15/ CLO1	
II	3D Graphics and Transformations: 3D Concepts: 3D coordinate systems, projections (parallel, perspective). 3D Transformations: Translation, rotation, scaling, reflection, shearing, composite transformations. Viewing Pipeline: Viewing coordinates, clipping, and viewport transformation.	15/ CLO2	
III	Rendering Techniques: Hidden Surface Removal: Zbuffer, backface culling, painter's algorithm. Lighting and Shading: Light sources, illumination models, shading models (flat, Gouraud, Phong). Texture Mapping: Texture mapping techniques, mipmapping, bump mapping.	15/ CLO3	

IV	Multimedia Concepts: Multimedia Basics: Definitions, components (text, images, audio, And video), applications. Audio and Video: Audio formats, video formats, compression techniques (JPEG, MPEG). Multimedia Systems: Multimedia hardware, software, multimedia databases.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS: • Donald Hearn and M.Pauline Baker: Computer Graphics, PHI Publications • Plastock: Theory & Problem of Computer Graphics, Schaum Series. • Foley & Van Dam: Fundamentals of Interactive Computer Graphics, AddisonWesley. • Newman: Principles of Interactive Computer Graphics, McGraw Hill. • Tosijas, L.K. : Computer Graphics, Springerverleg • S Gokul: Multimedia Magic, BPB Publication. • Bufford: Multimedia Systems, Addison Wesley. • Jeffcoate: Multimedia in Practice, Pretice Hall.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	2
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	2	2	3	3	3	3	2	1	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A - Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	2nd		
Nature of Course/Course Composition	Theory		
Name of the Course	Computer Networks		
Course Code	26L6.0-CSC-203		
Course Type	CC7		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	Course Outcomes CLO1: Recognize and Describe about the working of Computer Networks. CLO2: Illustrate reference models with layers, protocols and interfaces. CLO3: Summarize functionalities of different Layers CLO4: Combine and distinguish functionalities of different Layers.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
Instructions for Paper- Setter:			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics		Contact Hours/ CLOs
I	Introduction to Computer Networks: Basic Concepts: Network types (LAN, WAN, MAN), topologies (bus, star, ring, and mesh), protocols, OSI and TCP/IP models. Physical Layer: Transmission media (wired, wireless), switching techniques (circuit, packet, message). Data Link Layer: Error detection and correction, flow control, MAC protocols (Ethernet, token ring).		15/ CLO1
II	Network Layer: Routing Algorithms: Distance vector, link state, path vector, hierarchical routing. IP Addressing: IPv4, IPv6, subnetting, CIDR, NAT. Network Layer Protocols: ARP, RARP, ICMP, IGMP.		15/ CLO2
III	Transport Layer: Transport Layer Protocols: TCP, UDP, SCTP. Congestion Control: Techniques (leaky bucket, token bucket), TCP congestion control (slow start, congestion avoidance). Quality of		15/ CLO3

	Service (QoS): Concepts, techniques (traffic shaping, policing), protocols (RSVP, DiffServ).	
IV	Application Layer: Application Layer Protocols: HTTP, FTP, SMTP, POP3, IMAP, DNS. Network Security: Cryptography, digital signatures, certificates, SSL/TLS, firewalls. Emerging Trends: IoT, cloud computing, SDN, network virtualization.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
Instructions		
• A.S. Tanenbaum: Computer Networks (4th ed.), PrenticeHall of India. • W. Tomasi: Introduction to Data Communications and Networking, Pearson Education. • P.C. Gupta: Data Communications and Computer Networks, PrenticeHall of India. • Behrouz Forouzan and S.C. Fegan: Data Communications and Networking, McGraw Hill. • L. L. Peterson and B. S. Davie: Computer Networks: A Systems Approach, Morgan Kaufmann. • William Stallings: Data and Computer Communications, Pearson Education.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	3	2	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	3	3
CLO ₃	1	2	3	3	3	3	2	2	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	

Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	2nd		
Nature of Course/Course Composition	Theory		
Name of the Course	Theory of Computation		
Course Code	26L6.0-CSC-204		
Course Type	CC8		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Model, compare and analyses different computational models using combinatorial methods. CLO2: Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata. CLO3: To solve various problems of applying normal form techniques, push down automata and Turing Machines. CLO4: Identify limitations of some computational models and possible methods of proving them.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
Instructions for Paper- Setter:			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	Contact Hours/ CLOs	
I	Automata Theory: Finite Automata: Deterministic (DFA), nondeterministic (NFA), equivalence, And minimization. Regular Expressions: Definitions, operations, equivalence with finite automata. Pumping Lemma: Applications, proving non regular languages.	15/ CLO1	
II	Context Free Grammars and Pushdown Automata: Context Free Grammars (CFGs): Definitions, derivations, parse trees, ambiguity. Pushdown Automata (PDA): Definitions, acceptance by empty stack and final state,	15/ CLO2	

	equivalence with CFGs. Pumping Lemma for CFLs: Applications, proving non context free languages.	
III	Turing Machines: Turing Machines (TMs): Definitions, configurations, variations (multitude, nondeterministic), equivalence with other models. Decidability: Decidable languages, undecidable languages, examples (halting problem). Reducibility: Recursive and recursively enumerable languages, reductions, Rice’s theorem.	15/ CLO3
IV	Computational Complexity: Complexity Classes: P, NP, NP complete, And NP hard, examples. Time and Space Complexity: Definitions, asymptotic notations, complexity analysis. Approximation Algorithms: Concepts, examples (vertex cover, traveling salesman problem).	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
Instructions		
• Introduction to automata theory, language & computations Hopcroft & O.D. Ullman, R.Mothwani, 2001, A.W. • Theory of Computer Sc. (Automata, Languages and computations): K.L.P. Mishra & N.Chandrasekaran, 2000PHI. • Introduction to formal Languages & Automata Peter LinZ, 2001, Narosa Publ. • Fundamentals of the Theory of Computation Principles and Practice By Ramond Greenlaw and H.James Hoover, 1998, Harcourt India Pvt. Ltd. • Elements of theory of Computation by H.R.Lewis & C.H.Papaditriou, 1998,PHI. • Introduction to languages and the Theory of Computation by John C.Martin 2003, T.M.H.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	3	2	3	3	3	3	2	2	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of the Programme	M. Sc. Computer Science		
Semester	2 nd		
Nature of Course/Course Composition	Practical		
Name of the Course	Practical-3 (Tableau Data Visualization)		
Course Code	26L6.0-CSC-205		
Course Type	PC3		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Create and customize a variety of interactive visualizations and dashboards in Tableau to effectively represent and explore data insights. CLO2: Prepare and transform data for analysis by applying data cleaning techniques, handling missing values, and integrating multiple data sources. CLO3: Apply advanced analytical techniques in Tableau, such as creating calculated fields, performing trend analysis, and utilizing forecasting tools to derive meaningful conclusions. CLO4: Design and implement interactive dashboards and visual storytelling elements that clearly communicate insights and support data-driven decision-making.		
	Theory	Practical	Total
Credits	0	4	4
Teaching hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Duration (in Hours)	0	03	
Part B- Contents of the Course			
Instructions for Examiner:			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 40.			
Unit	Topics	Contact Hours/ CLOs	
I	Introduction to Data Visualization and Tableau: Overview of data visualization, Introduction to Tableau, Installation and setup, Tableau interface and architecture, Connecting to Data, Connecting to various data sources, Data preparation and cleaning Data blending and joining, Data extraction and live connections	30/CLO1	
II	Basic Visualization, Creating basic charts (bar, line, pie), Using marks and shelves, Sorting and filtering data, Creating calculated fields, Advanced Visualizations, Advanced chart types (scatter, bubble, heat map), Dual axis and combination charts, Using parameters, Customizing tooltips	30/CLO2	
III	Dashboards and Stories, Creating dashboards, Adding interactivity to dashboards, Designing effective dashboards, Creating stories, Data Aggregation and Calculations, Aggregating data, Using table calculations,	30/CLO3	

	Level of detail (LOD) expressions, Mapping and Geospatial Analysis, Creating maps, Using geographic data, Custom geocoding Advanced calculations	
IV	Performance Optimization, Optimizing workbook performance, Data extract optimization, Performance recording and analysis Best practices for performance, Sharing and Collaboration, Publishing to Tableau Server and Tableau Online, Sharing workbooks and dashboards, Embedding visualizations, Collaboration features, Advanced Topics and Project Work, Advanced analytics (forecasting, clustering), Integration with other tools (e.g., R, Python)	30CLO4
	Contact Hours	120
Evaluation Methods		
Internal Assessment	MM-30	End Term Examination: 70
Class Participation:	5	Lab record
Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce
Mid-Term Exam:	15	Write-up and exam of the practical
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• Data visualization with Tableau Parveen Kumar , • Orielly communicating data with Tableau Ben jones • Data Visualization: Introduction to Data Visualization with Python, R and Tableau Robert Collins.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	2	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	3	2	3	1	3	3	2	1	3
CLO ₄	3	3	2	2	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	120
Communication Development	
Indian Knowledge System	

Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	120

Part A – Introduction			
Name of the Programme	M. Sc. Computer Science		
Semester	2nd		
Nature of Course/Course Composition	Practical		
Name of the Course	Practical-4(MongoDB)		
Course Code	26L6.0-CSC-206		
Course Type	PC4		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Design and Implement MongoDB Schemas: Create and design efficient MongoDB schemas using collections and documents, ensuring optimal data modeling for various applications. CLO2: Perform CRUD Operations: Apply MongoDB commands to perform Create, Read, Update, and Delete (CRUD) operations on documents within a MongoDB database. CLO3: Utilize Aggregation Framework: Implement MongoDB's aggregation framework to perform complex data queries and transformations, including filtering, grouping, and sorting data. CLO4: Manage and Optimize MongoDB Performance: Employ techniques for indexing, query optimization, and performance tuning to ensure efficient database operations and high performance.		
	Theory	Practical	Total
Credits	0	4	4
Teaching hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Duration (in Hours)	0	03	
Part B- Contents of the Course			
<u>Instructions for Examiner:</u>			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 40.			
Unit	Topics	Contact Hours/ CLOs	
I	Introduction to MongoDB , Overview of NoSQL databases ,Introduction to MongoDB, Installation and setup, MongoDB architecture, CRUD Operations, Creating databases and collections, Inserting documents, Querying documents, Updating documents, Deleting documents	30/CLO1	
II	Data Modelling, Schema design, Data types and validation, embedding vs. referencing, Designing efficient data models Indexing, Introduction to indexing, Creating and managing indexes,	30/CLO2	

	Indexing strategies, Performance considerations	
III	Aggregation Framework, Introduction to aggregation, Aggregation pipeline, Common aggregation operations, use cases and examples, Replication, Introduction to replication, Setting up replica sets, Managing replica sets, Failover and recovery, Sharding, Introduction to sharding, Shard keys and sharding strategies, Setting up a sharded cluster, Managing and monitoring sharded clusters	30/CLO3
IV	Performance Tuning and Optimization, Query optimization, Index optimization, Monitoring and profiling, Best practices for performance tuning, Security, Authentication and authorization, Role based access control, Data encryption, Security best practices, Advanced Topics and Project Work, Advanced aggregation techniques	30CLO4
	Contact Hours	120
Evaluation Methods		
Internal Assessment	MM-30	End Term Examination: 70
Class Participation:	5	Lab record
Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce
Mid-Term Exam:	15	Write-up and exam of the practical
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• MongoDB: The Definitive Guide (Paperback) by Kristina Chodorow • MongoDB Applied Design Patterns: Practical Use Cases with the Leading NoSQL Database (Paperback), by Rick Copeland		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	3	2	3	3	3	3	3	3
CLO ₂	2	3	2	1	3	3	3	2	3
CLO ₃	2	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	3	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	120
Communication Development	
Indian Knowledge System	

Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	120

Semester III

Part A - Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	3rd		
Nature of Course/Course Composition	Theory		
Name of the Course	Artificial Intelligence		
Course Code	26L6.5-CSC-301		
Course Type	CC9		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CO1: Describe the modern view of AI as the study of agents that receive precepts from the Environment and perform actions. CO2: Demonstrate awareness of informed search and exploration methods. CO3: Explain about AI techniques for knowledge representation, planning and uncertainty Management. CO4: Develop knowledge of decision making and learning methods.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics		Contact Hours/ CLOs
I	Introduction and applications of artificial intelligence, Problem solving: Defining the Problem as state space search, Production system, Problem characteristics, Problem System characteristics, Search techniques: Generate and test, Hill climbing, Best first search, A* algorithm, Problem reduction, Expert system: Definition, Role of knowledge in expert system, Architecture of expert system.		15/ CLO1
II	Expert system development life cycle: Problem selection, Prototype construction, Formalization, Implementation, Evaluation, Knowledge acquisition: Knowledge engineer, Cognitive behavior, Acquisition		15/ CLO2

	techniques, Knowledge representation: Level of representation, Knowledge representation schemes, Formal logic, Inference Engine, Semantic net, Frame, Scripts. Propositional and Predicate logics, Propositional equivalence, Rules of Inference.	
III	Perception: Sensing, Speech recognition, Vision, Action, Neural networks: Introduction, Comparison of artificial neural networks with biological neural networks, learning in neural networks, Perceptrons, Back propagation networks, application of neural networks. Fuzzy logic: Definition, Difference between Boolean and Fuzzy logic, fuzzy subset, fuzzy membership function, fuzzy expert system, Inference process for fuzzy expert system, fuzzy controller.	15/ CLO3
IV	Programming of Lisp: Background: history, installing, resources. Basics: symbols, evaluation, data types, lists, conditionals, functions, lambda forms, Emacs, REPL. Backquote, vectors, sequences, file system, loop, format, packages, streams, debugger, compiling, Prolog in Lisp, knowledge representation, constraints, unification, Macros and Object: Macros, closures, reader macros, Error system, performance tuning, Typesystem, CLOS, Structs, FFI, OS hook, External libraries.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• David W. Rolston: Principles of Artificial Intelligence and Expert System Development, McGraw Hill Book Company. • Elaine Rich, Kevin Knight: Artificial Intelligence, Tata McGraw Hill. • Carl Townsend: Introduction to Turbo Prolog, BPB • Stamations V. Kartalopous: Understanding Neural Networks and Fuzzy Logic, PHI • Satinder Bal Gupta: Artificial Intelligence, Shree Mahavir Book Depot(Publishers), New Delhi. • Practical Common Lisp (Peter Seibel) http://www.gigamonkeys.com/book/ • Common Lisp –https://www.cs.cmu.edu/~dst/LispBook/book.pdf • On Lisp (Paul Graham) –http://www.paulgraham.com/onlisp.html		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	2	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	3	2	3	2	3	3	2	2	3
CLO ₄	2	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	3rd		
Nature of Course/Course Composition	Theory		
Name of the Course	Data Mining and Warehouse		
Course Code	26L6.5CSC-302		
Course Type	CC10		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CO1: Understand the functionality of the various data mining and data warehousing component. CO2: Appreciate the strengths and limitations of various data mining and data warehousing models. CO3: Explain the analyzing techniques of various data. CO4: Remove redundancy and incomplete data from the dataset using data pre-processing methods.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics		Contact Hours/ CLOs
I	Introduction data warehouse, Need, definition, goals, Data Mart, Data warehouse architecture, ETL process, star, and snowflake and galaxy schemas for multidimensional databases, Designing fact tables. Partitioning.		15/ CLO1
II	OLTP vs OLAP technology, multidimensional data models and different OLAP operations, OLAP Server: ROLAP, MOLAP and HOLAP. Data cubes, efficient computation of data cubes, distributed and virtual data warehouse.		15/ CLO2
III	Data preprocessing, Data mining primitives, Types of Data Mining, Data Mining query language, Architectures of data mining. Data generation & Summarization based characterization, Mining class comparisons, Mining Association Rules in large databases: Association rule mining, single dimensional Boolean association rules from		15/ CLO3

	Transactional DBS, Multi-level association rules from transaction DBS, multidimensional association rules. Correlation analysis, Constraint based association mining.	
IV	Classification and Prediction: Classification by decision tree induction, Back propagation, Bayesian classification, classification based in association rules, Prediction, Cluster analysis, partitioning and hierarchical methods, Density based method, web mining, Temporal and spatial data mining. Introduction to Data Mining tools: Rapid Miner, Programming, Orange Weka, Oracle BI, Advanced Miner.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• W.H.Inmon: Building Data Ware House, John Wiley & Sons. • S . Anahory and D.Murray: Data warehousing, Pearson Education, ASIA. • Jiawei Han & Micheline Kamber: Data Mining Concepts & Techniques, Harcourt India PVTLtd. (Morgan Kaufmann Publishers). • Michall Corey, M.Abbey, I Azramson & Ben Taub: Oracle 8i Building Data Ware Housing,TMH. • I.H. Whiffen: Data Mining, Practical Machine Cearing tools & techniques with Java (Morgan Kanffmen). • Sima Yazdanri & Shirky S. Wong: Data Ware Housing with oracle. • A.K. Pujari: Data Mining Techniques, University Press. • IBM An Introduction to Building the Data Warehouse, PHI Publication. • Pieter Adriaans Dolf Zantinge: Data Mining, Addition Wesley.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	2	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	2	2	3	3	3	3	2	3	3
CLO ₄	3	1	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	3rd		
Nature of Course/Course Composition	Theory		
Name of the Course	Scripting Technology		
Course Code	26L6.5CSC-303		
Course Type	DEC1		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CO1: Write PHP scripts to handle HTML forms. CO2: Write regular expressions including modifiers, operators, and Meta characters. CO3: Create PHP programs that use various PHP library functions, and that manipulate files and directories. CO4: Demonstrate the basic techniques used to create scripts for automating system administrative tasks.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	Contact Hours/ CLOs	
I	Introduction to PHP, Evaluation of PHP, Basic Syntax, Defining variable and constant, PHP Data type, Operator and Expression. Decisions and loop Making Decisions, Doing Repetitive task with looping, Mixing Decisions and looping with Html.	15/ CLO1	
II	Function: Define a function, Call by value and Call by reference, Recursive function, String Creating and accessing, String Searching & Replacing String, Formatting String, String Related Library function. Array Anatomy of an Array, Creating index based and Associative array Accessing array, Element Looping with Index based array, Looping with associative array using each () and for each(), Some useful Library function.	15/ CLO2	
III	TCL: The TCL phenomena, Philosophy, Structure, Syntax, Parser, Variables and data in TCL, Control flow, Data structures, Simple	15/ CLO3	

	input/output, Procedures, Working with Strings, Patterns, Files and Pipes, Example code..	
IV	Advanced TCL: The eval, source, exec and up level commands, Libraries and packages, Namespaces, Trapping errors, Eventdriven programs, Making applications ‘Internetaware’, ‘Nutsandbolts’ internet programming, Security issues, running untrusted code, The C interface.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• The Joy of PHP Programming: A Beginner’s Guide – by Alan Forbes • PHP & MySQL Novice to Ninja – by Kevin Yank • Head First PHP & MySQL – by Lynn Beighley & Michael Morrison • Learning PHP, MySQL, JavaScript, and CSS: A StepbyStep Guide to Creating Dynamic Websites – by Robin Nixon • Clif Flynt, “Tcl/Tk: A Developer’s Guide”, 2003, Morgan Kaufmann Series. • John Ousterhout, “Tcl and the Tk Toolkit”, 2 nd Edition, 2009, Kindel Edition.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	2	3	3	3	3	3
CLO ₂	2	3	2	3	3	3	2	1	3
CLO ₃	2	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	

Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	3rd		
Nature of Course/Course Composition	Theory		
Name of the Course	Mobile Computing		
Course Code	26L6.5-CSC-304		
Course Type	DEC1		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CO1: Describe the evolution of Mobile computing from existing technologies. CO2: Implement different types of Virtualization technologies and Service Oriented Architecture systems. CO3: Elucidate the concepts of Mobile Computing architecture and its design challenges. CO4: Analyze the issues in Resource provisioning and Security governance in Mobile computing.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics		Contact Hours/ CLOs
I	Introduction to Mobile Computing: Basic Concepts: Definitions, characteristics, applications. Mobile Devices: Types, architectures, operating systems (Android, iOS). Mobile Communication: Cellular networks, WiFi, Bluetooth, NFC.		15/ CLO1
II	Mobile Application Development: Android Development: Basics, components (activities, services, broadcast receivers, And content providers), UI design. IOS Development: Basics, components (view controllers, storyboards, UI elements), UI design. Cross Platform Development: Tools (React Native, Flutter), advantages, challenges.		15/ CLO2
III	Mobile Security: Security Challenges: Threats, vulnerabilities, attacks. Security Mechanisms: Authentication, encryption, secure coding		15/ CLO3

	practices. Mobile Device Management (MDM): Concepts, tools, policies. Cloud Computing introduction: Basic structure of cloud computing, working model for cloud computing deployment and service model, benefits, risks, limitations, components, Types of cloud Environment, characteristics, architecture from front end and back end, Evolution. Applications (Business, Data storage & backup, Management, Social etc.)	
IV	Advanced Mobile Computing Topics: Mobile Cloud Computing: Concepts, architectures, applications. Internet of Things (IoT): Concepts, architectures, applications. Emerging Trends: 5G, edge computing, augmented reality (AR), virtual reality (VR).	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• "Mobile Computing: Principles and Practice" by Mahesh P. Matha • "Mobile Computing" by Raj Kamal • "Handbook of Mobile Computing" edited by Ivan Stojmenovic • "Mobile Computing: Technology, Applications, and Service Creation" by Asoke K. Talukder, Hasan Ahmed, and Roopa R. Yavagal • "Mobile Computing" by Tomasz Imielinski and Henry F. Korth (Editors) • "Fundamentals of Mobile and Pervasive Computing" by Frank Adelstein, Sandeep K. S. Gupta, Golden Richard III, and Loren Schwiebert • "Mobile Computing: Implementing Pervasive Information and Communications Technologies" by Peter J. Radcliffe		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	1	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	1	2	3	3	2	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	3rd		
Nature of Course/Course Composition	Theory		
Name of the Course	Network Security & Cryptography		
Course Code	26L6.5-CSC-306		
Course Type	DEC2		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO1: classify the symmetric encryption techniques CLO2: Illustrate various Public key cryptographic techniques CLO3: Evaluate the authentication and hash algorithms. CLO4: Discuss authentication applications		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics		Contact Hours/ CLOs
I	Introduction: Plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography		15/ CLO1
II	Symmetric Key Algorithms: Introduction, algorithms types and modes, DES, AES. Asymmetric Key Algorithms: Introduction, history of asymmetric key cryptography, RSA symmetric and asymmetric key cryptography together, Digital signature.		15/ CLO2
III	Internet Security Protocols: Basic concepts, Secure Socket Layer (SSL), Transport Layer Security (TLS), and Secure Hyper Text Transfer protocol (SHTTP), Time Stamping		15/ CLO3
IV	Protocol (TSP), Secure Electronic Transaction (SET), S SL versus SET, Electronic Money, Email Security.		15/ CLO4
	Total Contact hours		60
Evaluation Methods			

Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• Cryptography and Network Security, 2nd Edition by Atul Kahate, TMH • Network Management Principles & Practices by Subramanian, Mani (AWL) • SNMP: A Guide to Network Management (MGH) • Telecom Network Management by H.H. Wang (MGH) • Network Management by U. Dlack (MGH)		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	2	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	3	2	3	1	3	3	2	1	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	3rd		
Nature of Course/Course Composition	Theory		
Name of the Course	Internet of Things (IoT)		
Course Code	26L6.5-CSC-307		
Course Type	DEC2		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Able to understand the application areas of IOT. CLO2: Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks. CLO3: Able to understand building blocks of Internet of Things and characteristics. CLO4: Implement interfacing of various sensors with Arduino/Raspberry Pi.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	Contact Hours/ CLOs	
I	Introduction of IoT, Importance of IoT, Elements of an IoT ecosystem, Technology drivers, Business drivers, Sensors, Transducers, Sensor Features, Sensor Resolution, Sensor Classes, Analog and Digital Sensors, Scalar Sensors, Vector Sensors, Types of Sensors, Actuation, Types of Actuator, Components of IoT, IoT Gateways, UAV Networks, IPv4 and IPv6, IoT vs M2M, IoT vs WoT..	15/ CLO1	
II	Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – 6LoWPANs, CoAP, XMPP, AMQP, MQTT, SMQTT, RPL, IEEE802.15.4, Zigbee– Network layer – APS layer – Security	15/ CLO2	
III	HART and Wireless HART, NFC, Bluetooth, L2CAP, Piconet, RFComm, SDP, Z Wave, ISO 100.11A, GFSK, WSN, WMSN, Nano networks, Device Interoperability, Introduction to Arduino IDE, Arduino Code	15/ CLO3	

	Basics, Types of Arduino Board, Sketch Structure, Libraries, Loops, Control Statements, Operators.	
IV	Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms/middleware.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• Vijay Madisetti, Arshdeep Bahga,” Internet of Things A HandsOn Approach”,2014. • Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013, Daniel Kellmereit, “The Silent Intelligence: The Internet of Things”. 2013, ISBN 0989973700		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	2	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	1	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of the Programme	M. Sc. Computer Science		
Semester	3rd		
Nature of Course/Course Composition	Practical		
Name of the Course	Practical-5 (Tensor Flow)		
Course Code	26L6.5-CSC-309		
Course Type	PC5		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Develop and Train Machine Learning Models: Design, build, and train machine learning models using TensorFlow, including both supervised and unsupervised learning techniques. CLO2: Implement Deep Learning Architectures: Apply TensorFlow to create and implement deep learning architectures, such as neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs). CLO3: Optimize Model Performance: Utilize TensorFlow's tools and techniques for model optimization, including hyperparameter tuning, regularization, and performance evaluation metrics. CLO4: Deploy TensorFlow Models: Learn to deploy trained TensorFlow models into production environments using TensorFlow Serving, TensorFlow Lite, or TensorFlow.js for various applications.		
	Theory	Practical	Total
Credits	0	4	4
Teaching hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Duration (in Hours)	0	03	
Part B- Contents of the Course			
<u>Instructions for Examiner:</u>			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 40.			
Unit	Topics	Contact Hours/ CLOs	
I	Introduction to Tensor Flow and Machine Learning, Overview of machine learning, Introduction to Tensor Flow, Installation and setup, Tensor Flow architecture, Tensor Flow Basics, Tensors and operations, Variables and placeholders, Data pipelines, Practical exercises	30/CLO1	
II	Building Neural Networks, Introduction to neural networks, Building a simple neural network, Activation functions, Practical exercises, Training Neural Networks, Loss functions and optimization, Backpropagation,	30/CLO2	

	Training and evaluation, Practical exercises	
III	Convolutional Neural Networks (CNNs), Introduction to CNNs, Building CNNs with Tensor Flow, Image classification, Practical exercises, Recurrent Neural Networks (RNNs), Introduction to RNNs, Building RNNs with Tensor Flow, Sequence prediction, Practical exercises, Advanced Tensor Flow Techniques, Transfer learning, Fine-tuning models, Tensor Flow Hub, Practical exercises	30/CLO3
IV	Tensor Flow for Natural Language Processing (NLP), Introduction to NLP, Text pre-processing, Building NLP models with Tensor Flow, Practical exercises, Tensor Flow for Time Series Analysis, Introduction to time series analysis, Building time series models, Forecasting with Tensor Flow, Practical exercises, Advanced Topics and Project Work, Advanced Tensor Flow features, Integration with other tools, Capstone project: Design and implement a machine learning solution using Tensor Flow	30/CLO4
	Contact Hours	120
Evaluation Methods		
Internal Assessment	MM-30	End Term Examination: 70
Class Participation:	5	Lab record
Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce
Mid-Term Exam:	15	Write-up and exam of the practical
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
- HandsOn Machine Learning with ScikitLearn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Third Edition, Aurélien Géron - Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models, Joseph Babcock - Beginning with Deep Learning Using TensorFlow: A Beginners Guide to TensorFlow and Keras for Practicing Deep Learning Principles and Applications, Mohan K Silaparasetty - Advanced Natural Language Processing with TensorFlow 2, Ashish Bansal		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	2	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	120
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	120

Part A – Introduction			
Name of the Programme	M. Sc. Computer Science		
Semester	3rd		
Nature of Course/Course Composition	Practical		
Name of the Course	Practical-6 (Microsoft Power Automate)		
Course Code	26L6.5-CSC-310		
Course Type	PC6		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Create Automated Workflows: Design and implement automated workflows using Microsoft Power Automate to streamline business processes and improve efficiency by automating repetitive tasks. CLO2: Integrate with Various Services: Connect Power Automate with a range of services and applications, including Microsoft 365, third-party APIs, and other data sources, to enable seamless data flow and process automation. CLO3: Utilize Triggers and Actions: Develop proficiency in using triggers and actions to define and execute automated processes, including conditional logic, loops, and error handling. CLO4: Monitor and Optimize Flows: Apply techniques to monitor the performance and health of automated workflows, analyse execution history, and optimize flows for reliability and efficiency.		
	Theory	Practical	Total
Credits	0	4	4
Teaching hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Duration (in Hours)	0	03	
Part B- Contents of the Course			
<u>Instructions for Examiner:</u>			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes. The maximum marks for the write-up and execution of the practical will be 40.			
Unit	Topics	Contact Hours/ CLOs	
I	Introduction to Power Automate, Overview of Power Automate, Setting up Power Automate, Power Automate interface and architecture, Creating Basic Flows, Introduction to flows, Creating and managing flows, Triggering flows, Practical exercises, Working with Data, Connecting to data sources, Data manipulation and transformation, Using variables and expressions Practical exercises	30/CLO1	
II	Advanced Flow Techniques, Conditional logic, Looping and iteration,	30/CLO2	

	Error handling, Practical exercises, Integrating with Other Services, Connecting to Microsoft services, Integrating with third-party services, Using connectors, Practical exercises, Power Automate Desktop, Introduction to Power Automate Desktop, Creating desktop flows, Automating desktop applications, Practical exercises	
III	Robotic Process Automation (RPA), Introduction to RPA, Building RPA solutions, Managing RPA bots, Practical exercises, Monitoring and Managing Flows, Monitoring flow performance, Troubleshooting and debugging, Best practices for flow management, Practical exercises	30/CLO3
IV	Security and Compliance, Security best practices, Compliance and governance, Data protection, Practical exercises, Advanced Topics and Project Work, Advanced Power Automate features, Integration with other automation tools, Capstone project: Design and implement an automated solution	30/CLO4
	Contact Hours	120
Evaluation Methods		
Internal Assessment	MM-30	End Term Examination: 70
Class Participation:	5	Lab record
Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce
Mid-Term Exam:	15	Write-up and exam of the practical
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
- Workflow Automation with Microsoft Power Automate, Aaron Guilmette - Learn Microsoft Power Apps Second Edition, Matthew Weston - Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool UiPath		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	1	2	3	3	3	3	2	S	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	120

Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	120

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	3rd		
Nature of Course/Course Composition	Theory		
Name of the Course	Python Programming		
Course Code	26L6.5-OEC-311		
Course Type	OEC		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CO1: Exploring the different ways of running Python. CO2: Teach the students to deal with real world data by importing data and performing various data analysis operations.		
	Theory	Practical	Total
Credits	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Duration (in Hours)	02	0	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 07 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
Unit	Topics		Contact Hours/CLOs
I	Introduction to Python Programming, History of Python, its features, Scope of Python, Downloading and installing Python, Python code execution process, run a simple program on Python interpreter and IDLE. The concept of data types; variables, assignments; numerical types; arithmetic operators and expressions; comments in the program. Conditions, Boolean logic, logical operators; ranges; Control statements: if else, loops (for, while); short circuit (lazy) evaluation, Lists, tuples, and dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries		15/CLO1
II	Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modelling, inheritance, polymorphism, operator overloading; exception handling, try block. Installing and exploring different python libraries used in Graphical User Interface design, Basics of File handling in python, Introduction to Matplotlib		15/CLO2

	Total Contact hours	30
Evaluation Methods		
Internal Assessment: 15 Marks		End Term Examination: 35 Marks
• Class Participation:	5	Written Examination: 35
• Seminar/presentation/assignment/quiz/class test etc.:	5	
• Mid-Term Exam:	5	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• Fundamentals of Python: First Programs Author: Kenneth Lambert Publisher: Course Technology, Cengage Learning, 2012 ISBN13:9781111822705 • Michael Urban and Joel Murach, Python Programming, Shroff /Murach,2016 • Mark Lutz, Programming Python, O'Reilly, 4th Edition, 2010 • Sheetal Taneja & Naveen Kumar, Python Programming A Modular Approach with Graphics, Database, Mobile and Web Applications, Based on Python 3.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	30
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	30

Semester IV

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	4th		
Nature of Course/Course Composition	Theory		
Name of the Course	Machine Learning & Generative AI		
Course Code	26L6.5-CSC-401		
Course Type	DEC3		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO1: Exploring the different ways of running Python. CLO2: Teach the students to deal with real world data by importing data and performing various data analysis operations. CLO3: Plotting the data for data visualization. CLO4: How to install python software and IDEs.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	Contact Hours/ CLOs	
I	Basic Concepts: Definitions, types of learning (supervised, unsupervised, reinforcement), applications. Supervised Learning: Linear regression, logistic regression, decision trees, and support vector machines. Unsupervised Learning: Clustering (kmeans, hierarchical), dimensionality reduction (PCA, tSNE). Reinforcement learning: Agents and Environments, States, Actions, and Rewards, Policy, Value Function, Multi Agent RL (MARL), Hierarchical RL, Model Based, Model Free RL, Meta RL, Offline RL, Curiosity Driven RL etc.	15/ CLO1	
II	Neural Networks: Perceptron, multilayer perceptron, back propagation. Deep Learning: Convolutional neural networks (CNNs), recurrent neural networks (RNNs), long short term memory (LSTM). Training Techniques: Optimization algorithms (SGD, Adam), regularization, and dropout.	15/ CLO2	

III	Generative Models: Autoencoders, variational autoencoders (VAEs), generative adversarial networks (GANs). Applications: Image generation, text generation, style transfer. Advanced Topics: Transformer models, GPT, BERT, and diffusion models.	15/ CLO3
IV	Model Evaluation: Metrics (accuracy, precision, recall, F1score), cross validation, hyper parameter tuning. Deployment: Model serving, monitoring, scaling. Ethics and Fairness: Bias, fairness, interpretability, ethical considerations.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• <i>Jake VanderPlas</i>:Python Data Science Handbook. Publisher(s): O'Reilly Media, Inc. 2016.ISBN: 9781491912058. • U Dinesh Kumar ManaranjanPradhan:Machine Learning using Python Paperback, Wiley,2019. • AbhishekVijayvargia:Machine Learning with Python Language Paperback, BPB Pulications 2018. • Kareem Alkaseer:Machine Learning & Big Data. • Wes Mckinney:Python for Data Analysis, 2e Paperback, Kindle Edition, 2017. • Generative Deep Learning, Teaching Machines to Paint, Write, Compose, and Play by David Foster · 2019		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	1	3	2	3
CLO ₃	1	2	3	3	1	3	2	2	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	

Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	4th		
Nature of Course/Course Composition	Theory		
Name of the Course	Digital Forensic		
Course Code	26L6.5-CSC-402		
Course Type	DEC3		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Understand the fundamental concepts of digital forensics. CLO2: Apply data acquisition and analysis techniques. CLO3: Investigate network and mobile device security incidents. CLO4: Analyze malware and respond to security incidents effectively.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
Instructions for Paper- Setter:			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	Contact Hours/ CLOs	
I	Basic Concepts: Definitions, types of digital forensics (computer, network, mobile), forensic process. Legal Aspects: Laws, regulations, standards, chain of custody. Forensic Tools: Software and hardware tools, open source tools, commercial tools.	15/ CLO1	
II	Data Acquisition: Imaging, cloning, live acquisition, volatile data collection. File Systems: FAT, NTFS, text, HFS, file system analysis. Data Recovery: Techniques, tools, deleted file recovery, formatted drive recovery.	15/ CLO2	
III	Network Forensics: Packet analysis, log analysis, intrusion detection, and network traffic analysis. Mobile Forensics: Mobile device architecture, data acquisition, analysis, tools. Cloud Forensics: Challenges, techniques, tools, legal considerations.	15/ CLO3	
IV	Malware Analysis: Static and dynamic analysis, reverse engineering, tools. Incident Response: Preparation, detection, containment, eradication,	15/ CLO4	

	recovery. Reporting and Presentation: Documentation, report writing, presenting findings in court.	
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
- Decrypting Digital Evidence, A Deep Dive into Forensic Analysis, By Grayson Rivera - Basic Understanding of Digital Forensic Investigations, By Randy L. Davis Jr.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	1	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	4th		
Nature of Course/Course Composition	Theory		
Name of the Course	Soft Computing		
Course Code	26L6.5-CSC-403		
Course Type	DEC3		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Grasp core principles: Students will understand the fundamental concepts behind fuzzy logic, artificial neural networks, and genetic algorithms. CLO2: Apply core functionalities: Students will be able to explain the components and functionalities of each computational intelligence paradigm. CLO3: Solve specific problems: Students will gain the ability to apply fuzzy logic and neural networks to solve problems in decision making, pattern recognition, classification, regression, and clustering. CLO4: Optimize and search: Students will understand how genetic algorithms work and how to apply them for optimization and search tasks, including their role in machine learning.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
Instructions for Paper- Setter:			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics		Contact Hours/ CLOs
I	Basic Concepts: Definitions, components (fuzzy logic, neural networks, genetic algorithms), applications. Fuzzy Logic: Fuzzy sets, membership functions, fuzzy rules, fuzzy inference systems. Applications: Control systems, decision making, and pattern recognition.		15/ CLO1

II	Artificial Neural Networks: Architecture, learning algorithms, backpropagation. Types of Neural Networks: Feedforward, recurrent, convolutional. Applications: Classification, regression, clustering.	15/ CLO2
III	Genetic Algorithms: Representation, selection, crossover, mutation, fitness function. Other Evolutionary Algorithms: Genetic programming, differential evolution, particle swarm optimization. Applications: Optimization, search problems, machine learning.	15/ CLO3
IV	NeuroFuzzy Systems: Concepts, architectures, learning algorithms. GeneticFuzzy Systems: Concepts, architectures, applications. Applications: Control systems, robotics, and data mining.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• M. Mitchell: An Introduction to Genetic Algorithms, Prentice-Hall. 38 • Timothy J.Ross: Fuzzy Logic with Engineering Applications, McGraw-Hill. • Davis E.Goldberg: Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley. • S. Rajasekaran and G.A.V.Pai: Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI. • D. E. Goldberg: Genetic Algorithms in Search, Optimization, and Machine Learning, Addison.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	2	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	

Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	4th		
Nature of Course/Course Composition	Theory		
Name of the Course	Network Security & Cryptography		
Course Code	26L6.5-CSC-405		
Course Type	DEC4		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Articulate core security principles: Explain the security goals (confidentiality, integrity, availability) and identify common threats, vulnerabilities, and attacks on information systems. CLO2: Analyze security services and mechanisms: Describe and differentiate between various security services (authentication, authorization, nonrepudiation, access control) and mechanisms (firewalls, IDS/IPS) used to achieve them. CLO3: Apply cryptographic techniques: Understand the principles of classical cryptography, symmetric and asymmetric key cryptography (DES, AES, RSA, ECC), and their applications in securing communication channels. CLO4: Evaluate secure communication protocols: Analyze and compare secure communication protocols like SSL/TLS, IPsec, VPNs, and email security solutions (PGP, S/MIME).		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics		Contact Hours/ CLOs
I	Basic Concepts: Definitions, security goals (confidentiality, integrity, availability), threats, vulnerabilities, attacks. Security Services: Authentication, authorization, nonrepudiation, access control.		15/ CLO1

	Security Mechanisms: Firewalls, intrusion detection systems (IDS), intrusion prevention systems (IPS)	
II	Classical Cryptography: Substitution ciphers, transposition ciphers, cryptanalysis. Symmetric Key Cryptography: DES, AES, block cipher modes of operation. Asymmetric Key Cryptography: RSA, Diffie Hellman key exchange, elliptic curve cryptography (ECC).	15/ CLO2
III	Secure Communication Protocols: SSL/TLS, IPsec, VPNs. Email Security: PGP, S/MIME. Wireless Security: WEP, WPA, WPA2, security in mobile networks.	15/ CLO3
IV	Public Key Infrastructure (PKI): Certificates, certificate authorities, digital signatures. Cryptographic Hash Functions: MD5, SHA family, HMAC. Emerging Trends: Quantum cryptography, blockchain security, zero trust architecture.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS: • MAIWALD and ERIC, Fundamentals of Network Security, McGraw Hill, 2010 • Cryptography and Network Security, 2nd Edition by Atul Kahate, TMH • Network Management Principles & Practices by Subramanian, Mani (AWL) • SNMP: A Guide to Network Management (MGH) • Telecom Network Management by H.H. Wang (MGH) • Network Management by U. Dlack (MGH)		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	1	2	3	3	3	3	2	S	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	4th		
Nature of Course/Course Composition	Theory		
Name of the Course	Cyber Physical System & Security		
Course Code	26L6.5-CSC-406		
Course Type	DEC4		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO1: Understanding core concepts, components, and applications. CLO2: Designing and analyzing CPS using modeling and security considerations. CLO3: Implementing communication protocols and network architectures. CLO4: Addressing real-time constraints and emerging trends in CPS.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	Contact Hours/ CLOs	
I	Basic Concepts: Definitions, characteristics, applications, CPS architecture. Components: Sensors, actuators, embedded systems, communication networks. CPS Design: Modeling, simulation, verification, validation.	15/ CLO1	
II	Communication Protocols: Wired (Ethernet, CAN), wireless (WiFi, Zigbee, Bluetooth). Network Architectures: Centralized, decentralized, hybrid. Real-time Systems: Concepts, scheduling, real-time communication.	15/ CLO2	
III	Security Challenges: Threats, vulnerabilities, attacks. Security Mechanisms: Authentication, encryption, secure communication. Intrusion Detection: Techniques, tools, anomaly detection.	15/ CLO3	

IV	IoT and CPS: Integration, applications, challenges. Smart Grids: Concepts, architectures, security. Emerging Trends: Autonomous systems, smart cities, industrial IoT.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• Cyber Security and Business Analysis: An essential guide to secure and robust systems by <u>Bindu Channaveerappa</u>. • Principles of Cyber-Physical Systems Paperback – Import, by Rajeev Alur • Cyber-Physical Systems: A Model-Based Approach Hardcover – Import, by Walid M. Taha, Abd-Elhamid M. Taha , Johan Thunberg.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	2	3	2	3	3	1	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	2	2	3	2	3	3	2	2	3
CLO ₄	3	3	2	3	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	4th		
Nature of Course/Course Composition	Theory		
Name of the Course	Biometric Security		
Course Code	26L6.5-CSC-407		
Course Type	DEC4		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Grasp core concepts: Understand biometrics, different traits used, and system architecture. CLO2: Design and analyze systems: Apply enrollment, feature extraction, matching, and decision-making processes. CLO3: Evaluate specific technologies: Analyze fingerprint, face, and iris recognition techniques and algorithms. CLO4: Mitigate security risks: Identify threats and countermeasures like liveness detection and template protection.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
Instructions for Paper- Setter:			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	Contact Hours/ CLOs	
I	Basic Concepts: Definitions, characteristics, applications, biometric system architecture. Biometric Traits: Physiological (fingerprint, face, iris), behavioral (voice, gait, signature). Biometric System Design: Enrollment, feature extraction, matching, decision making.	15/ CLO1	
II	Fingerprint Recognition: Techniques, sensors, feature extraction, matching algorithms. Face Recognition: Techniques, sensors, feature extraction, matching algorithms. Iris Recognition: Techniques, sensors, feature extraction, matching algorithms.	15/ CLO2	

III	Security Challenges: Spoofing, replay attacks, template security. Countermeasures: Liveness detection, multifactor authentication, template protection. Privacy Issues: Data privacy, regulatory compliance (GDPR, HIPAA).	15/ CLO3
IV	Multimodal Biometrics: Concepts, architectures, fusion techniques. Biometric Cryptosystems: Concepts, architectures, applications. Emerging Trends: Deep learning for biometrics, mobile biometrics, and biometric standards.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
- Implementing Biometric Security (Wiley Red Books) by John Chirillo , Scott Blaul. - Introduction to Biometrics by by Anil K. Jain , Arun A. Ross , Karthik Nandakumar. "Biometrics: Advanced Identity Verification: The Complete Guide" by Julian Ashbourn.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	2	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	2	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	4th		
Nature of Course/Course Composition	Theory		
Name of the Course	Blockchain Technology and Quantum Computing		
Course Code	26L6.5-CSC-409		
Course Type	DEC5		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1. Explain core concepts: Describe the history, characteristics, benefits, and limitations of blockchain technology. CLO2. Analyze transactions and networks: Understand the role of transactions, blocks, distributed systems, peer to peer networks, and cryptography in blockchain operation. CLO3. Differentiate blockchain types: Distinguish between public, private, and consortium blockchains and their application areas. CLO4. Grasp blockchain protocols: Explain the concepts of digital signatures, digital wallets, mining, and consensus mechanisms (Proof of Work, Proof of Stake).		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics		Contact Hours/ CLOs
I	Introduction: History of Blockchain, Overview, Characteristics, Benefits, Limitations Transactions and Blocks, Distributed Systems, Peer to Peer Network, Public key Cryptography,		15/ CLO1
II	Hashing. Types of Blockchain: Public Blockchain, Private Blockchain, Consortium Blockchain, Application Areas, Digital Signature, Digital Wallet.		15/ CLO2

	Blockchain Protocol, Currency, Mining, Consensus: Proof of Work, Proof of Stake, Byzantine Generals' Computing Problems, 51% attack, Double Spending Problem. Tiers of Blockchain Technology: Blockchain 1.0, Blockchain 2.0, Blockchain 3.0, Blockchain 4.0.	
III	Bitcoin Blockchain: Structure, Operations, Features, Consensus Model, Incentive Model, Token, ERC20, ERC721 Ethereum: Introduction, Structure, Operations, Smart Contracts, Blockchain Development on Ethereum, creating a Block, Adding the Hash Function to the Block, Ethereum Virtual Machine Creating Smart Contracts, Bitcoin vs Ethereum.	15/ CLO3
IV	Introduction to Quantum Computation: Historical background of Quantum Computing, Qbits, and Bloch sphere representation of a qubit, multiple qubits. Basic mathematics for Quantum Computing. Quantum Circuits: single qubit gates, multiple qubit gates, design of quantum circuits. Quantum Information and Cryptography: Comparison between classical and quantum information theory, Grover & Shor Algorithm, Bell states.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
- Blockchain Technology: Algorithms and Applications by Asharaf S., Sivadas Neelima , Adarsh S., Franklin John. - Quantum Computing and Blockchain in Business by Arun Krishnakumar - Quantum and Blockchain for Modern Computing Systems: Vision and Advancements: Quantum and Blockchain Technologies: Current Trends and Challenge by Adarsh Kumar , Sukhpal Singh Gill Ajith Abraham .		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	2	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	4th		
Nature of Course/Course Composition	Theory		
Name of the Course	Wireless Technology		
Course Code	26L6.5-CSC-410		
Course Type	CSC410		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Discuss the Fundamentals of Wireless Communication. CLO2: Comprehend the Fundamental Principles of Wide Area Wireless Networking Technologies and their Applications. CLO3: Explain Wireless Metropolitan and Local Area Networks. CLO4: Describe Wireless Personal Area Networks and Ad hoc Networks		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	Contact Hours/ CLOs	
I	Digital Modulation Techniques including ASK, FSK, BPSK, and QPSK; Electromagnetic Spectrum; Multiplexing Techniques such as FDM, TDM, and OFDM; OSI and TCP/IP Models; Need for Security, Types of Security Threats and Attacks; Introduction to Wireless Communication and Applications; Multiple Access Techniques including FDMA, TDMA, CDMA, and OFDMA along with their advantages and disadvantages; Spread Spectrum Techniques including DSSS and FHSS; Evolution of Wireless Generations from 1G to 5G based on technological differences and advancements; 5G systems covering key requirements, drivers, use cases, and Massive MIMO. Self-Learning Topics: QAM, MSK, and GMSK.	15/ CLO1	
II	Principle of Cellular Communication including Frequency Reuse Concept, Cluster Size, System Capacity, Co-channel Interference, and Signal Quality; GSM System Architecture, GSM Radio Subsystem, and Frame	15/ CLO2	

	Structure; GPRS and EDGE System Architecture; UMTS Network Architecture; CDMA2000 Network Architecture; LTE Network Architecture; Overview of LoRa and LoRa WAN. Self-Learning Topics: IS-95.	
III	IEEE 802.16 (WiMAX) including Mesh Mode, Physical Layer, and MAC Layer; IEEE 802.11 (Wi-Fi) covering Architecture, Protocol Stack, Enhancements, and Applications; IEEE 802.15.1 (Bluetooth) including Piconet, Scatternet, and Protocol Stack; IEEE 802.15.4 (ZigBee) covering WPAN Device Architecture and Protocol Stack; Wireless Sensor Networks (WSN) including Design Considerations, Issues and Challenges, Architecture, and Applications; Introduction to Ad Hoc Networks such as MANET and VANET, their Characteristics, Applications, Advantages, and Limitations; Overview of E-VANET (Electrical Vehicular Ad Hoc Networks). Self-Learning Topics: WLL (Wireless Local Loop) and HR-WPAN (UWB).	15/ CLO3
IV	Security in GSM, UMTS Security, Bluetooth Security, WEP, and WPA2; Cisco Unified Wireless Network; Designing Wireless Networks using Lightweight Access Points (LAPs) and Wireless LAN Controllers (WLCs). Self-Learning Topics: Study of Wireless Security Tools and Cisco Unified Wireless Network Mobility Services.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS: • Wireless Communications: Principles and Practice by Theodore S. Rappaport. • Wireless Communications by Andrea Goldsmith. • Mobile Communications by Jochen Schiller. • Wireless and Mobile Networks by William Stallings. • Data Communications and Networking by Behrouz A. Forouzan. • Computer Networks by Andrew S. Tanenbaum and David J. Wetherall. • Wireless Communications and Networks by William Stallings.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	1	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	1	2	3	3	3	3	2	2	3
CLO ₄	3	3	2	1	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	4th		
Nature of Course/Course Composition	Theory		
Name of the Course	Edge computing		
Course Code	26L6.5-CSC-411		
Course Type	CSC411		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1: Understanding Security and privacy issues and their management in Edge and Fog Computing. CLO2: Network Slicing Management in Edge and Fog, Software Defined Networking and application in Fog Computing. CLO3: Introduction to RaspberryPi and its hardware layout. CLO4: Review underlying technologies, limitations, and challenges along with future research direction and discuss generic conceptual framework for optimization problems in fog computing.		
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	03		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	Contact Hours/ CLOs	
I	Introduction to Edge Computing Edge computing purpose and definition, Edge computing applications, Edge computing Architecture. Introduction to Fog Computing: Fog Computing,	15/ CLO1	
II	Characteristics, Issues and challenges. Fog Computing Architecture. Applications of Fog Computing like health, transportation, smart cities, healthcare and vehicles. Edge vs Fog Computing. Fog Computing Communication Technologies: Introduction, IEEE 802.11,4G,5G standards, WPAN, Short-range Technologies, LPWAN and other medium and Long-range Technologies.	15/ CLO2	
III	Network Slicing in 5G, Network Slicing Management in Edge and Fog, Middleware for Fog and Edge Computing, Need for Fog and Edge	15/ CLO3	

	Computing Middleware, Clusters for Lightweight Edge Clouds. RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout and Pinouts, Operating Systems on RaspberryPi.	
IV	Fog computing requirements when applied to IoT: Scalability, Interoperability, Fog IoT architectural model, Challenges on IoT Stack Model via TCP/IP Architecture, Data Management, filtering, Event Management, Device Management, cloudification, virtualization, security and privacy issues. Integration of IoT devices with fog and cloud computing: Advantages and challenges.	15/ CLO4
	Total Contact hours	60
Evaluation Methods		
Internal Assessment: 30 Marks		End Term Examination: 70 Marks
• Class Participation:	5	Written Examination: 70
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya • Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by Rajkumar Buyya and Satish Narayana Srirama • Amir Vahid Dastjerdi and Rajkumar Buyya, —Fog Computing: Helping the Internet of Things Realize its Potential, University of Melbourne. • Sensors, Cloud, and Fog: The Enabling Technologies for the Internet of Things Paperback by Sudip Misra, Subhadeep Sarkar , Subarna Chatterjee. • Flavio Bonomi, Rodolfo Milito, Preethi Natarajan and Jiang Zhu, —Fog Computing: A Platform for Internet of Things and Analytics, Big Data and Internet of Things: A Roadmap for Smart Environments, Studies in Computational Intelligence 546, DOI: 10.1007/9783319050294_7, © Springer International Publishing Switzerland 2014. • Flavio Bonomi, Rodolfo Milito, Jiang Zhu, Sateesh Addepalli, —Fog Computing and Its Role in the Internet of Things, MCC’12, August 17, 2012, Helsinki, Finland. Copyright 2012 ACM 978 1450315197/12/08		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉
CLO ₁	3	1	2	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	3
CLO ₃	1	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	2	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours Devoted
Employability/Entrepreneurship	
Skill Enhancement	60
Communication Development	
Indian Knowledge System	
Environmental Awareness	
Current Issues and Social Awareness	
Women empowerment/ Gender issues	
Public policies	
Technology Development	60

Part A – Introduction			
Name of Programme	M. Sc. Computer Science		
Semester	4th		
Nature of Course/Course Composition	Theory		
Name of the Course	Research Ethics		
Course Code	26L6.5-CSC-413		
Course Type	EEC		
Course Level	600-699		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO1. Grasp core concepts of philosophy: Define philosophy and understand its branches, including ethics. CLO2. Analyze ethical principles: Explore the nature of moral judgment and reactions in the context of science and research.		
	Theory	Practical	Total
Credits	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Duration (in Hours)	02	0	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 07 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
Unit	Topics		Contact Hours/ CLOs
I	Introduction to Philosophy: definition, nature and scope, concept, branches Ethics: definition, moral philosophy, nature of moral judgment and reactions. Ethics with respect to science and research, Intellectual honesty and research integrity Scientific misconducts: Falsification, Fabrication and Plagiarism (FPP) Redundant publications: duplicate and over lapping publications, salami slicing Selective reporting and misrepresentation of data		15/CLO1
II	Publication ethics: definition, introduction and importance Best practices / standard setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest Publication misconduct: Definition, concept, problems that lead to unethical behavior and vice versa, types Violation and publication ethics, authorship and contributor ship Identification of		15/CLO2

	publication misconduct, complaints and appeals Predatory publishers and journals. Open access publications and initiatives SHERPA/RoMEO online recourse to check publisher copyright & self-archiving policies Software tool of identify predatory publications developed by SPPU Journals finder/journals suggestion tools viz. JANE, Elsevier Journals Finder, Springer Journals Suggester, etc. Computing, Machine Learning based security in Fog Computing, Cyber Physical Energy Systems over Fog Computing.	
	Total Contact hours	30
Evaluation Methods		
Internal Assessment: 15 Marks		End Term Examination: 35 Marks
• Class Participation:	5	Written Examination: 35
• Seminar/presentation/assignment/quiz/ class test etc.:	5	
• Mid-Term Exam:	5	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
• Nicolas H. Steneck. Introduction to the Responsible Conduct of Research. Office of • Research Integrity, 2007. Available at: http://ori.hhs.gov/sites/default/files/rcrintro.pdf • The student's Guide to Research Ethics By Paul Oliver Open University Press, 2003. • Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003. • Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN: 9788193948217. • http://www.insaindia.res.in/pdf/Ethics_Book.pdf • Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997. • Bijorn Gustavii: How to write and illustrate scientific papers? Cambridge University Press. • Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008. • Graziano, A., M., and Raulin, M.,L.: Research Methods – A process of Inquiry, Sixth Edition, Pearson, 2007. • Bird, A. (2006). Philosophy of Science. Routledge. • MacIntyre, Alasdair (1967) A Short History of Ethics. London. • P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN: 9789387480865.		

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Technology Development	30