SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

FACULTY OF ENGINEERING & TECHONOLOGY

ORDINANCE No. V-42 (B1)

RELATING TO COURSE CURRICULUM & SYLLABUS OF PG PROGRAM

MASTER OF TECHNOLOGY (M.Tech.) CSE

(Effective from the Session – 2025-26)

Apporved by the Academic Council of the Meeting held on 06 May 2025

Apporved by the Executive Council of the Meeting held on 28 June 2025

Faculty of Engineering & Technology DEAN

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
SUBHARTI INSTITUTE OF TECHNOLOGY AND ENGINEERING
STUDY & EVALUATION SCHEME as per NEP-2020

SWAMI VIVEKANAND

SUBHARTI UNIVERSITY, MEERUT

EVALUATION SCHEME & SYLLABUS
as per NEP 2020

M.TECH. (COMPUTER SCIENCE ENGINEERING)

W.E.F. SESSION 2025-26

SUBHARTI INSTITUTE OF TECHNOLOGY AND ENGINEERING
Subhartipuram, NH-58 Delhi-Haridwar Bypass Road,
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Faculty of Engineering & Technology
DEAN

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
SUBHARTI INSTITUTE OF TECHNOLOGY AND ENGINEERING
STUDY & EVALUATION SCHEME as per NEP-2020
M. Tech. I Year/I Semester (COMPUTER SCIENCE ENGINEERING)
w.e.f. academic Session 2025-26

SEMESTER I: Foundation and Advanced Core Concepts															
S. No.	Course Code	Course Name	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	PCSE-101	Advanced Data Structures	Core Subject	3	1	0	20	10	30	-	70	-	100	4
2	PCSE -102	Research Methodology and IPR	Core Subject	3	1	0	20	10	30	-	70	-	100	4
3	PCSE -103	Distributed Systems	Core Subject	3	1	0	20	10	30	-	70	-	100	4
4	PCSE -115 to PCSE -118	Elective -I	Elective - I	3	0	0	20	10	30	-	70	-	100	3
5	PCSE -119 to PCSE-122	Elective -2	Elective - 2	3	0	0	20	10	30	-	70	-	100	3
6	PCSE -127 to PCSE -129	Open Elective - I	Open Elective - I	3	0	0	20	10	30	-	70	-	100	3
7	PCSE -151	Advanced Data Structures Lab	Lab	0	0	4	-	-	-	15	-	35	50	2
TOTAL													650	23

M. Tech. I Year/II Semester (COMPUTER SCIENCE ENGINEERING)
w.e.f. academic Session 2025-26

SEMESTER I: Foundation and Advanced Core Concepts															
S. No.	Course Code	Course Name	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	PCSE -201	Advance Algorithms	Core Subjects	3	1	0	20	10	30	-	70	-	100	4
2	PCSE -202	Wireless Sensor Networks	Core Subjects	3	1	0	20	10	30	-	70	-	100	4
3	PCSE -203	English for Research Paper Writing	Core Subjects	3	1	0	20	10	30	-	70	-	100	4
4	PCSE -215 to PCSE -218	Elective -3	Elective -3	3	0	0	20	10	30	-	70	-	100	3
5	PCSE -219 to PCSE-222	Elective -4	Elective -4	3	0	0	20	10	30	-	70	-	100	3
6	PCSE -227 to PCSE -229	Open Elective–II	Open Elective–II	3	0	0	20	10	30	-	70	-	100	3
7	PCSE -251	Advance Algorithms Lab	LAB	0	0	4	-	-	-	15	-	35	50	2
8	PCSE -252	Industry Internship	Field Work	-	-	-	-	-	-	50	-	-	50	2
TOTAL													700	25

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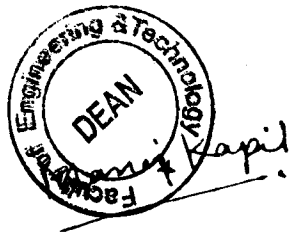
M. Tech. II Year/III Semester (COMPUTER SCIENCE ENGINEERING)
w.e.f. academic Session 2025-26

SEMESTER III														
S. No	Course Code	Course Name	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	PCSE -301	Big Data Analytics & Mining	Core Subjects	3	1	0	20	10	30	-	70	-	100	4
2	PCSE -351	Dissertation Phase -I	Project	0	0	12	-	-	-	100	-	200	300	12
TOTAL													400	16

M. Tech. IInd Year/IV Semester (COMPUTER SCIENCE ENGINEERING)
w.e.f academic Session 2025-26

SEMESTER IV														
S. No	Course Code	Course Name	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	PCSE-451	Dissertation Phase II	Project	0	0	20	-	-	-	200	-	300	500	20
TOTAL													500	20

M.TECH. (PE) TOTAL CREDITS - 84



Electives [Computer Science Engineering]

	Course Code	Course Title
Elective-I	PCSE -115	Advanced Network Principles and Protocols
	PCSE -116	Introduction to Intelligent Systems
	PCSE -117	Data Science
	PCSE -118	Mobile Applications and Services
Elective-II	PCSE -119	Advanced Database Management System
	PCSE -120	Optimization Techniques
	PCSE -121	Parallel Computer Architecture
	PCSE -122	Data Preparation and Analysis
Elective-III	PCSE -215	Cloud Computing Principles
	PCSE -216	Advance Cryptography
	PCSE -217	Advanced Computer Vision
	PCSE -218	Advanced Concepts in Operating Systems
Elective-IV	PCSE -219	Human and Computer Interaction
	PCSE -220	Social Network Mining and Analysis
	PCSE -221	Digital Forensics
	PCSE -222	Advanced Digital Design

Open Electives [Computer Science Engineering]

	Course Code	Course Title
Elective-I	PCSE -127	Business Analytics
	PCSE -128	Industrial Safety
	PCSE -129	Operations Research
Elective-II	PCSE -227	Cost Management of Engineering Projects
	PCSE -228	Composite Materials
	PCSE -229	Waste to Energy

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PCSE-101	Advanced Data Structures	3L:1T:0P	4 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.	K1,K2
CO2	Students should be able to understand the necessary mathematical abstraction to solve problems.	K2, K3
CO3	To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.	K3, K5
CO4	Student should be able to come up with analysis of efficiency and proofs of correctness.	K3, K_4

K1–Remember, K2–Understand, K3 –Apply, K4–Analyze, K5 –Evaluate, K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Algorithms, Performance Analysis- time complexity and Space Complexity. Asymptotic notations, Complexity analysis. Advanced datatypes, Linear List ADT, Array Representation, Linked Representation, Singly linked list-Insertion, deletion, search operations. Double Linked List- Sparse Matrices and their representations.	
Unit-2:	**8**
Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists	
Unit-3:	**8**
Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees	
Unit-4:	**8**
Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.	
Unit -5:	

Faculty of Engg. & Technology M. J. P. Rohilkhand DEAN

Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing. Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem	

Reference Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

PCSE-102	Research Methodology and IPR	3L:1T:0P	4 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Analyze research related information	K1,K2
CO2	Analyze research related information	K3, K5
CO3	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.	K3, K_4
CO4	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.	K3, K_4
CO5	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.	K3, K_4

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	
Unit-2:	**8**
Research Design- Need, Features of good design, Induction and Deduction	
Unit-3:	**8**
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee .	
Unit-4:	**8**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	
Unit-5:	**8**
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	

Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 ndEdition , "Research Methodology: A Step by Step Guide for beginnersHalbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
4. Mayall , "Industrial Design", McGraw Hill, 1992.
5. Niebel , "Product Design". McGraw Hill, 1974.
6. Asimov , "Introduction to Design", Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

PCSE-103	Distributed Systems	3L:1T:0P	4 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain fundamental concepts, models, and architecture of distributed systems	K1, K2
CO2	Understand the principles of inter-process communication, synchronization, and consistency mechanisms	K2
CO3	Apply distributed algorithms for election, mutual exclusion, and clock synchronization	K3
CO4	Analyze distributed file systems, fault tolerance, and recovery strategies	K4
CO5	Evaluate the performance and scalability of distributed middleware and communication protocols	K5
CO6	Design scalable and secure distributed applications or system components	K6

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

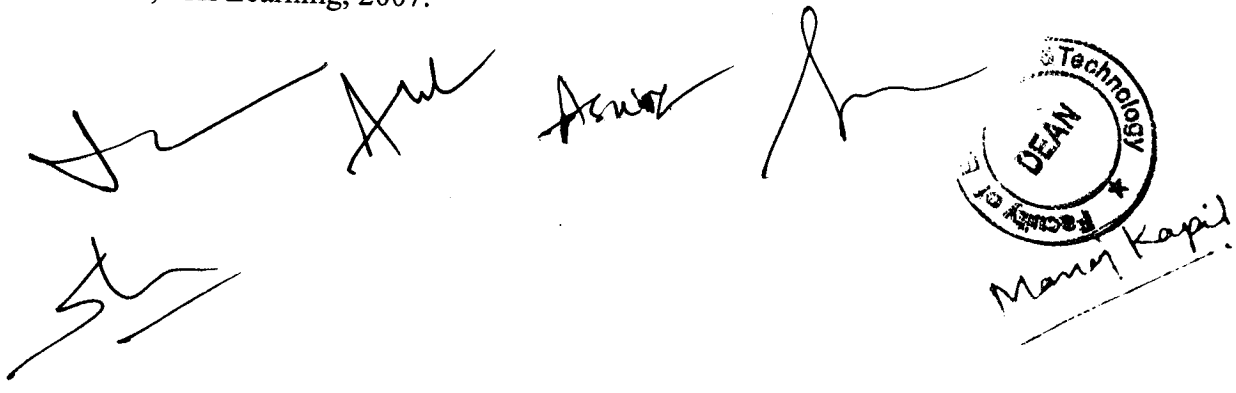
COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Characterization of Distributed Systems: Introduction, Examples of Distributed systems, Resource Sharing and Web, Challenges. System Models: Introduction, Architectural models, Fundamental models.	
Unit-2:	**8**
Time and Global States: Introduction, Clocks, Events and Process states, Synchronizing Physical clocks, Logical time and Logical clocks, Global states. Coordination and Agreement: Introduction, Distributed mutual exclusion, Elections, Multicast Communication, Consensus and Related problems.	
Unit-3:	**8**
Inter process Communication: Introduction, Characteristics of Inter process communication, External Data Representation and Marshalling, Client-Server Communication, Group Communication, Case Study: IPC in UNIX. Distributed Objects and Remote Invocation: Introduction, Communication between Distributed Objects, Remote Procedure Call, Events and Notifications, Case study: Java RMI.	
Unit-4:	**8**
Distributed File Systems: Introduction, File service Architecture, Case Study: 1: Sun Network File System, Case Study 2: The Andrew File System. Distributed Shared Memory: Introduction, Design and Implementation issues, Consistency Models.	
Unit-5:	**8**

Transactions and Concurrency Control: Introduction, Transactions, Nested Transactions, Locks, Optimistic concurrency control, Timestamp ordering, Comparison of methods for concurrency control. Distributed Transactions: Introduction, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery.	

Reference Books:

1. Andrew S. Tanenbaum, Maarten Van Steen. *Distributed Systems: Principles and Paradigms*, second edition, Pearson Education, 2007.
2. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair. *Distributed Systems: Concepts and Design*, fifth edition, Pearson Education, 2011.
3. Ajay D. Kshemkalyani, Mukesh Singhal. *Distributed Computing: Principles, Algorithms, and Systems*, first edition, Cambridge University Press, 2008.
4. Pradeep K. Sinha. *Distributed Operating Systems: Concepts and Design*, first edition, PHI Learning, 2007.



PCSE-151	Advanced Data Structures Lab	0L:0T:3P	1 Credit

CO	CO Statement	Bloom's Level
CO1	The course is designed to develop skills to design and analyze simple linear and non linear data structures.	K2, K3
CO2	It strengthen the ability to the students to identify and apply the suitable data structure for the given real world problem	K3
CO3	It enables them to gain knowledge in practical applications of data structures	K4, K5

List of Experiments (Indicative & not limited to)

1. Write a program in JAVA to implement Hashing.
2. Write a program in JAVA for Implementation of Array ADT and String ADT.
3. Write a program in JAVA to implement Queue ADT using Linked list with the basic functions of Create(), IsEmpty(), Insert(), Delete() and IsFull() with suitable prototype to a functions.

4Write a program in JAVA to transform BST into Threaded Binary Tree.

5. Write a program in JAVA to implement Tree Traversals on Binary Trees and Graphs Search Methods.
6. Write a program in JAVA to find the black height of any given node in Red-Black tree and find the black height of the Red-Balck tree.
7. Write a program in JAVA to implement operations on AVL Trees and Splay
8. Write a program in JAVA to implement Pattern Matching Technique using Brute Force Algorithm.
9. Write a program in JAVA to perform string matching using Boyer-Moore algorithm.
10. Write a program in JAVA to perform string matching using Knuth-Morris-Pratt algorithm.
11. Write a program in JAVA to perform the following
    a. Insertion into B-Tree
    b. Searching into B-Tree

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta. *Fundamentals of Data Structures in C++*, second edition, Universities Press, 2008.
2. Mark Allen Weiss. *Data Structures and Algorithm Analysis in C++*, fourth edition, Pearson Education, 2014.
3. Narasimha Karumanchi. *Data Structures and Algorithms Made Easy*, second edition, CareerMonk Publications, 2011.

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PCSE-201	Advanced Algorithms	3L:0T:0P	1 Credit

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	After completion of course, students would be able to	K1,K2
CO2	Analyze the complexity/performance of different algorithms.	K3, K5
CO3	Analyze the complexity/performance of different algorithms.	K3, K_4
CO4	Categorize the different problems in various classes according to their complexity.	K3, K_4
CO5	Students should have an insight of recent activities in the field of the advanced data structure.	K3, K_4

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

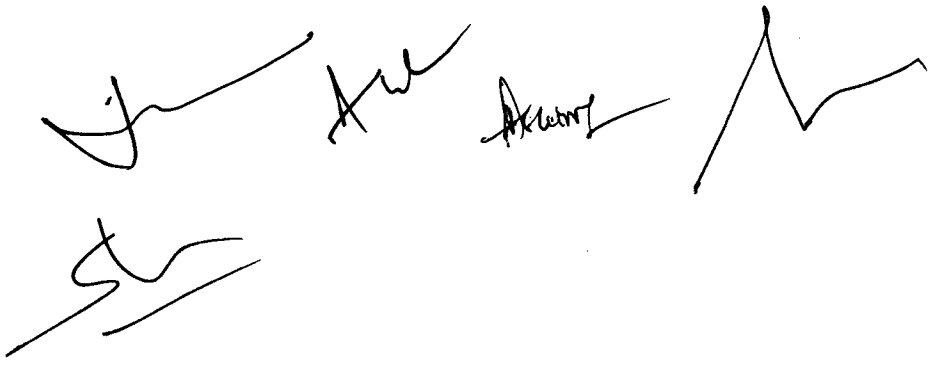
COURSE CONTENTS:

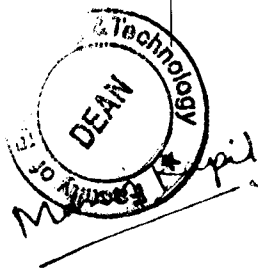
Content	Contact Hours
Unit 1	**8**
Classification of algorithms, Algorithm specifications, Recursive algorithm, Divide and Conquer approach, Greedy algorithm, Coin change problem, Scheduling Algorithm	
Unit-2:	**8**
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithmand time/space analysis, example of amortized analysis. Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.	
Unit-3:	**8**
Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.	
Unit-4:	
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.	
Unit-5:	

Sorting: Review of various sorting algorithms, topological sorting. Recent Trends in problem solving paradigms using recent searching and sortingtechniques by applying recently proposed data structures.		8

Reference Books:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.





PCSE-202	Wireless Sensor Networks	3L:0T:0P	1 Credit

Course Outcomes:

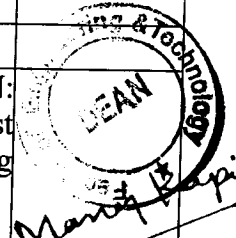
On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Describe and explain radio standards and communication protocols for wireless sensornetworks.	K1,K2
CO2	Explain the function of the node architecture and use of sensors for various applications.	K3, K5
CO3	Be familiar with architectures, functions and performance of wireless sensornetworks systems and platforms.	K3, K_4

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

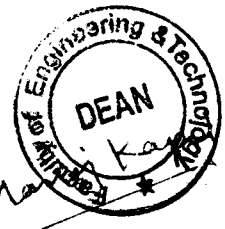
COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Introduction to Wireless Sensor Networks: Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors, Components of WSN. Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture Hardware Platforms: Motes, Hardware parameters	
Unit-2:	**8**
Introduction to ns-3: Introduction to Network Simulator 3 (ns-3), Descriptionof the ns-3 core module and simulation example.NS 3 tracing and visualization	
Unit-3:	**8**
Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis MAC Protocol Analysis: Asynchronous duty-cycled. X-MAC Analysis(Markov Chain)	
Unit-4:	**8**
Security: Possible attacks, counter measures, SPINS, Static and dynamic key distribution, Cryptography techniques, Mechanism to prevent routing attacks.	
Unit-5:	
Routing protocols: Introduction, MANET protocols Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast Opportunistic Routing Analysis: Analysis of opportunistic routing (MarkovChain)Advanced topics in wireless sensor networks.	



Reference Books:

1. KazemSohraby, Daniel Minoli and TaiebZnati, "wireless sensor networks - Technology, Protocols, and Applications", Wiley Interscience 2007
2. Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, "Wireless Sensor Network Technologies for the Information Explosion Era", springer 2010



PCSE 203	ENGLISH FOR RESEARCH PAPER WRITING	3L:0T:0P	1 Credit

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Understand that how to improve your writing skills and level of readability	K1,K2
CO2	Learn about what to write in each section	K3, K5
CO3	Understand the skills needed when writing a Title	K3, K4
CO4	Ensure the good quality of paper at very first-time submission	K3, K4

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. General Structure of Research Paper.	
Unit-2:	**8**
Clarifying Who Did What, Highlighting Your Findings, Hedging and 4 Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction. Appropriate keywords for indexing and research	
Unit-3:	**8**
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	
Unit-4:	**8**
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Ethical considerations in method reporting.	
Unit-5:	**8**
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions useful phrases, how to ensure paper is as good as it could possibly be the 4 first- time submission. Limitation and Future work	

Reference Books:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

PCSE-251	Advanced Algorithms Lab	3L:0T:0P	1 Credit

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Analyse a variety of algorithms with practical applications and the resource requirements of each.	K1,K2
CO2	Determine the most suitable algorithm for any given task and then apply it to the problem	K3, K5
CO3	Demonstrate adequate comprehension of the theory of intractability and prove when certain kinds of problems are intractable	K3, K_4
CO4	Work with advance algorithms	K3, K_4

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

List of Experiments (Indicative &not limited to)

1. RECURSION 1. Write Java programs that use both recursive and non-recursive functions for implementing the following searching methods: a) Linear search b) Binary search 2. Write Java programs to implement the following using arrays and linked lists a) List ADT
2. STACKS 3. Write Java programs to implement the following using an array. a) Stack ADT b) Queue ADT 4. Write a Java program that reads an infix expression and converts the expression to postfix form. (Use stacks ADT).
3. QUEUES 5. Write a Java program to implement circular queue ADT using an array. 6. Write a Java program that uses both a stack and a queue to test whether the given string is a palindrome or not.
4. LINKED LIST 7. Write Java programs to implement the following using a singly linked list. a) Stack ADT b) Queue ADT 8. Write Java programs to implement the deque (double ended queue) ADT using a) Array b) Singly linked list c) Doubly linked list.
5. BINARY SEARCH TREE
   Write a Java program to implement priority queue ADT. 10. Write a Java program to perform the following operations: A) Construct a binary search tree of elements. B) Search for a key element in the above binary search tree. C) Delete an element from the above binary search tree.
6. SHORTEST PATH PROBLEM 11. Write a Java program to implement all the functions of a dictionary (ADT) using Hashing. 12. ortest path problem.
7. BINARY TREES 13. Write Java programs that use recursive and non-recursive functions to traverse the given binary tree in a) Preorder b) Inorder c) Postorder. 14. Write Java programs for the implementation of bfs and dfs for a given graph.
8. SORTING 15. Write Java programs for implementing the following sorting methods: 16. a) Bubble sort d) Merge sort g) Binary tree sort b) Insertion sort e) Heap sort c) Quick sort f) Radix sort 17. Write a Java program to perform the following operations: a) Insertion into a B-tree b) Searching in a B-tree
9. KRUSKAL`S ALGORITHM 18. 19. Write a Java program that implements KMP algorithm for pattern matching.

Reference Books:

1. Data structures, Algorithms and Applications in java, 2nd Edition, S.Sahani, Universities Press. 2. Design and Analysis of Algorithms, P. H. Dave and H.B.Dave, Pearson education.
3. Data Structures and java collections frame work, W. J. Collins, Mc Graw Hill.
4. Java: the complete reference, 7th edition, Herbert Schildt, TMH.
5. Java for Programmers, P. J. Deitel and H. M. Deitel, Pearson education / Java: How to Program . J. Deitel and H. M. Deitel , 8th edition, PHI.
6. Java Programming, D.S. Malik, Cengage Learning.

PCSE-301	BIG DATA MINING AND ANALYTICS	3L:0T:0P	4 Credit

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and understand the basic concepts, characteristics, and challenges of Big Data and Data Mining	K1, K2
CO2	Summarize and compare various big data technologies and processing frameworks like Hadoop, Spark, etc.	K2, K4
CO3	Apply data preprocessing, transformation, and feature selection techniques on large datasets	K3
CO4	Analyze various data mining techniques such as clustering, classification, and association rule mining	K4
CO5	Evaluate performance and scalability of machine learning algorithms on large-scale datasets	K5

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Introduction to big data: Data, Characteristics of data and Types of digital data: Unstructured, Semi-structured and Structured - Sources of data. Big Data Evolution -Definition of big data Characteristics and Need of big data-Challenges of big data. Big data analytics, Overview of business intelligence.	
Unit-2:	**8**
Big data technologies and Databases: Hadoop – Requirement of Hadoop Framework – Design principle of Hadoop –Comparison with other system SQL and RDBMS-Hadoop Components –Architecture -Hadoop 1 vs Hadoop 2.	
Unit-3:	**8**
Map Reduce and YARN framework: Introduction to Map Reduce , Processing data with Hadoop using Map Reduce, Introduction to YARN, Architecture, Managing Resources and Applications with Hadoop YARN. Big data technologies and Databases: NoSQL: Introduction to NoSQL - Features and Types Advantages & Disadvantages -Application of NoSQL.	
Unit-4:	**8**
New SQL: Overview of New SQL - Comparing SQL, NoSQL and NewSQL.Mongo DB: Introduction – Features – Data types – Mongo DB Query language – CRUD operations – Arrays – Functions: Count – Sort – Limit – Skip – Aggregate – Map Reduce. Cursors – Indexes – Mongo Import – Mongo Export.Cassandra: Introduction – Features – Data types – CQLSH – Key spaces – CRUD operations –Collections – Counter –	

TTL – Alter commands – Import and Export – Querying System tables.	
Unit-5:	**8**
Big Data Frame Works for Analytics Hadoop Frame Work: Map Reduce Programming: I/O formats, Map side join-Reduce Side Join-Secondary Sorting-Pipelining Map Reduce jobs Spark Frame Work: Introduction to Apache spark-How spark works, Programming with RDDs:Create RDDspark Operations-Data Frame	

Reference Books:

1. Seema Acharya and Subhashini Chellappan, "Big Data and Analytics", Wiley India Pvt. Ltd.,2016.
2. Mike Frampton, "Mastering Apache Spark", Packt Publishing, 2015.
3.. Tom White, "Hadoop: The Definitive Guide", O"Reilly, 4th Edition, 2015.
4. Donald Miner, Adam Shook, "Map Reduce Design Pattern", O"Reilly, 2012

DEPARTMENT ELECTIVES:

PCSE-115	Advanced Network Principles and Protocols	3L:0T:0P	3 Credit

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain OSI and TCP/IP protocol stack and advanced networking concepts	K1, K2
CO2	Compare and analyze transport, routing, and congestion control mechanisms	K4
CO3	Apply protocol design principles to construct secure and efficient networking solutions	K3
CO4	Evaluate the performance of modern network protocols such as MPLS, BGP, OSPF, and emerging trends	K5
CO5	Design and simulate advanced protocol architectures for specialized network scenarios	K6
CO6	Analyze current research and industry trends in network virtualization, SDN, and 5G technologies	K4, K5

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Introduction to Networks - Application of Networks - Architecture Topology Switching - SLIP, PPP -ALOHA protocols, CSMA/CD, IEEE 802.3, 802.4, 802.5	
Unit-2:	**8**
Network Layer Issues- Routing, Congestion control- Internetworking - Issues, Address Learning Bridges, Spanning tree, Source routing, Bridges, Routers, Gateway	
Unit-3:	**8**
Network Protocol- IP datagram - hop by hop routing, ARP, RARP, DHCP -Sub net Addressing, Address Masking, ICMP, RIP, RIPV2, OSPF, DNS, LAN and WAN Multicast	
Unit-4:	**8**
Transport Layer- Design issues, Connection Management, Transmission Control Protocol (TCP) - User Datagram Protocol (UDP).	
Unit-5:	**8**
Application Layer Protocol- Telnet - TFTP - FTP - SMTP - Ping Finger, Bootstrap Network Time Protocol- SNMP.	

Reference Books:

1. Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks", 5th Edition, Pearson, 2011
2. William Stallings, "Data and Computer Communications", 9th Edition, Pearson, 2011
3. W Richard Stevens and G. Gabrani, "TCP/IP Illustrated - Volume I, The protocols", Pearson Education, 2009

PCSE-116	Introduction to Intelligent Systems	3L:0T:0P	3 Credit

Course Outcomes:

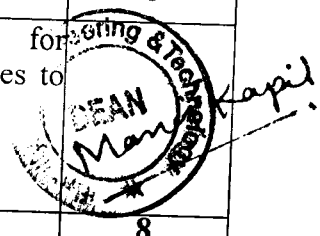
On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and describe fundamental concepts of intelligent systems, including AI, ML, and knowledge representation	K1, K2
CO2	Understand and differentiate various problem-solving strategies and reasoning methods	K2, K4
CO3	Apply machine learning and knowledge-based systems to solve basic intelligent system problems	K3
CO4	Analyze search strategies, logic-based systems, and inference techniques	K4
CO5	Evaluate performance and limitations of different intelligent algorithms and models	K5
CO6	Design and develop simple intelligent agents or systems for real-world applications	K6

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	8
Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.	
Unit-2:	8
Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources.	
Unit-3:	8
Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes	
Unit-4:	8
Data visualisation: Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings).	
Unit-5:	8
Applications of Data Science, Technologies for visualisation, Bokeh (Python), Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science	



Reference Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press

PCSE-118	Mobile Applications and Services	3L:0T:0P	3 Credit

Course Outcomes:

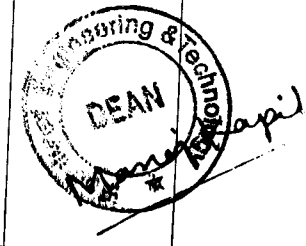
On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain mobile platform architectures, communication protocols, and mobile OS fundamentals	K1, K2
CO2	Understand mobile application development frameworks and lifecycle management	K2
CO3	Apply UI/UX design principles and development tools to create functional mobile applications	K3
CO4	Analyze mobile-specific challenges like battery optimization, limited bandwidth, and varying screen sizes	K4
CO5	Evaluate mobile application performance, usability, and security for different platforms	K5
CO6	Design and deploy real-time mobile apps integrated with cloud-based services and APIs	K6

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Introduction:Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User	
Unit-2:	**8**
More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis, . Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider	
Unit-3:	**8**
Communications via Network and the Web:State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony Notifications and Alarms:Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics	
Unit-4:	**8**



Putting It All Together : Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia	
Unit-5:	**8**
Platforms and Additional Issues : Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking , Active Transactions, More on Security, Hacking Android, Recent trends inCommunication protocols for IOT nodes, mobile computimng techniques in IOT, agents based communications in IOT	

Reference Books:

1. Wei-Meng Lee, *Beginning Android™ 4 Application Development*, 2012, John Wiley & Sons.
2. Reto Meier, Ian Lake, *Professional Android*, 4th Edition, 2018, Wrox (John Wiley & Sons).
3. Bill Phillips, Chris Stewart, Kristin Marsicano, *Android Programming: The Big Nerd Ranch Guide*, 4th Edition, 2019, Pearson Education.
4. Asoke K. Talukder, Hasan Ahmed, Roopa R. Yavagal, *Mobile Computing: Technology, Applications and Service Creation*, 2nd Edition, 2010, McGraw-Hill Education.
5. Ravi Kant Soni, *Mobile Application Development*, 1st Edition, 2017, Wiley India.

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PCSE-119	Advanced Database Management System	3L:0T:0P	3 Credit

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain advanced DBMS concepts such as distributed databases, object-oriented databases, and NoSQL systems	K1, K2
CO2	Analyze query processing and optimization techniques in centralized and distributed databases	K4
CO3	Apply transaction management, concurrency control, and recovery techniques to ensure database reliability	K3
CO4	Evaluate performance trade-offs in database systems, including indexing, partitioning, and data replication	K5
CO5	Design advanced data models and schemas for complex applications involving semi-structured and unstructured data	K6
CO6	Implement and test database solutions using modern database technologies and frameworks	K3, K6

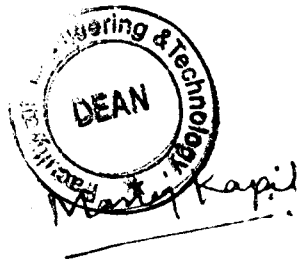
K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Engineering application of Optimization, Formulation of design problems as mathematical programming problems.	
Unit-2:	**8**
General Structure of Optimization Algorithms, Constraints, The Feasible Region.	
Unit-3:	**8**
Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.	
Unit-4:	**8**
Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.	
Unit-5:	**8**
Real life Problems and their mathematical formulation as standard programming problems. Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.	

Reference Books:

1. Ramez Elmasri, Shamkant B. Navathe. *Fundamentals of Database Systems*, seventh edition, Pearson Education, 2017.
2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan. *Database System Concepts*, seventh edition, McGraw-Hill Education, 2020.
3. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom. *Database Systems: The Complete Book*, second edition, Pearson Education, 2008.
4. Raghu Ramakrishnan, Johannes Gehrke. *Database Management Systems*, third edition, McGraw-Hill Education, 2003.



PCSE-121	Parallel Computer Architecture	3L:0T:0P	3 Credit

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Define and describe the fundamentals of parallel computing and architectural classifications	K1, K2
CO2	Analyze performance metrics and scalability issues in parallel architectures	K4
CO3	Apply principles of pipelining, shared memory, and distributed memory systems	K3
CO4	Evaluate the efficiency of synchronization techniques, interconnection networks, and memory models	K5
CO5	Design and simulate parallel computing solutions for scientific or data-intensive problems	K6
CO6	Examine current trends in parallel processing, including GPU architectures, multicore systems, and quantum concepts	K4, K5

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Fundamentals of Computer Design: Defining Computer Architecture – Trends in Technology – Trends in Power in Integrated Circuits – Trends in Cost – Dependability – Measuring, Reporting and Summarizing Performance – Quantitative Principles of Computer Design – Basic and Intermediate concepts of pipelining – Pipeline Hazards – Pipelining Implementation issues.	
Unit-2:	**8**
Instruction-Level Parallelism and Its Exploitation: Instruction-Level Parallelism: Concepts and Challenges – Basic Compiler Techniques for Exposing ILP – Reducing Branch Costs with Prediction – Overcoming Data Hazards with Dynamic Scheduling – Dynamic Scheduling: Algorithm and Examples – Hardware-Based Speculation – Exploiting ILP Using Multiple Issue and Static Scheduling – Exploiting ILP Using Dynamic Scheduling, Multiple Issue and Speculation – Studies of the Limitations of ILP – Limitations on ILP for Realizable Processors – Hardware versus Software Speculation – Using ILP Support to Exploit Thread-Level Parallelism	
Unit-3:	**8**
Data-Level and Thread-Level Parallelism Vector Architecture – SIMD Instruction Set Extensions for Multimedia – Graphics Processing Units – Detecting and Enhancing Loop-Level Parallelism – Centralized Shared-Memory Architectures – Performance of Shared-Memory Multiprocessors – Distributed Shared Memory and Directory Based Coherence – Basics of Synchronization – Models of Memory Consistency – Programming Models and Workloads for Warehouse-Scale Computers – Computer Architecture of Warehouse-Scale Computers – Physical Infrastructure and Costs of Warehouse-Scale Computers	

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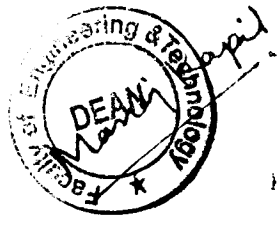
Unit-4:	**8**
Memory Hierarchy Design Cache Performance – Six Basic Cache Optimizations – Virtual Memory – Protection and Examples of Virtual Memory – Ten Advanced Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – The Design of Memory Hierarchies	
Unit-5:	**8**
Storage Systems & Case Studies Advanced Topics in Disk Storage – Definition and Examples of Real Faults and Failures – I/O Performance, Reliability Measures and Benchmarks – Designing and Evaluating an I/O System – The Internet Archive Cluster Case Studies / Lab Exercises: INTEL i3, i5, i7 processor cores, NVIDIA GPUs, AMD, ARM processor cores – Simulators – GEM5, CACTI, SIMICS, Multi2sim and INTEL Software development tools.	

Reference Books:

1. David.A.Patterson, John L.Hennessy, "Computer Architecture: A Quantitative approach", Elsevier, 5th Edition 2012.
2. K.Hwang, Naresh Jotwani, "Advanced Computer Architecture, Parallelism, Scalability, Programmability", Tata McGraw Hill, 2nd Edition 2010.



PCSE-122	Data Preparation and Analysis	3L:0T:0P	3 Credit

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain basic data types, data sources, and common issues in raw data	K1, K2
CO2	Apply data cleaning techniques such as handling missing values, noise, and outliers	K3
CO3	Analyze various data transformation methods including normalization, encoding, and aggregation	K4
CO4	Evaluate feature selection and dimensionality reduction techniques for preprocessing	K5
CO5	Design and develop reproducible data preparation pipelines for analytics and machine learning tasks	K6
CO6	Interpret and visualize data characteristics and preprocessing outcomes using statistical and graphical tools	K3, K4

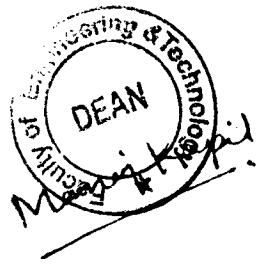
K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real-time issues.	
Unit-2:	**8**
Data Cleaning: Consistency checking. Heterogeneous and missing data, Data Transformation and segmentation	
Unit-3:	**8**
Exploratory Analysis: Descriptive and comparative statistics, Clustering and association, Hypothesis generation	
Unit-4:	**8**
Visualization: Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity.	

Reference Books:

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, *Introducing Data Science: Big Data, Machine Learning, and More*, Manning Publications, 1st Edition, 2016.
2. V. Katti, *Data Preprocessing Techniques for Data Mining*, Wiley India, 1st Edition, 2021.
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, *Introduction to Data Mining*, Pearson Education, 2nd Edition, 2018.
4. Ronald D. Penney, *Data Cleaning: Problems and Current Approaches*, Nova Science Publishers, 1st Edition, 2019.
5. Paul Teetor, *R Cookbook: Proven Recipes for Data Analysis, Statistics, and Graphics*, O'Reilly Media, 2nd Edition, 2019.



PCSE-215	Cloud Computing Principles	3L:0T:0P	3 Credit

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain basic data types, data sources, and common issues in raw data	K1, K2
CO2	Apply data cleaning techniques such as handling missing values, noise, and outliers	K3
CO3	Analyze various data transformation methods including normalization, encoding, and aggregation	K4
CO4	Evaluate feature selection and dimensionality reduction techniques for preprocessing	K5
CO5	Design and develop reproducible data preparation pipelines for analytics and machine learning tasks	K6
CO6	Interpret and visualize data characteristics and preprocessing outcomes using statistical and graphical tools	K3, K4

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
History of Centralized and Distributed Computing - Overview of Distributed Computing, Cluster computing, Grid computing. Technologies for Network based systems- System models for Distributed and cloud computing- Software environments for distributed systems and clouds.	
Unit-2:	**8**
Introduction to Cloud Computing- Cloud issues and challenges - Properties - Characteristics - Service models, Deployment models. Cloud resources: Network and API - Virtual and Physical computational resources - Data-storage. Virtualization concepts - Types of Virtualization- Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs .	
Unit-3:	**8**
Service models - Infrastructure as a Service (IaaS) - Resource Virtualization: Server, Storage, Network - Case studies. Platform as a Service (PaaS) - Cloud platform & Management: Computation, Storage - Case studies. Software as a Service (SaaS) - Web services - Web 2.0 - Web OS - Case studies – Anything as a service (XaaS).	
Unit-4:	**8**
Cloud Programming and Software Environments – Parallel and Distributed Programming paradigms – Programming on Amazon AWS and Microsoft Azure – Programming support of Google App Engine – Emerging Cloud software Environment.	

Unit-5:	
Cloud Access: authentication, authorization and accounting - Cloud Provenance and meta-data - Cloud Reliability and fault-tolerance - Cloud Security, privacy, policy and compliance- Cloud federation, interoperability and standards.	

Reference Books:

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier – 2012
2. Barrie Sosinsky, " Cloud Computing Bible" John Wiley & Sons, 2010
3. Tim Mather, Subra Kumaraswamy, and Shahed Latif, Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, O'Reilly 2009

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PCSE-216	Advanced Cryptography	3L:0T:0P	3 Credit

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain the mathematical foundations of cryptography, including number theory and algebra	K1, K2
CO2	Analyze classical and modern cryptographic algorithms such as AES, RSA, and ECC	K4
CO3	Apply cryptographic primitives for data confidentiality, integrity, authentication, and key exchange	K3
CO4	Evaluate the strength, efficiency, and security of cryptographic protocols under various attack models	K5
CO5	Design secure systems using digital signatures, zero-knowledge proofs, and advanced protocols	K6
CO6	Explore current research and emerging trends in post-quantum cryptography, homomorphic encryption, and blockchain security	K4, K5

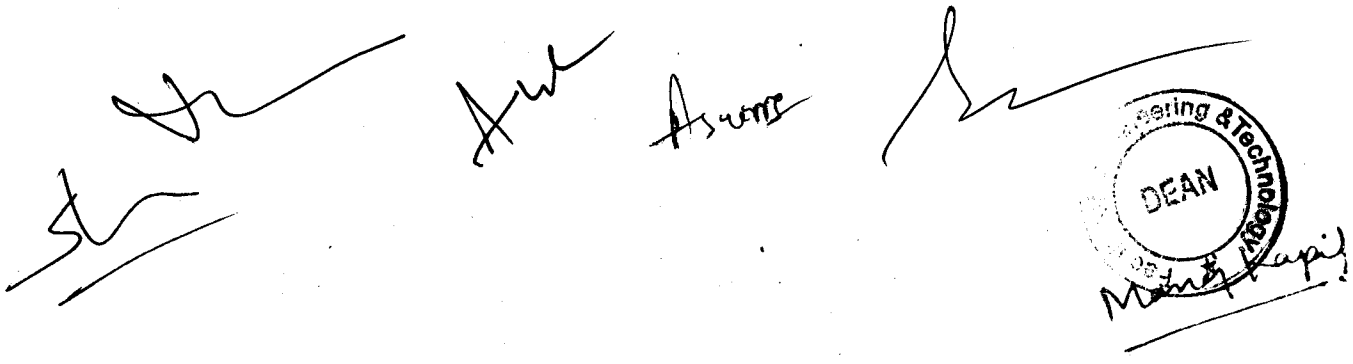
K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Algebra: Group, cyclic group, cyclic subgroup, field, probability. Number Theory: Fermat's theorem , Cauchy 's theorem, Chinese remainder theorem, primality testing algorithm, Euclid's algorithm for integers, quadratic residues, Legendre symbol, Jacobi symbol etc..	
Unit-2:	**8**
Cryptography and cryptanalysis, Classical Cryptography, substitution cipher, different type of attack: CMA,CPA,CCA etc, Shannon perfect secrecy, OTP, Pseudo random bit generators, stream ciphers and RC4	
Unit-3:	**8**
Block ciphers: Modes of operation, DES and its variants, AES, linear and differential cryptanalysis.	
Unit-4:	**8**
One-way function, trapdoor one-way function, Public key cryptography, RSA cryptosystem, Diffie-Hellman key exchange algorithm, Elgamal Cryptosystem.	
Unit-5:	
Cryptographic hash functions, secure hash algorithm, Message authentication, digital signature, RSA digital signature, Elgamal digital signature.	

Reference Books:

1. Stinson. D. Cryptography: Theory and Practice, third edition, Chapman & Hall/CRC, 2010.
2. W. Stallings, Cryptography and Network Security Principles and practice, 5/e, Pearson Education Asia, 2012.
3. Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, second edition, Tata McGraw Hill, 2011
4. Thomas Koshy, Elementary Number Theory with applications, Elsevier India, 2005.



CSE-217	Advanced Computer Vision	3L:0T:0P	3 Credit

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain fundamental concepts of image formation, filtering, and feature extraction	K1, K2
CO2	Analyze and apply algorithms for image segmentation, object recognition, and motion estimation	K3, K4
CO3	Evaluate the performance of classical and deep learning-based computer vision models	K5
CO4	Design and develop vision pipelines using CNNs, R-CNNs, YOLO, and transformers for visual tasks	K6
CO5	Apply 3D vision, stereo imaging, and multi-view geometry to solve advanced visual perception problems	K3, K4
CO6	Explore current research trends and applications in medical imaging, autonomous driving, and AR/VR	K5

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Advanced Deep Neural Networks o Basics of DNNs (Perceptrons) Convolutional Neural Networks (CNNs) o Video Understanding o Recurrent Neural Networks (RNNs) o Image Captioning o Attention Mechanism o Vision Transformers	
Unit-2:	**8**
Learning Mechanisms o Self-supervised Learning o Semi-supervised Learning o Multi-tasking & Knowledge Distillation	
Unit-3:	**8**
Hough Transform Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT basedcircular object detection – accurate center location – speed problem – ellipse detection –Case study: Human Iris location – hole detection – generalized Hough Transform – spatial matched filtering ,GHT for ellipse detection, object location.	
Unit-4:	**8**
3D Vision And Motion Methods for 3D vision – projection schemes – shape from shading –photometric stereo – shape from texture – shape from focus – active range finding – surfacerepresentations – point based representation – volumetric representations – 3D objectrecognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment– translational alignment – parametric motion – spline based motion – optical flow – layered motion	
Unit-5:	

Applications Application: Photo album – Face detection – Face recognition – Eigen faces. Active appearance and 3D shape models of faces Application: Surveillance – foreground. Background separation – particle filters – Chamfer matching, tracking, and occlusion. combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians	

Reference Books:

1. Richard Szeliski. *Computer Vision: Algorithms and Applications*, second edition, Springer, 2022.
2. Simon J.D. Prince. *Computer Vision: Models, Learning, and Inference*, first edition, Cambridge University Press, 2012.
3. David A. Forsyth, Jean Ponce. *Computer Vision: A Modern Approach*, second edition, Pearson Education, 2011.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville. *Deep Learning*, first edition, MIT Press, 2016.

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PCSE-218	Advanced Concepts in Operating Systems	3L:1T:0P	4 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain fundamental and advanced concepts of operating systems, including kernel architecture	K1, K2
CO2	Analyze the working of advanced process scheduling, memory management, and I/O subsystems	K4
CO3	Apply concurrency control mechanisms like semaphores, monitors, and message passing	K3
CO4	Evaluate system performance, deadlock handling, and fault tolerance strategies in distributed OS	K5
CO5	Design and simulate advanced OS components such as microkernel-based systems or virtual memory managers	K6
CO6	Explore trends in OS such as real-time OS, cloud OS, mobile OS, and security-hardened kernels	K5

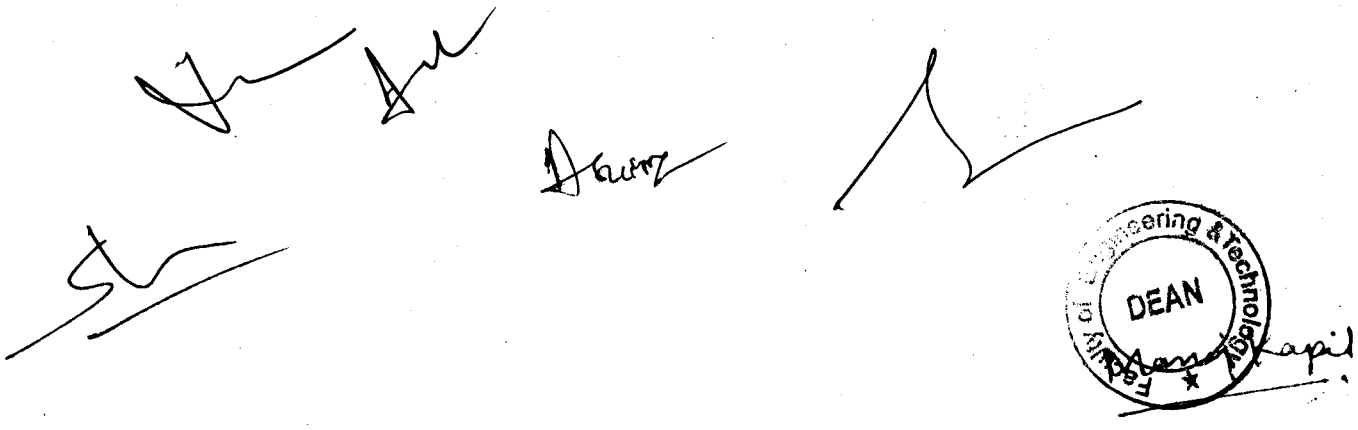
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

COURSE CONTENTS:

Content	Contact Hours
Unit-1:	**8**
Multiprocessor Operating Systems: System Architectures- Structures of OS – OS design issues – Process synchronization – Process Scheduling and Allocation- memory management.	
Unit-2:	**8**
Distributed Operating Systems: System Architectures- Design issues – Communication models – clock synchronization – mutual exclusion – election algorithms- Distributed Deadlock detection	
Unit-3:	**8**
Distributed scheduling - Distributed shared memory - Distributed File system – Multimedia file systems - File placement - Caching	
Unit-4:	**8**
Database Operating Systems: Requirements of Database OS – Transaction process model – Synchronization primitives - Concurrency control algorithms.	
Unit-5:	**8**
Mobile Operating Systems: ARM and Intel architectures - Power Management - Mobile OS Architectures - Underlying OS - Kernel structure and native level programming - Runtime issues- Approaches to power management.	

Reference Books:

1. M Singhal and NG Shivaratri , Advanced Concepts in Operating Systems, Tata McGraw Hill Inc, 2001
2. A S Tanenbaum, Distributed Operating Systems, Pearson Education Asia, 2001
3. Source Wikipedia, Mobile Operating Systems, General Books LLC, 2010



PCSE-219	Human and Computer Interaction	3L:1T:0P	4 Credits

Course Outcomes:
On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain basic concepts, principles, and models of human-computer interaction	K1, K2
CO2	Understand cognitive models, user behavior, and design heuristics in HCI	K2
CO3	Apply HCI principles to design effective, usable, and accessible user interfaces	K3
CO4	Analyze user requirements and evaluate usability using formal methods and user testing	K4
CO5	Evaluate interactive systems for efficiency, learn ability, and user satisfaction	K5
CO6	Design prototypes and apply iterative user-centered design techniques for system development	K6

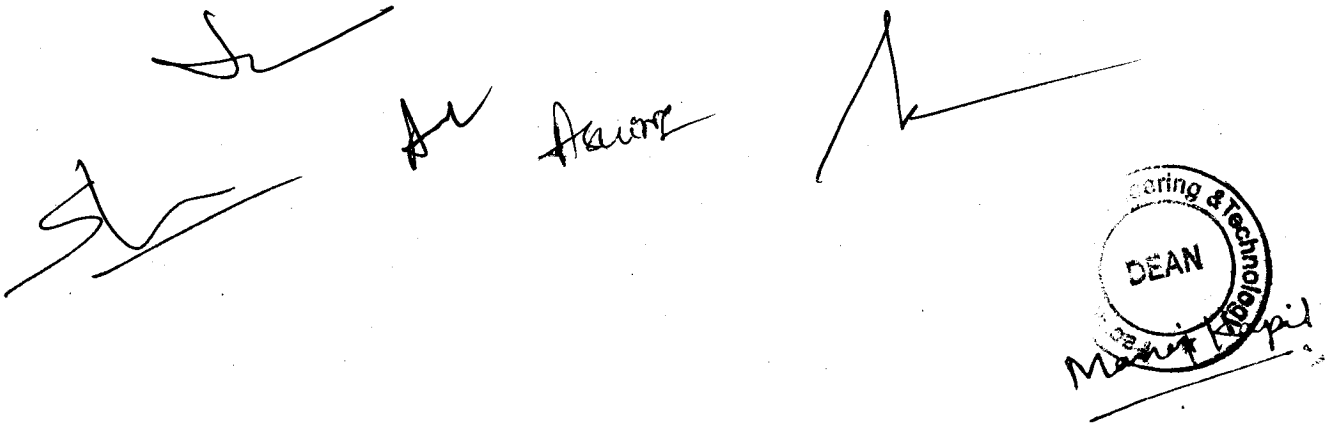
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

COURSE CONTENTS:

Content	Contact Hours
Unit-1:	**8**
Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models– frameworks – Ergonomics – styles – elements – interactivity- Paradigms.	
Unit-2:	**8**
Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules– principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.	
Unit-3:	**8**
Cognitive models –Socio-Organizational issues and stake holder requirements– Communication and collaboration models-Hypertext, Multimedia and WWW.	
Unit-4:	**8**
Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.	
Unit-5:	**8**
Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies. Recent Trends: Speech Recognition and Translation, Multimodal System	

Reference Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004 (UNIT I , II & III)
2. Brian Fling, "Mobile Design and Development", First Edition , O Reilly Media Inc., 2009
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O Reilly, 2009.



PCSE-220	Social Network Mining and Analysis	3L:1T:0P	4 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and describe fundamental concepts of social networks, graph theory, and their properties	K1, K2
CO2	Understand and interpret structural measures such as centrality, clustering, and connectivity	K2, K3
CO3	Apply algorithms to detect communities, link prediction, and influence propagation in social graphs	K3, K5
CO4	Analyze real-world networks using models such as small-world, scale-free, and random graph models	K4,K5
CO5	Evaluate the effectiveness of mining techniques on large-scale social network datasets	K6 K1
CO6	Design and develop applications or models for social network analysis using tools like NetworkX or Gephi	

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

COURSE CONTENTS:

Content	Contact Hours
Unit-1:	**8**
Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks - Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.	
Unit-2:	**8**
Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix- Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications	
Unit-3:	**8**
Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.	
Unit-4:	**8**
Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score.	

Unit-5:	8
A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection	

References Books:

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, —Computational Social Network Analysis: Trends, Tools and Research Advancesl, Springer, 2012
2. Borko Furht, —Handbook of Social Network Technologies and Applicationsl, Springer, 1 st edition, 2011
3. Charu C. Aggarwal, —Social Network Data Analyticsl, Springer; 2014
4. Giles, Mark Smith, John Yen, —Advances in Social Network Mining and Analysisl, Springer, 2010.
5. Guandong Xu , Yanchun Zhang and Lin Li, —Web Mining and Social Networking – Techniques and applicationsl, Springer, 1st edition, 2012
6. Peter Mika, —Social Networks and the Semantic Webl, Springer, 1st edition, 2007

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PCSE-221	Digital Forensics	3L:1T:0P	4 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain fundamental concepts, terminologies, and legal frameworks related to digital forensics	K1, K2
CO2	Understand forensic acquisition, preservation, and analysis techniques for different digital media	K2
CO3	Apply forensic tools and methodologies to examine digital evidence from file systems, memory, and networks	K3
CO4	Analyze artifacts and patterns in digital devices to detect malicious activities or breaches	K4
CO5	Evaluate the validity and integrity of digital evidence presented in legal contexts	K5
CO6	Design and document an end-to-end digital forensic investigation process	K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

COURSE CONTENTS:

Content	Contact Hours
Unit-1:	**8**
Digital Forensics Science: Forensics science, computer forensics, and digital forensics. Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics	
Unit-2:	**8**
Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.	
Unit-3:	**8**
Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.	
Unit-4:	**8**
Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case, Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.	
Unit-5:	**8**

Mobile Forensics: mobile forensics techniques, mobile forensics tools. Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.	

References Books:

1. John Sammons, The Basics of Digital Forensics, Elsevier
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

PCSE-222	Advanced Digital Design	3L:1T:0P	3 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain the principles of digital logic, finite state machines, and RTL design	K1, K2
CO2	Understand advanced digital components and hardware description languages (HDL like Verilog/VHDL)	K2
CO3	Apply HDL to design, simulate, and synthesize digital circuits	K3
CO4	Analyze timing, resource utilization, and power-performance trade-offs in digital circuit design	K4
CO5	Evaluate the performance and correctness of digital systems using verification techniques	K5
CO6	Design optimized, synthesizable digital architectures for real-world applications	K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

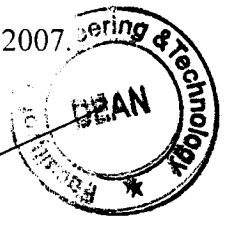
COURSE CONTENTS:

Content	Contact Hours
Unit-1:	**8**
Review of Combinational and Sequential logic design – Structural models of combinational logic – Propagation delay – Behavioral Modeling – Boolean equation based behavioral models of combinational logic – Cyclic behavioral model of flip-flop and latches – A comparison of styles for behavioral modeling – Design documentation with functions and tasks	
Unit-2:	**8**
Synthesis of Combinational and Sequential logic – Introduction to synthesis – Synthesis of combinational logic – Synthesis of sequential logic with latches – Synthesis of three-state devices and bus interfaces – Synthesis of sequential logic with flip-flops – Registered logic – State encoding – Synthesis of gated clocks and clock enables – Anticipating the results of synthesis – Resets – Synthesis of loops – Design traps to avoid – Divide and Conquer: partitioning a design	
Unit-3:	**8**
Design and Synthesis of Datapath Controllers – Partitioned sequential machines – Design example: Binary counter – Design and synthesis of a RISC stored-program machine – Processor, ALU, Controller, Instruction Set, Controller Design and Program Execution – UART – Operation, Transmitter, Receiver.	
Unit-4:	**8**
Programmable logic devices – Storage devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Programmability of PLDs – Complex PLDs – Introduction to Altera and Xilinx FPGAs – Algorithms – Nested loop programs and data flow graphs – Design Example of Pipelined Adder, Pipelined FIR Filter – Circular buffers – FIFOs and Synchronization across clock domains – Functional	

units for addition, subtraction, multiplication and division – Multiplication of signed binary numbers and fractions.	
Unit-5:	**8**
Postsynthesis Design Validation – Postsynthesis Timing Verification – Elimination of ASIC Timing Violations – False Paths – Dynamically Sensitized Paths – System Tasks for Timing Verificaion – Fault Simulation and Testing – Fault Simulation – Fault Simulation with Verifault-XL, lab exercises using Xilinx and Bluespec.	

Reference Books:

1. Michael D. Ciletti, "Advanced Digital Design with the VERILOG HDL, 2nd Edition, Pearson Education, 2010.
2. Samir Palnitkar "Verilog HDL", 2nd Edition, Pearson Education, 2003.
3. Stephenbrown, "Fundamentals of Digital Logic with Verilog", McGraw-Hill-2007.



OPEN ELECTIVES

PCSE-127	Business Analytics	3L:1T:0P	4 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Understand the role of business analytics within an organization.	K1,K2
CO2	Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization	K3, K5
CO3	To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.	K3, K_4
CO4	To become familiar with processes needed to develop, report, and analyze business data.	K3, K_4
CO5	Use decision-making tools/Operations research techniques.	K3, K_4
CO6	Mange business process using analytical and management tools.	K3, K_4
CO7	Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc	K3, K_4

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Business analytics: Overview of Business analytics, Scope of Businessanalytics,BusinessAnalytics Process, Relationship of Business Analytics Process and organisation,competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods,Review of probability distribution and data modelling, sampling andestimation methods overview.	
Unit-2:	**8**
Trendiness and Regression Analysis: Modelling Relationships and Trends inData, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models forBusiness analytics, problem solving, Visualizing and Exploring Data,Business. Analytics Technology.	
Unit-3:	
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step inthe	

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business analytics Process, Prescriptive Modelling, nonlinear Optimization.	
Unit-4:	**8**
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time. Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation UsingAnalytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	
Unit-5:	**8**
Decision Analysis: Formulating Decision Problems, Decision Strategies withthe without Outcome Probabilities, Decision Trees, The Value ofInformation, Utility and Decision Making.	

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

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PCSE-128	Industrial Safety	3L:1T:0P	4 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Explain the principles and importance of industrial safety and its role in protecting human resources, assets, and the environment.	K1,K2
CO2	Identify potential hazards and risks in various industrial environments, including mechanical, electrical, chemical, and construction sites.	K3, K5
CO3	**Apply safety management systems, policies, and procedures** to prevent accidents and ensure workplace safety.	K3, K_4
CO4	Select and recommend appropriate personal protective equipment (PPE) and safety devices for different industrial situations.	K3, K_4

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards,types, causes and preventive steps/procedure, describe salient points factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	
Unit-2:	**8**
Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.	
Unit-3:	**8**
Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	
Unit-4:	

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.	
Unit-5:	**8**
Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance	

Reference Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

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PCSE-129	Operations Research	3L:1T:0P	3 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.	K1,K2
CO2	Students should able to apply the concept of non-linear programming	K3, K5
CO3	Students should able to carry out sensitivity analysis	K3, K_4
CO4	Student should able to model the real world problem and simulate it	K3. K_4

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Optimization Techniques, Model Formulation, models, General L.R , Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models	
Unit-2:	**8**
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming	
Unit-3:	**8**
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - maxflow problem - CPM/PERT	
Unit-4:	**8**
Scheduling and sequencing - single server and multiple server models deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	
Unit-5:	**8**
Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	

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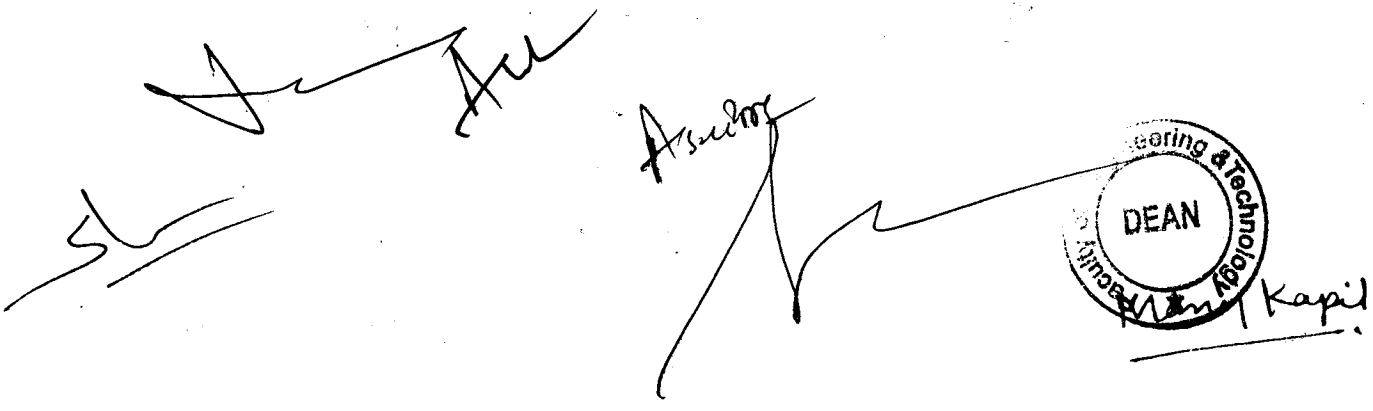
Reference Books:

1. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
2. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
3. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010



PCSE-227	Cost Management of Engineering Projects	3L:1T:0P	4 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Understand the fundamental concepts of project cost management and its significance in the successful execution of engineering projects.	K1,K2
CO2	Estimate project costs using various methods and techniquessuch as analogous, parametric, and bottom-up estimating.	K3, K5
CO3	Prepare and interpret project budgets, cash flow forecasts, and cost control reports for engineering projects.	K3, K_4
CO4	Apply techniques for cost planning, budgeting, and monitoring throughout the project lifecycle to manage project finances effectively.	K3, K_4

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

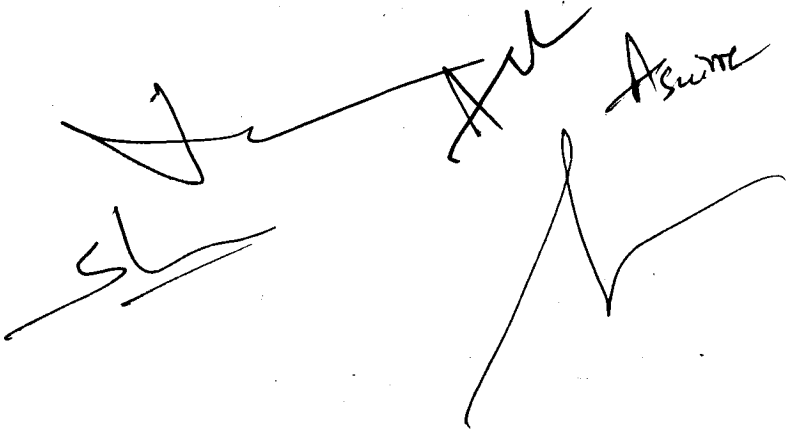
COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.	
Unit-2:	**8**
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process	
Unit-3:	**8**
Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis.	
Unit-4:	**8**
Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.	

Unit-5:	8
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	

Reference Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.



PCSE-228	Composite Materials	3L:1T:0P	4 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Understand the fundamental concepts, classification, and applications of composite materials in engineering industries.	K1,K2
CO2	Explain the properties and roles of matrix and reinforcement materialsin composite systems, including fibers, particulates, and laminates.	K3, K5
CO3	Analyze the mechanical behavior of composite materialsunder different loading conditions and environmental influences.	K3, K_4
CO4	Select appropriate manufacturing processes for different types of composite materials, such as hand lay-up, filament winding, pultrusion, resin transfer molding, etc.	K3, K_4

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

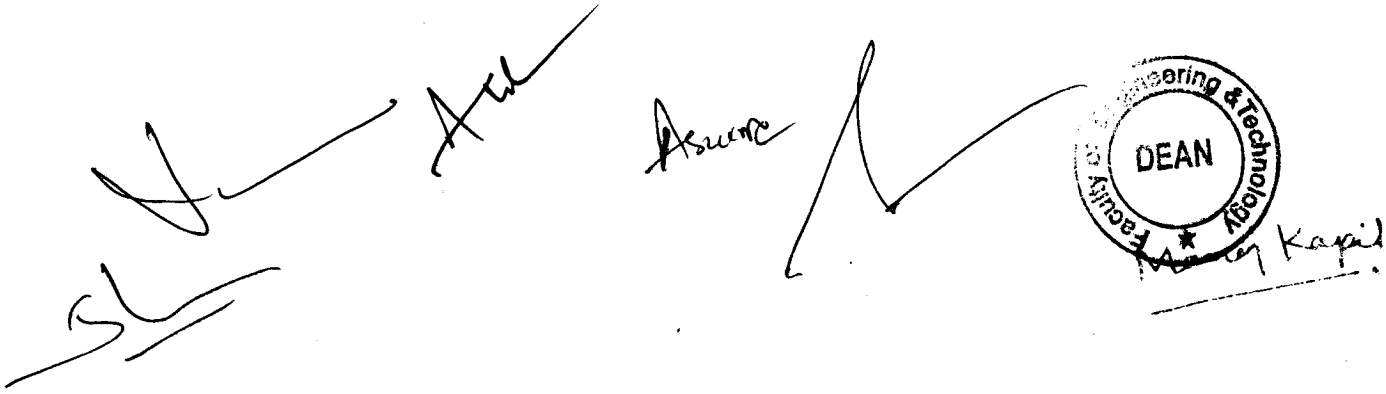
COURSE CONTENTS:

Content	Contact Hours
Unit 1	**8**
INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.	
Unit-2:	**8**
REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.	
Unit-3:	**8**
Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.	
Unit-4:	**8**
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.	
Unit-5:	

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	

Reference Books:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.



PCSE-229	Waste to Energy	3L:1T:0P	3 Credits

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Recall and explain the classification, characteristics, and energy potential of various types of waste	K1, K2
CO2	Understand the principles and technologies involved in waste-to-energy conversion processes	K2
CO3	Apply thermochemical and biochemical methods for energy extraction from waste (e.g., incineration, anaerobic digestion)	K3
CO4	Analyze technical, environmental, and economic feasibility of waste-to-energy systems	K4
CO5	Evaluate the performance, sustainability, and policy implications of existing waste-to-energy projects	K5
CO6	Design small-scale waste-to-energy systems suitable for local/community-level applications	K6

K1–Remember,K2–Understand,K3 –Apply,K4–Analyze,K5 –Evaluate,K6–Create

COURSE CONTENTS:

Content	ContactHours
Unit 1	**8**
Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.	
Unit-2:	**8**
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.	
Unit-3:	**8**
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.	
Unit-4:	**8**
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.	
Unit-5:	

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion Biomass energy programme in India.	

Reference Books:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

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