

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

PGDCA

(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 PGDCA programme is a one-year postgraduate diploma that combines theoretical knowledge with practical expertise in computer applications, preparing students to meet diverse computational challenges and contribute to technological innovation in academia, industry, and government sectors. The curriculum emphasizes major courses such as Data Structures and Algorithms, Database Design Concepts, Distributed Operating Systems, Computer Organization and Architecture, Object-Oriented Programming with Java, Computer Graphics and Multimedia, Computer Networks, and Theory of Computation. Practical training is integrated through modules in C++, Microsoft Azure, Java, Tableau Data Visualization, MongoDB, and applied graphics, while seminars enhance communication and research aptitude. The programme also incorporates courses on Constitutional, Human and Moral Values, and IPR to instill ethical and professional responsibility.

The programme seeks to:

- Provide foundational knowledge of computer science concepts, theories, and practices.
- Develop practical skills to design, implement, and evaluate computing solutions for real-world problems.
- Enhance project-based learning through assignments, seminars, and hands-on lab work.
- Foster innovation and critical thinking in addressing technological challenges.
- Prepare students for careers in software development, IT services, database management, web development, and system administration.
- Equip graduates with professional, ethical, and entrepreneurial competencies required in the digital economy.
- Encourage lifelong learning and adaptability to emerging technologies.

By integrating classroom instruction, laboratory work, project-based learning, and internships, PGDCA ensures balanced development of analytical thinking, problem-solving abilities, and adaptability to evolving digital trends. Graduates are well-prepared for careers in software development, database administration, web application development, and IT support, while also being eligible to pursue advanced studies in Computer Science.

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 OBJECTIVES (POs)

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.

Scheme of Examination for Postgraduate Programme

Subject	PGDCA
Total number of Semesters	02
Total Marks	1400
Total Credit	56
Framework	-
Scheme	-

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-PGD-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-PGD-102	Database Design Concepts	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	CC-3	26L6.0-PGD-103	Distributed Operating System	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	CC-4	26L6.0-PGD-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-PGD-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-PGD-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-PGD-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-PGD-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-PGD-202	Computer Graphics & Multimedia	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	CC-7	26L6.0-PGD-203	Computer Networks	4T / 0P	4	4+0+0=4	30+0=30	70+0=70	100	3 Hours
	CC-8	26L6.0-PGD-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-PGD-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-PGD-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+4	34	195	455	650	
	Internship	26L6.0-PGD-207	An internship course of 4 Credits of 4-6 weeks duration during summer vacation after 2nd semester is to be completed by every student. Internships can be either for enhancing the employability or for developing the research aptitude.				50	50	100	

Semester 1

Part A - Introduction			
Name of Programme	PGDCA		
Semester	1st		
Nature of Course/Course Composition	Theory		
Name of the Course	Data structures and algorithms		
Course Code	26L6.0-PGD-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	3	2	3	3	3	3	3	3
CLO ₂	2	1	2	2	3	3	1	2	3
CLO ₃	1	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	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	PGDCA		
Semester	1st		
Nature of Course/Course Composition	Theory		
Name of the Course	Database Design Concepts		
Course Code	26L6.0-PGD-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	2	3	2	3
CLO ₃	3	2	3	3	3	3	2	2	2
CLO ₄	3	3	2	1	2	3	1	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	PGDCA		
Semester	1st		
Nature of Course/Course Composition	Theory		
Name of the Course	Distributed operating system		
Course Code	26L6.0-PGD-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, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Definition and Characteristics:		15/ CLO1

	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	3	2	3	3	3	2	3
CLO ₃	2	2	3	3	3	2	2	1	2
CLO ₄	3	3	2	3	2	3	3	3	1

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	PGDCA		
Semester	1st		
Nature of Course/Course Composition	Theory		
Name of the Course	Computer organization and architecture		
Course Code	26L6.0-PGD-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	2	3	3	2	1
CLO ₃	3	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	1	3	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	PGDCA		
Semester	1st		
Nature of Course/Course Composition	Practical		
Name of the Course	Practical-1 C++		
Course Code	26L6.0-PGD-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		30/CLO1

	with C++ syntax, datatype, variables, strings, functions, and default values in functions, recursion, namespaces, operators, flow control, arrays and pointers.	
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	1	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	2
CLO ₃	1	2	3	3	3	3	2	3	3
CLO ₄	3	3	2	3	2	3	3	3	1

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	PGDCA		
Semester	1st		
Nature of Course/Course Composition	Practical		
Name of the Course	Practical-2 Azure Lab Syllabus		
Course Code	26L6.0-PGD-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 architecture, Setting up an Azure account. Azure Virtual Machines:		30/CLO1

	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			
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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	3	1	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	2	2
CLO ₃	3	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

Semester II

Part A - Introduction			
Name of Programme	PGDCA		
Semester	2nd		
Nature of Course/Course Composition	Theory		
Name of the Course	Object Oriented Programming with Java		
Course Code	26L6.0-PGD-201		
Course Type	CC5		
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: 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			
<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 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. Interfaces and Abstract Classes: Definition, implementation,		15/ CLO2

	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	2	2	3	3	3	3	3	1
CLO ₂	2	3	3	3	3	3	3	2	3
CLO ₃	1	3	3	3	1	3	2	3	3
CLO ₄	3	3	2	1	3	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	PGDCA		
Semester	2nd		
Nature of Course/Course Composition	Theory		
Name of the Course	Computer Graphics & Multimedia		
Course Code	26L6.0-PGD-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,		15/ CLO4

	images, audio, And video), applications. Audio and Video: Audio formats, video formats, compression techniques (JPEG, MPEG). Multimedia Systems: Multimedia hardware, software, multimedia databases.	
	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. • Tosijasu, L.K. : Computer Graphics, Springer-Verlag • S Gokul: Multimedia Magic, BPB Publication. • Bufford: Multimedia Systems, Addison Wesley. • Jeffcoate: Multimedia in Practice, Prentice 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	3	2	3	3	3	3	3	2
CLO ₂	2	3	2	2	3	1	3	2	3
CLO ₃	3	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	PGDCA		
Semester	2nd		
Nature of Course/Course Composition	Theory		
Name of the Course	Computer Networks		
Course Code	26L6.0-PGD-203		
Course Type	CC7		
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:	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			
<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 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 Service (QoS): Concepts, techniques (traffic shaping, policing), protocols (RSVP, DiffServ).		15/ CLO3

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	3	3	3	3	3	3	3
CLO ₂	2	3	2	2	3	3	3	3	1
CLO ₃	1	2	3	3	3	3	3	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	PGDCA		
Semester	2nd		
Nature of Course/Course Composition	Theory		
Name of the Course	Theory of Computation		
Course Code	26L6.0-PGD-204		
Course Type	CC8		
Course Level	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO _{s1}) 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			
<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	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, equivalence with CFGs. Pumping Lemma for CFLs: Applications, proving non context free languages.		15/ CLO2

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	2	2	3	3	3	3	3	3
CLO ₂	2	3	3	2	3	3	3	1	3
CLO ₃	3	2	3	3	3	3	2	2	2
CLO ₄	3	3	2	1	2	1	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	PGDCA		
Semester	2 nd		
Nature of Course/Course Composition	Practical		
Name of the Course	Practical-3 (Tableau Data Visualization)		
Course Code	26L6.0-PGD-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		30/CLO3

	calculations, 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 execution 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	3	3	2	2	3	3	3	2	3
CLO ₃	3	2	3	1	3	1	2	2	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	PGDCA		
Semester	2nd		
Nature of Course/Course Composition	Practical		
Name of the Course	Practical-4(MongoDB)		
Course Code	26L6.0-PGD-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, Indexing strategies, Performance considerations	30/CLO2	

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 execution 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	1	3	3	3	3	3	3
CLO ₂	2	3	2	1	3	3	3	2	2
CLO ₃	3	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