

**Meerut Institute of Engineering and Technology
Meerut**



EVALUATION SCHEME AND SYLLABI

For

**B.Tech – 2nd Year
(Computer Science)**

Effective from the Session: 2026-27

Affiliated With



Dr. A.P.J ABDUL KALAM TECHNICAL UNIVERSITY UTTAR PRADESH

Sec-11, Jankipuram Vistar, Lucknow - 226031, Uttar Pradesh, India

SEMESTER –III															
S.NO.	Subject Code	Subject	Category	T/P	Periods			Evaluation Scheme						Total	Credit
					L	T	P	Continuous Internal			End				
								CT	TA	Total	PS	TE	PE		
1	MCS301	Data Structures	PCC	T	3	0	0	20	10	30		70		100	3
2	MCS302	Computer Organisation and Architecture	PCC	T	3	0	0	20	10	30		70		100	3
3	MCS303	Discrete Structures & Theory of Logic	PCC	T	3	0	0	20	10	30		70		100	3
4	MEC304	Digital Electronics	ESC	T	3	0	0	20	10	30		70		100	3
5	MAS302/ MCS304	Universal Human Value and Professional Ethics / Fundamentals of Cyber Security	HSMC/PCC	T	2	0	0	20	10	30		70		100	2
6	MAE301/ MAE302	Verbal Ability and Communication skills /Quantitative and Logical Reasoning *	AEC	T	2	0	0				50			50	2
7	MCS351	Data Structure Lab	PCC	P	0	0	4				50		50	100	2
8	MCS352	Computer Organization and Architecture Lab	PCC	P	0	0	2				50		50	100	1
9	MCS353	Internship /Mini Project/Startup and Entrepreneurial Activity Assessment**	PR / INT	P	0	0	2				100			100	1
10	MSE351	Competitive Coding workshop-I*	SEC	P	0	0	2				50			50	1
11	MCS354/ MCS355/ MCS356	Cyber Security Workshop/Robotics Process Automation (UiPath)/AWS	PCC	P	0	0	2				50			50	1
12	MNC302	Sports and Yoga***	NC	P	0	0	2				50			50	0
		Total			16	0	14							950	22

*The subject will be evaluated by an external assessment agency

**The Mini Project or internship (4 weeks) will be done during summer break after 2nd Semester and will be assessed during III semester

*** Compulsory Qualifying Audit Course

SEMESTER –IV															
S.NO.	Subject Code	Subject	Category	T/P	Periods			Evaluation Scheme						Total	Credit
					L	T	P	Continuous Internal Assessment				End Semester			
								CT	TA	Total	PS	TE	PE		
1	MCS401	Operating System	PCC	T	3	0	0	20	10	30		70		100	3
2	MCS402	Object Oriented Programming with Java	PCC	T	3	0	0	20	10	30		70		100	3
3	MCS403	Design and Analysis of Algorithm	PCC	T	3	1	0	20	10	30		70		100	4
4	MAS401	Linear Algebra & Statistics	BSC	T	3	1	0	20	10	30		70		100	4
5	MAS402/ MCS404	Universal Human Value and Professional Ethics / Fundamentals of Cyber Security	HSMC/ PCC	T	2	0	0	20	10	30		70		100	2
6	MAE401/ MAE402	Verbal Ability and Communication*/Quantitative and Logical Reasoning*	AEC	T	2	0	0				50			50	2
7	MCS451	Operating System Lab	PCC	P	0	0	2				50		50	100	1
8	MCS452	Object Oriented Programming with Java Lab	PCC	P	0	0	2				50		50	100	1
9	MCS453	Design and Analysis of Algorithm Lab	PCC	P	0	0	2				50		50	100	1
10	MSE451	Competitive Coding workshop--II*	SEC	P	0	0	2				50			50	1
11	MCS454/ MCS455/ MCS456	Cyber Security Workshop/Robotics Process Automation (UiPath)/AWS	PCC	P	0	0	2				50			50	1
12	MNC401	Environment Sciences ***	NC	T	2	0	0	20	10	30		70		100	0
		Minor Degree/Honors Degree MT-1/HT-1													
		Total			18	2	10							950	23

*The subject will be evaluated by an external assessment agency

**The Mini Project or internship (4 weeks) will be done during summer break after 2nd Semester and will be assessed during III semester

*** Compulsory Qualifying Audit Course

DETAILED SYLLABI

B.Tech – 2nd Year
(Computer Science)

Effective From Session: 2026-27

Semester – III

MCS301		DATA STRUCTURES	L T P : 3 0 0	Credits: 3
The students will be able to				BL
CO-1:	Apply concepts of algorithms, arrays, searching, and sorting techniques to solve computational problems and analyze their efficiency.			K2
CO-2:	Implement linked lists, polynomial operations, and hashing techniques for efficient data organization and manipulation.			K3
CO-3:	Analyze the use of stacks, queues, iteration, and recursion concepts in expression evaluation and problem solving.			K3
CO-4:	Analyze and implement tree structures, binary search trees, traversals, AVL trees, and heaps for hierarchical data processing.			K4
CO-5:	Analyze graph representations and algorithms such as DFS, BFS, Prim's, Kruskal's, Dijkstra's, and Warshall algorithms for solving network problems.			K5
Unit	Topic			Hrs.
I	Introduction: Basic Terminology, Built in Data Types in C. Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big Oh, Big Theta and Big Omega, Time-Space trade-off. Abstract Data Types (ADT) Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Derivation of Index Formulae for 1-D,2-D,3-D and n-D Array Application of arrays, Sparse Matrices and their representations. Searching: Concept of Searching, Sequential search, Index Sequential Search, Binary Search. Sorting: Insertion Sort, Selection, Bubble Sort, Quick Sort, Merge Sort, and Radix Sort.			09
II	Linked lists: Array Implementation and Pointer Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List & Operations on a Linked List: Insertion, Deletion, Traversal, Polynomial Representation and Addition Subtraction & Multiplications of Single variable & Two variables Polynomial. Hashing: Concept of Hashing & Collision resolution Techniques used in Hashing.			09
III	Stacks: Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Iteration and Recursion- Principles of recursion, Tail recursion, Removal of recursion Problem solving using iteration and recursion with examples such as binary search, Fibonacci numbers, and Hanoi towers. Tradeoffs between iteration and recursion. Queues: Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, DE queue and Priority Queue			10
IV	Trees: Basic terminology used with Tree, Binary Trees, Binary Tree Representation: Array Representation and Pointer (Linked List) Representation, Binary Search Tree, Strictly Binary Tree, Complete Binary Tree, Extended Binary Trees, Tree Traversal algorithms: In-order, Pre-order and Post-order, Constructing Binary Tree from given Tree Traversal, Operation of Insertion, Deletion, Searching & Modification of data in Binary Search. Threaded Binary trees, Traversing Threaded Binary trees. Huffman coding using Binary Tree. Concept & Basic Operations for AVL Tree, B Tree & Binary Heaps, Heap sort			10
V	Graphs: Terminology used with Graph, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List, Adjacency. Graph Traversal: Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transitive Closure and Shortest Path algorithm: Warshal Algorithm and Dijkstra Algorithm			7
TEXT BOOKS: 1. Horowitz and Sahani, “Fundamentals of Data Structures”, Galgotia Publications Pvt Ltd Delhi India. 2. Lipschutz, “Data Structures” Schaum’s Outline Series, Tata McGraw-hill Education (India) Pvt. Ltd 3. Thareja, “Data Structure Using C” Oxford Higher Education.				

REFERENCE BOOKS:

1. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, “Data Structures Using C and C++”, PHI Learning Private Limited, Delhi India.
2. Gilberg ,Forouzan, Data Structures: A Pseudocode Approach with C 3rd edition , Cengage Learning publication.
3. AK Sharma, “Data Structure Using C”, Pearson Education India.
4. Rajesh K. Shukla, “Data Structure Using C and C++” Wiley Dreamtech Publication.
5. Michael T. Goodrich, Roberto Tamassia, David M. Mount “Data Structures and Algorithms in C++”, Wiley India.
6. P. S. Deshpandey, “C and Data structure”, Wiley Dreamtech Publication.
7. R. Kruse etal, “Data Structures and Program Design in C”, Pearson Education.
8. **Berztiss, AT: Data structures, Theory and Practice, Academic Press.**
9. **Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with applications”, McGraw Hill.**

MCS302	Computer Organisation and Architecture	L T P : 3 0 0	Credits: 3
The students will be able to			BL
CO1	Identify the computer hardware and how software interacts with the computer hardware	K2	
CO2	Apply the concepts of Instruction Set Architecture, addressing modes, and CPU organization, including ALU and control unit design.	K3	
CO3	Examine the detailed operation of Basic Processing units and analyze the performance of Pipelining with different instruction sets.	K4	
CO4	Evaluate memory hierarchy, cache design, and virtual memory techniques for efficient data storage and retrieval.	K4	
CO5	Demonstrate I/O mechanisms and assess modern architectures like multicore processors, GPUs, and emerging computing trends.	K4	

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

Unit	Topic	Hrs
I	Introduction: Functional units of a computer system and their interconnections, Buses: Types of Buses, Number systems, Signed number representation (1's and 2's complement), Floating point representation (IEEE 754), Addition and Subtraction of signed Numbers.	9
II	Design of the ALU: Multiplication: Signed operand multiplication, Booth's algorithm and array multiplier. Division and logic operations. Floating point arithmetic operation, Arithmetic & logic unit design. stack organization and addressing modes.	9
III	Control Unit & Parallelism: Instruction types, formats, instruction cycles and sub cycles RISC vs. CISC and Hardwired control and Micro programmed control Instruction pipeline and stages, Pipeline hazards: Data hazards, Control hazards and Structural hazards, Performance improvement techniques, Parallel processing concepts, Flynn's classification (SIMD, MIMD), Introduction to multicore processors	9
IV	Memory Organization: Memory hierarchy (Registers, Cache, Main Memory, Secondary Memory), Cache memory: Mapping techniques (Direct, Associative, Set-associative), Replacement policies, Virtual memory, Paging and segmentation, Introduction to Disk Scheduling.	9
V	Input/output Organization & Advanced Topics: I/O organization and interfaces, Interrupts and interrupt handling, Direct Memory Access (DMA), I/O techniques (Programmed, Interrupt-driven), Bus structure and arbitration, Multiprocessor systems, Emerging trends: Introduction to GPU architecture, AI accelerators and Energy-efficient computing.	9

Text Books:-

1. Computer System Architecture - M. Mano
2. William Stallings, Computer Organization and Architecture-Designing for Performance, Pearson Education, Seventh edition, 2006.
3. Structured Computer Organization, Tannenbaum (PHI).

Reference Books:-

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky Computer Organization, McGraw-Hill, Fifth Edition.
2. John P. Hayes, Computer Architecture and Organization, Tata McGraw Hill, Third Edition.
3. Behrooz Parahami, "Computer Architecture", Oxford University Press, Eighth Impression.
4. David A. Patterson and John L. Hennessy, "Computer Architecture-A Quantitative Approach", Elsevier, a division of Reed India Private Limited, Fifth edition.

Web Link:

1. https://archive.nptel.ac.in/content/syllabus_pdf/106105163.pdf
2. <https://nptel.ac.in/courses/106106166>

MCS303	Discrete Structures & Theory of Logic	L T P : 3 0 0	Credits: 3
The students will be able to			BL
CO1	Apply sets, relations, and functions to formally represent discrete data and relational databases		K3
CO2	Formulate logical statements, evaluate truth values, and apply rules of inference to validate theoretical computational models		K3
CO3	Describe algebraic properties of Lattices and Boolean algebras		K3
CO4	Apply basic algebraic structures and simple combinatorial techniques to solve computational problems		K3
CO5	Model and solve real-world connectivity, traversal, and scheduling problems using graph based concepts like bipartite matching, graph coloring, Eulerian, and Hamiltonian circuits		K3

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

Unit	Topic	Hrs
I	Sets, Relations, and Functions: Algebra of Sets; Binary relations, operations, properties, graphical and matrix representations; Closures (reflexive, symmetric, transitive), Warshall algorithm; Functions, important functions, types of functions	10
II	Mathematical Logic: Propositions; Truth Tables; Tautology, Contradiction, Satisfiability; Propositional Algebra; Rules of logical reasoning; Predicates, Quantifiers, Theory of Inference	08
III	Lattices and Boolean Algebras: Posets, Hasse diagram, Extremal elements; Properties of Lattices; Bounded, Complemented, Distributed, and Modular Lattices; Boolean Algebras; Important Examples; Some other properties	08
IV	Algebraic Structures & Combinatorics: Groups and Subgroups; Order; Cyclic Groups, Cosets, Lagrange's Theorem; Normal Subgroups, Quotient, Homomorphism; Permutations and Symmetric Group S_3 , Rings and Fields (introduction and elementary properties); Basic Counting Techniques, Pigeonhole Principle	10
V	Graph Theory: Definitions and Motivating examples; Some common Graphs; Euler Theorem; Degree Sequence; Matrix representations; Isomorphism; Subgraphs; Bipartite Graphs, Bipartite Matching (applications of stable marriage problem); Graph Colorings, Euler and Hamiltonian Graphs, Planar Graphs	12

TEXT BOOKS:

1. K.H. Rosen, Discrete Mathematics and Its Applications (6/e), McGraw-Hill, 2006.
2. C.L. Liu and D.P. Mohapatra, Elements of Discrete Mathematics,
3. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science,
4. N. Deo, Graph Theory with Applications to Engineering and Computer Science
5. R.P. Grimaldi, Discrete and Combinatorial Mathematics (5/e), Pearson, 2004.

REFERENCE BOOKS:

6. E. Lehman, F.T. Leighton, and Albert R. Meyer, Mathematics for Computer Science, MIT,
7. B. Kolman, R.C. Busby, and S.C. Ross, Discrete Mathematical Structures (5/e), Pearson, 2004.
8. V. Krishnamurthy, Combinatorics: Theory and Application, East-West Press, New Delhi, 2008.
9. R.A. Brualdi, Introductory Combinatorics (5/e), Pearson Education. 2019.
10. D. Gusfield and R.W. Irving, The Stable Marriage Problem: Structure and Algorithms, MIT Press, Cambridge, Massachusetts, 1989.

MEC311	Digital Electronics	L T P: 3 0 0	Credits: 3
The students will be able to			BL
CO1	To represent, convert, and perform arithmetic on diverse data types within digital systems		K3
CO2	foundational of knowledge and practical skills required to design, analyse, and troubleshoot digital electronic circuits		K4
CO3	To design, analyse, and optimize digital logic circuits		K4
CO4	To know about operation of binary storage elements, effectively build time-critical memory systems like registers, and construct advanced counting mechanisms		K4
CO5	Skills to analyse, design, and interface data conversion circuits, programmable logic, and digital integrated circuits		K4

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

Unit	Topic	Hrs
I	Review of Number System: -Some Common Terms- Binary Number System, Decimal Number System, Octal Number, Hexadecimal Number System; 1's Complement, 2's Complement; Conversion: Binary, Decimal, Octal, Hexadecimal number system to each other; The Four Axioms; Binary Codes: Excess-3 Code, Gray Code, Alphanumeric Codes, Seven-segment Display Code, Error Detection and Correction Codes Digital Arithmetic; Basic Rules of Binary Addition and Subtraction also Using the 2's Complement Method; BCD Addition and Subtraction in Excess-3 Code; Binary Multiplication; Binary Division; Floating-Point (single & double precision) Arithmetic's.	8
II	Review of Logic Gates: Positive and Negative Logic; Truth Table; Logic Gate: Universal Gates; Some Common Applications of Logic Gates. Boolean Algebra and Simplification Techniques: Introduction to Boolean Algebra; Postulates of Boolean Algebra; Theorems of Boolean Algebra; Sum-of-Products Boolean Expressions (SOP), Product-of-Sums Expressions (POS) Expanded Forms of Boolean, Expressions Canonical Form of Boolean Expressions and Nomenclature; Quine-McCluskey Tabular Method; Karnaugh Map Method; don't care condition and realization of Boolean function.	8
III	Designing of combinational Circuit: Combinational Circuits; Implementing Combinational Logic; Arithmetic Circuits –Basic Building Blocks: Half adder, Full adder, Half Subtractor, Full subtractor, Controlled Inverter; Adder & Subtractor; BCD Adder; Carry Propagation–Look-Ahead Carry Generator; Arithmetic Logic Unit (ALU), Multipliers, Magnitude Comparator, Multiplexer; Encoders, Demultiplexers and Decoders; Design Applications-Relevant Information.	10
IV	Flip-Flop and Related Devices Flip-flops – Types of flip-flop – RS (NAND and NOR) flip-flop, Edge triggered D flip-flop, Edge triggered T flip-flop, Edge triggered JK flip-flop, Master-Slave flip-flop – Triggering, propagation delay time, setup time, hold time. Counters and Registers: Registers – Introduction- Modes of operation of register (SISO, SIPO, PISO and PIPO), universal shift register. Counters – Asynchronous counter- Synchronous counter – Ripple counters – MOD-7 ripple counter – Decade counter – 4-bit down counter – Up/down	12
	counter.	1

	Introduction of FSM and ASM.	
V	Unit V Programmable Logic Devices: Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM. Programmable Logic Devices (PLD) – Programmable Logic Array (PLA) - Programmable Array Logic (PAL and PLA), design approach using Logisim software Logic Families: Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan- in, noise margin, logic families and their characteristics-RTL, TTL, ECL, CMOS	10

TEXT BOOKS:

1. M. Morris Mano and M. D. Ciletti, “Digital Design”, Pearson Education.
2. R. P. Jain, “Modern Digital Electronics”, McGraw Hill Publication.
3. A. Anand Kumar, “Fundamental of Digital Circuits”, PHI 4th edition, 2018

REFERENCE BOOKS:

1. Ronald J Tocci, Neal S. Windmer "Digita System-Principiland Applicatione "Pearson
2. Digital Circuits and Design, S. Salivahanan, Oxford University Press.
3. David J. Comer, “Digital Logic & State Machine Design”, Oxford University Press.
4. D. V. Hall, “Digital Circuits and Systems”, McGraw Hill, 1989.
5. Maini, Anil Kumar. "Digital Electronics-Principles, Devices, and Applications" John Wiley & Sons

Web Link:

<https://nptel.ac.in/courses/108105132>
<https://nptel.ac.in/courses/108105132>
<https://nptel.ac.in/courses/106105185>

MAS302/MAS402		Universal Human Value & Professional Ethics	L T P:2-0-0	Credit: 2
The students will be able to				BL
CO-1:	Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society			K2
CO-2:	Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.			K3
CO-3:	Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society			K4
CO-4:	Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.			K4
CO-5:	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work			K4
Unit	Topic			Proposed Lecture 30
I	Course Introduction - Need, Basic Guidelines, Content and Process for Value Education Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration-what is it? - its content and process; „Natural Acceptance“ and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities-the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.			7
II	Understanding Harmony in the Human Being - Harmony in Myself Understanding human being as a co-existence of the sentient „I“ and the material „Body“, Understanding the needs of Self („I“) and „Body“ - Sukh and Suvidha, Understanding the Body as an instrument of I“ (I being the doer, seer and enjoyer), Understanding the characteristics and activities of „I“ and harmony in „I“, Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.			6
III	Understanding harmony in the Family - the basic unit of human interaction , Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family.			7
IV	Understanding Harmony in Nature and Existence - Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence			5

	as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence	
V	Implications of the above Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations	5

TEXT BOOKS:

1. M. P. Deisenroth, A. A. Faisal, and C. S. Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
2. G. Strang, Introduction to Linear Algebra (5/e), Wellesley-Cambridge Press, 2016.
3. J. L. Devore, Probability and Statistics for Engineering and the Sciences (9/e), Cengage Learning, 2012.
4. R.E. Walpole, R.H. Myers, S. L. Myers, Probability and Statistics for Engineers & Scientists (9/e), Pearson, 2010.

REFERENCE BOOKS:

1. R. Bronson, G.B. Costa, Linear Algebra - An introduction (2/e), Academic press, 2007.
2. H. Anton, C. Rorres, Elementary linear algebra: Applications Version (9/e), Wiley.
3. S. C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S Chand Publishers.
4. S. M. Ross, Probability and Statistics for Engineers and Scientists, Academic Press.

MCS 304	Fundamentals of Cyber Security	L T P: 2 0 0	Credits: 2
The students will be able to			BL
CO1	Understand the basic concepts of cyber security and cybercrimes		K2
CO2	Understand the Cyber Crimes Attacks in Mobile and Wireless Devices.		K2
CO3	Understand the tools and methods used in cyber crime		K2
CO4	Understand the concepts of cyber forensics		K2
CO5	Understand the cyber security policies and cyber laws		K2

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

Unit	Topic	Hrs
I	INTRODUCTION TO CYBER CRIME: Cybercrime- Definition and Origin of the word Cybercrime and Information Security, Fundamentals of Cyber Security and the CIA Triad (Confidentiality, Integrity, and Availability), Who are Cybercriminals? Classifications of Cybercrimes, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyber Offenses: How criminals plan the attacks, Types of cyber-attacks (Active and Passive Attacks), Social Engineering, Cyber stalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector.	05
II	CYBER CRIME: Mobile and Wireless Devices-Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Malware and Mobile Application Security, Mobile Devices: Security Implications for organizations, Organizational measures for handling mobile, Organizational Security Policies and Measures in Mobile Computing Era. Wireless Network Security: Wi-Fi, Bluetooth, NFC, and RFID Security.	05
III	TOOLS AND METHODS USED IN CYBERCRIME: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan-horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction to Phishing, Identity Theft (ID Theft)	05
IV	UNDERSTANDING COMPUTER FORENSICS: Introduction, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Mobile Device Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Challenges in Computer Forensics.	05
V	INTRODUCTION TO SECURITY POLICIES AND CYBER LAWS: Need for An Information Security Policy, Introduction to Indian Cyber Law, Objective and Scope of the Digital Personal Data Protection Act 2023, Intellectual Property Issues, Overview of Intellectual Property Related Legislation in India, Patent, Copyright, Trademarks, Cyber Incident Reporting and CERT-In Guidelines.	05

Recommended Text Books:

1. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, Publish Date 2013.
2. Stallings, William, "Cryptography and Network Security" : Principles and Practice. 7th ed. Pearson, 2017.

3. Basta, Basta, Brown, Kumar, Cyber Security and Cyber Laws, 1st edition, Cengage Learning publication
4. Dr. Surya PrakashTripathi, Ritendra Goyal, Praveen Kumar Shukla, KLSI. "Introduction to information security and cyber laws". Dreamtech Press. ISBN: 9789351194736, 2015.

Reference Books:

5. Cyber Security and Data Privacy by Krishan Kumar Goyal, Amit Garg, Saurabh Singhal, HP HAMILTON LIMITED Publication, ISBN-13-978-1913936020
6. Thomas J. Mowbray, "Cybersecurity: Managing Systems, Conducting Testing
7. Investigating Intrusions", Copyright © 2014 by John Wiley & Sons, Inc, ISBN: 978 - 1-118 -84965 -1.
8. James Graham, Ryan Olson, Rick Howard, "Cyber Security Essentials", CRC Press, 15-Dec 2010.
9. Anti- Hacker Tool Kit (Indian Edition) by Mike Shema, McGraw-Hill Publication.

MAE 301/401		Verbal Ability & Communication Skill	LTP:2-0-0	Credit:2
The students will be able to				BL
CO1	Develop effective communication skills in professional and social environments through structured verbal and non-verbal interaction.			K2
CO2	Understanding Vocabulary Enhancement, Grammar, and language proficiency for clear, confident, and impactful communication.			K3
CO3	Improve listening and comprehension abilities for better understanding, interpretation, and response in communication situations.			K4
CO4	Develop critical thinking and problem-solving abilities through Writings, discussions, debates, and situational analysis			K4
CO5	Perform effectively in Personal goals achievements, group discussions, and professional interactions by demonstrating confidence, adaptability, and communication competence.			K5
DETAILED SYLLABUS				
Unit	Topic			Proposed Lecture 20
I	Focus on Verbal Ability- Basics of Grammar(Parts of speech, Spotting Error, Sentence correction, Para- jumbles, Clauses & Phrases) Effective communication- Communication - Its types and characteristics, Exercises.			4
II	Vocabulary drills - Synonyms, Antonyms, Homonyms, Idioms and proverbs, One word substitution, Reading comprehension. Confidence building – Leadership, Introduction, Group exercises, Professional Etiquettes.			4
III	Presentation skills – Time management, Communication in teams – divide in three (Debate). Articles, Cloze test, Narration, Tenses, Prefix & Suffix, Modals, Critical reasoning.			4
IV	Professional skills – Paragraph writing, Precis writing, E-mail writing, Report writing. Presentation rounds, Newspaper reading, Group presentation.			4
V	Basics of essay writing - Analytical and subjective essays, Voice, Resume building, Summary(Pride & prejudice, Hard times by Charles dickens, The old man & the sea by Ernest Hemingway) Ethical & effective use of social media - Digital platforms(LinkedIn, Review, Feedback)			4
REFERENCE BOOKS:				
1. Essential English Grammar with Answers by Raymond Murphy, Second Edition.				
2. Novel-Pride & Prejudice by Jane Austen.				
3. Novel-Hard Times by Charles Dickens.				
4. Oxford Practice Grammar with Answers by John Eastwood.				
5. The Art of Public Speaking by Dale Carnegie & J. Berg Esewnwein.				

MAE 302/402	Quantitative & Logical Reasoning	LTP:2-0-0	Credit:2
The students will be able to			BL

CO1	Apply fundamental mathematical concepts and basic logical reasoning techniques to solve problems involving number systems, arithmetic operations, coding-decoding, and analogies.	K2
CO2	Analyze quantitative and logical reasoning problems involving commercial mathematics, algebraic concepts, numerical series, and blood relations using appropriate analytical techniques.	K3
CO3	Solve real-life quantitative aptitude and analytical reasoning problems involving proportional reasoning, motion, work efficiency, spatial orientation, and visual reasoning.	K4
CO4	Evaluate financial, spatial, and logical reasoning problems by applying concepts of interest calculations, arrangements, spatial visualization, Venn diagrams, and deductive reasoning.	K4
CO5	Interpret, analyze, and evaluate graphical and tabular data to identify trends, compare datasets, and support effective quantitative decision-making.	K5

DETAILED SYLLABUS

Unit	Topic	Proposed Lecture: 20
I	Classification of Numbers, Divisibility Rules, LCM/HCF, Average, Coding & Decoding, Analogy	4
II	Percentage, Profit and Loss, Algebra, Remainder Theorem, Series, Blood relations	4
III	Ratio and Proportion, Time and Work, Time, Speed and Distance , Train , Boats & Streams, Direction sense, Counting of figures & Odd one out	4
IV	Simple Interest, Compound Interest, Cube and Dice, Linear arrangement & Circular arrangement, Venn diagram, Syllogism	4
V	Data Interpretation (Table Charts), Data Interpretation (Bar Charts), Data Interpretation (Line Charts), Data Interpretation (Pie Charts)	4

REFERENCE BOOKS:

1. Dr. R.S. Agarwal Qualitative Aptitude
2. Dr. R.S. Agarwal Verbal & Non-Verbal Reasoning.
3. Dr. R.S. Agarwal Logical Reasoning.

MCS351	Data Structures Lab	L T P: 0 0 4	Credits: 2
The students will be able to			BL
CO1	<i>Implement array, linked list, stack, and queue data structures to perform fundamental operations.</i>		K3
CO2	<i>Apply sorting, hashing, and tree-based data structures to perform efficient data organization and retrieval.</i>		K3
CO3	<i>Apply graph traversal and shortest path algorithms to solve graph-related problems using suitable graph representations.</i>		K3

List of Experiments

Minimum ten experiments out of the following:

- 1. Write a program to perform insertion, deletion and display in a 1-D array.*
- 2. Write a program to find the transpose of a matrix.*
- 3. Write a program to implement Singly Linked List with insertion and display operations.*
- 4. Write a program to implement Singly Linked List with deletion and display operations.*
- 5. Write a program to reverse a Singly Linked List.*
- 6. Write a program to implement Circular Linked List with insertion and display operations.*
- 7. Write a program to implement Circular Linked List with deletion and display operations.*
- 8. Write a program to implement Doubly Linked List with insertion and display operations.*
- 9. Write a program to implement Doubly Linked List with deletion and display operations.*
- 10. Write a program to implement Radix Sort.*
- 11. Write a program to implement Quick Sort.*
- 12. Write a program to implement Merge Sort.*
- 13. Write a program to implement Stack using array.*

14. Write a program to implement Stack using linked list.
15. Write a program to convert infix expression to postfix expression using stack.
16. Write a program to solve Tower of Hanoi using recursion.
17. Write a program to implement Queue using linked list.
18. Write a program to implement Circular Queue using array.
19. Write a program to create a Binary Tree and perform preorder, inorder and postorder traversal.
20. Write a program to implement Binary Search Tree insertion and deletion.
21. Write a program to implement Min Heap and Max Heap.
22. Write a program to implement Breadth First Search traversal.
23. Write a program to implement Depth First Search traversal.
24. Write a program to find Minimum Spanning Tree using Kruskal's Algorithm.
25. Write a program to find Minimum Spanning Tree using Prim's Algorithm.

MCS352	Computer Organisation and Architecture Lab	L T P : 0 0 2	Credits: 1
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The students will be able to		BL
CO-1:	<i>Design and implement combinational logic circuits such as adders, code converters, decoders, and multiplexers using basic logic gates.</i>	K3
CO-2:	<i>Design and implement sequential logic circuits including flip-flops, counters, shift registers, and an 8-bit Arithmetic Logic Unit (ALU) to perform specified digital operations.</i>	K3
CO-3:	<i>Develop, simulate, and verify digital logic circuits using Logisim software to validate the functionality of combinational and sequential circuits.</i>	K3

List of Experiments

Hardware Based:

1. Implement Half Adder & Full Adder using basic logic gates.
2. Design Binary $\leftrightarrow$ Gray and Gray $\leftrightarrow$ Binary Code Converter.
3. Design 3-to-8-line Decoder.
4. Design 4x1 and 8x1 Multiplexers.
5. Design and verify Flip-Flops and excitation tables.
6. Design up/down Counter.
7. Implementation of Shift Registers.
8. Design of an 8-bit ARITHMETIC LOGIC UNIT.

Simulation Based:

9. Introduction to Logisim software and implementation of basic gates through it.
Implementation of Adders using Logisim software.

MSE351		Competitive Coding Workshop-I		L T P : 0 0 2		Credits: 1	
The students will be able to						BL	
CO-1:		Develop problem-solving skills using an online coding platform by implementing algorithms involving conditionals, loops, nested iterations, mathematical computations, pattern-based problems, and functions.					-K3
CO-2:		Apply programming concepts to solve problems involving 1D Arrays, 2D Arrays (Matrices), Strings, Singly Linked Lists, and Doubly Linked Lists through hands-on coding practice.					K3
CO-3:		Implement and analyze solutions using fundamental data structures and algorithms, including Stacks, Queues, and Binary Search, on an online coding platform.					K3
S. No.		Topics		List Of Experiments			Duration (Hrs)
1		Introduction of coding on Online platform and practice easy problems		1.) Start Coding 2.) Print ascii value in python 3.) Swap Two Numbers 4.) Area of Circle/Rectangle 5.) Distance between two points 6.) Celsius to Fahrenheit			2
2		Loops and Decisions Refresher & Digit Manipulation & Math		1.) Check the status 2.) Largest of Three 3.) Fizzbuzz Program 4.) Special Odd Series Sum 5.) Sum of Series 6.) Sum of even and Odd Numbers 7.) Count Digits 8.) Reverse a Number 9.) Palindrome Number 10.) Armstrong Number 11.) Sum of Digits 12.) GCD of Two Numbers 13.) LCM of Two Numbers 14.) Perfect Number 15.) Decimal to Binary 16.) Check Strong Number			6
3			"* * * * * *				

	Pattern Printing	* * * * * * * * * Print the given pattern." "1 1 2 1 2 3 1 2 3 4 1 2 3 4 5 Print the given pattern." "A B B C C C D D D D E E E E E Print the given pattern." "* * * * * * * * * * * * * * * Print the given pattern." "1 2 3 4 5 1 2 3 4 1 2 3 1 2 1 Print the given pattern." Print Square Number Pattern Floyd's Triangle Alphabet Pattern Double Triangle	4	
4	Array , 2D Arrays	1.) Find Min and Max in Array 2.) Linear Search 3.) Is Array Sorted? 4.) Rotate Array One Position 5.) Find Duplicate 6.) Countries at War 7.) Smallest/2nd Smallest 8.) Snake Pattern 9.) Diagonal Sum 10.) Sum of Triangles 11.) Search in 2D Matrix 12.) Search in a row-wise sorted matrix	4	
5	String	1) Count Unique Vowel Strings 2) Check Palindrome String 3) String Rotation Check 4) Anagram Check 5) First Unique Character 6) Binary String check	2	

6	Linklist , Doubly Linkedlist , Circular Linked List	1.) Reverse Linked List 2.) Middle of the Linked List 3.) Convert Binary Number in a Linked List to Integer 4.) Linked List Cycle 5.) Remove Linked List Elements 6.) Insertion at the beginning of Circular Linked List 7.) Length of Circular Linked List 8.) Insertion in an empty circular linked list 9.) Circular Linked List Traversal 10.) Check If Circular Linked List 11.) Doubly Linked List from an Array 12.) Size of Doubly Linked List 13.) Doubly Linked List Traversal	6	
7	Stack & Queue	1) Stack Operations 2) Reverse Using Stack 3) Special Stack 4) 20. Valid Parentheses 5) 225. Implement Stack using Queues 6) 496. Next Greater Element I 7) 225. Implement Stack using Queues 8) 232. Implement Queue using Stacks 9) 2073. Time Needed to Buy Tickets	4	
8	Binary Search	1.) 704. Binary Search 2.) 35. Search Insert Position 3.) 34. Find First and Last Position of Element in Sorted Array	2	
Assessment	Coding & MCQ Based Assessment covering above topics			

MCS 354	Cyber Security Workshop	L T P : 0 0 2	Credits: 1
The students will be able to			BL
CO1	Understand capturing packets using Wireshark and to analyze protocols like HTTP, DNS, SMTP, TCP and UDP		K2
CO2	Understand and analyze network captured traffic to detecting suspicious activities and identify signs of malware communication		K3
CO3	Understand and demonstrate vulnerabilities and exploit vulnerabilities		K3

List of Experiments:

1. Basic Packet Inspection: Capture network traffic using Wire shark and analyze basic protocols like HTTP, DNS, and SMTP to understand how data is transmitted and received.
2. Detecting Suspicious Activity: Analyze network traffic to identify suspicious patterns, such as repeated connection attempts or unusual communication between hosts.
3. Malware Traffic Analysis: Analyze captured traffic to identify signs of malware communication, such as command-and-control traffic or data infiltration.
4. Password Sniffing: Simulate a scenario where a password is transmitted in plaintext. Use Wireshark to capture and analyze the packets to demonstrate the vulnerability and the importance of encryption.
5. ARP Poisoning Attack: Set up an ARP poisoning attack using tools like Ettercap. Analyze the captured packets to understand how the attack can lead to a Man-in-the-Middle scenario.
6. SQL Injection: Use DVWA to practice SQL injection attacks. Demonstrate how an attacker can manipulate input fields to extract, modify, or delete database information.
7. Cross-Site Scripting (XSS): Exploit XSS vulnerabilities in DVWA to inject malicious scripts into web pages. Show the potential impact of XSS attacks, such as stealing cookies or defacing websites
8. Cross-Site Request Forgery (CSRF): Set up a CSRF attack in DVWA to demonstrate how attackers can manipulate authenticated users into performing unintended actions.
9. File Inclusion Vulnerabilities: Explore remote and local file inclusion vulnerabilities in DVWA. Show how attackers can include malicious files on a server and execute arbitrary code.
10. Brute-Force and Dictionary Attacks: Use DVWA to simulate login pages and demonstrate brute-force and dictionary attacks against weak passwords. Emphasize the importance of strong password policies.

Value added Practical:

Install and configure Wireshark for network packet capture and analysis.

Set up a virtualized environment and deploy DVWA with Kali Linux to perform basic web application security testing and vulnerability assessment.

Cyber Security Workshop (MCS354)

MCS355		Robotics Process Automation (UiPath)		L T P: 0 0 2		Credits:1	
The students will be able to						BL	
CO1	Understand RPA fundamentals, the UiPath environment, automation lifecycle, and identify suitable business processes for automation.					K2	
CO2	Design and develop UiPath automation workflows using variables, arguments, control flow, exception handling, UI automation, selectors, and data manipulation techniques.					K3	
CO3	Build, deploy, and manage end-to-end automation solutions involving screen scraping, data extraction, PDF, Excel, email automation, and UiPath Orchestrator following RPA best practices.					K3	
S. No	Experiment (Title) to be conducted						
1	To install and configure UiPath Studio and create the first "Hello World" automation using the Message Box activity.						
2	To create and use variables and arguments in UiPath workflows for storing and transferring data efficiently.						
3	To implement decision-making constructs using If, Switch, and Assign activities in UiPath workflows.						
4	To develop iterative workflows using While, Do While, and For Each loop for repetitive task automation.						
5	To design and organize automation workflows using Sequences and Flowcharts in UiPath.						
6	To implement exception handling mechanisms using Try-Catch, Retry Scope, and Global Exception Handler for robust automation.						
7	To automate user interface interactions using Selectors, Type Into, Click, and Recording features in UiPath.						
8	To perform data manipulation using variables, collections, lists, dictionaries, and data conversion activities in UiPath.						
9	To extract data from applications and documents using Screen Scraping, Data Scraping, and PDF Data Extraction techniques.						
10	To automate Microsoft Excel operations, including reading, writing, updating, and formatting Excel data using UiPath.						
11	To develop email automation bots for sending, receiving, and processing emails using UiPath.						
12	To publish, manage, and monitor robotic process automation workflows using UiPath Orchestrator.						

MCS356	AWS Lab	L T P : 0 0 2	Credits: 2
The students will be able to			BL
<i>C01</i>	<i>Understand cloud computing fundamentals, AWS services, and cloud cost management</i>		<i>K2</i>
<i>C02</i>	<i>Apply AWS security, IAM, and networking concepts to secure cloud environments.</i>		<i>K3</i>
<i>C03</i>	<i>Deploy and manage AWS compute, storage, and database services.</i>		<i>K3</i>

List of Experiments

Minimum ten experiments out of the following:

- 1 Introduction to AWS Management Console and Learner Lab AWS Console, Learner Lab
- 2 Create and Manage IAM Users, Groups and Policies IAM
- 3 Configure IAM Roles and Multi-Factor Authentication IAM, MFA
- 4 Create an S3 Bucket and Manage Objects Amazon S3
- 5 Configure S3 Versioning, Lifecycle and Encryption Amazon S3
- 6 Host a Static Website using Amazon S3 S3 Website Hosting
- 7 Launch and Configure an Amazon EC2 Instance Amazon EC2
- 8 Install and Deploy a Web Server on EC2 EC2, Apache/Nginx
- 9 Create and Attach an EBS Volume to EC2 Amazon EBS
- 10 Create a VPC with Public and Private Subnets Amazon VPC
- 11 Configure Route Tables, Internet Gateway and Security Groups VPC, IGW, Route Tables
- 12 Configure Elastic IP and NAT Gateway VPC, NAT Gateway
- 13 Create an Amazon RDS Database and Connect from EC2 Amazon RDS, EC2
- 14 Create and Query a DynamoDB Table Amazon DynamoDB
- 15 Create and Execute an AWS Lambda Function AWS Lambda
- 16 Deploy a Web Application using Elastic Beanstalk AWS Elastic Beanstalk
- 17 Configure CloudWatch Metrics, Logs and Alarms Amazon CloudWatch
- 18 Monitor API Activity using AWS CloudTrail AWS CloudTrail
- 19 Configure CloudFront for Content Delivery Amazon CloudFront
- 20 Build a Scalable Web Application using Load Balancer and Auto scaling ELB, Auto Scaling

Industry Oriented Experiments Syllabus:

- 21 Build a Global Content Delivery Architecture Amazon CloudFront, S3
- 22 Automate Cloud Infrastructure Deployment AWS CloudFormation,
- 23 Capstone: Design and Deploy a Production-Style Cloud Application VPC + EC2 + S3 + RDS + ELB + Auto Scaling + CloudWatch

MNC302/ MNC402	Sports and Yoga	L-T-P:002	Credits : 0
The students will be able to			BL
CO1: Demonstrate improved physical and mental well-being by practicing techniques that enhance fitness, emotional balance, and stress management in daily life.			
CO2: Apply knowledge and skills in sports, games, yoga, and related physical activities to promote a healthy lifestyle, teamwork, and overall personality development.			
CO3: Develop advanced proficiency in the selected discipline through continued practice, specialization, and the application of higher-level techniques.			
Module	Topics		
Sports/ Games	Some form of Athletics would be compulsory for all students, unless restricted due to medical / physical reasons. In addition to this, a student has to opt for at least one Sport/Game out of the remaining mentioned below. The chosen game may be same which was taken up by the students in previous year of study or may change the option. A fair theoretical knowledge and a reasonable amount of field / site practice of the chosen games will be essential. Compulsory 1. Athletics 2. Volleyball 3. Basketball 4. Handball 5. Football 6. Badminton 7. Kabaddi 8. Kho-kho 9. Table tennis 10. Cricket		
Yoga	1. Yogic postures: Prone and Balancing 2. Pranayama: Breath awareness, Sectional breathing, Nadishuddhi, Bhastrika, Ujjai, Cooling pranayama (Shitali, Shitkari), Bhramari, Udgat Pranayama (with Antar & Bahya Kumbhaka) 3. Practices leading to Meditation: Pranav and SohamJapa, Yoga Nidra (1,2,3), Antarmauna, AjapaDharana (Stage 1,2,3), Practices leading to Breath Meditation, Practices leading to Om Meditation, Practices leading to Vipassana Meditation, Transcendental Meditation		

Assessment:

Coordinator/mentor would be responsible for award of the sessional marks based upon following components.

- | | |
|---|--------|
| 1. Level of understanding and general awareness | (20 %) |
| 2. Involvements in the Practice Sessions | (50 %) |
| 3. Regularity, Sincerity and Discipline | (20 %) |
| 4. Participation in University level / District level / State level / National Level events | (10%) |

MCS401	Operating System	L T P : 3 0 0	Credits: 3
The students will be able to			BL
CO1	Explain OS structure, system calls, and services.	K1, K2	
CO2	Learn about processes, threads, and Scheduling algorithms.	K1, K2	
CO3	Understand the principles of concurrency and analyze synchronization techniques.	K4	
CO4	Analyse and Understand Various memory management strategies.	K4	
CO5	Understand file systems and storage mechanisms.	K1, K2	

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

Unit	Topic	Hrs
I	Introduction: Operating system and functions, Evolution of operating systems, Classification of operating systems: Batch systems, Interactive systems, Time-sharing systems, Real-time systems, Multiprocessor systems, Multicore systems, Distributed systems, Mobile operating systems and Embedded Operating Systems. Operating System Structure: Layered structure, Monolithic structure, Microkernel architecture, Modular operating systems, Virtual machine structure, Hybrid systems, Operating System Services. System Calls: Definition, Types of system calls (Process control, File management, Device management, Information maintenance, Communication), System call interface. Virtualisation Basics: Introduction to the Concept of virtualisation, Virtual machines, Types of hypervisors (Type 1 and Type 2), Advantages of virtualization.	08
II	Introduction to Process: Definition of process, Process states, Process Control Block (PCB), Process scheduling queues, Context switching, Process creation and termination. CPU Scheduling: Scheduling Concepts, Performance Criteria, Process address space, Process identification information, CPU scheduling algorithms: Multiprocessor Scheduling. Case & comparative study. Deadlock: System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock. Threads: Definition of threads, Benefits of multithreading, Types of threads (User-level threads and Kernel-level threads), Multithreading models.	10
III	Principle of Concurrency: Sequential vs concurrent execution, Interleaving, Parallelism, Issues in concurrent execution. Process Synchronization: Critical section problem, Requirements for a solution (Mutual exclusion, Progress, Bounded waiting). Classical Synchronization Problems: Producer–Consumer problem, Reader–Writer problem, Dining Philosophers problem, Sleeping Barber problem. Modern Concurrency Concepts: Race conditions, Starvation, Priority inversion. Inter-Process Communication (IPC): Shared memory, Message passing, Direct and indirect communication, Blocking and non-blocking communication. Software Solutions to Critical Section: Peterson’s solution. Synchronization Tools: Mutex locks, Semaphores (Binary and Counting), Spinlocks, Monitors, Condition variables.	08
IV	Memory Management: Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Swapping, contiguous memory allocation Protection schemes, Paging, Segmentation, Paged segmentation, Virtual memory concepts, Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing,	09

	Cache memory organization, Locality of reference.	
V	I/O Management and Disk Scheduling: I/O devices, and I/O subsystems, I/O buffering, Disk storage and disk scheduling, RAID. File System: File concept, File organization and access mechanism, File directories, and File sharing, File system implementation issues, File system protection and security. Comparison of UNIX and windows operating system.	08

Text Books:-

1. Silberschatz, Galvin and Gagne, “Operating Systems Concepts”, Wiley.
2. Operating Systems Concepts and Design by Milan Milenkovic, Tata McGraw-Hill.
3. D M Dhamdhere, “Operating Systems : A Concept based Approach”, 2nd Edition.

Reference Books:-

1. TMH 5. William Stallings, “Operating Systems: Internals and Design Principles”, 6th Edition, Pearson Education.
2. Harvey M Dietel, “An Introduction to Operating System”, Pearson Education.
3. Sibsankar Halder and Alex A Aravind, “Operating Systems”, Pearson Education.

Web Link:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_cs44
2. <https://nptel.ac.in/courses/106106144?>

ICS 403		OOPS with Java	L T P : 3 0 0	Credits: 3
The students will be able to				BL
CO1	Develop the core object-oriented programming concepts using Java			K ₃ , K ₄
CO2	Implement exception handling, file handling, and multi-threading in Java to build robust and efficient applications.			K ₂ , K ₄
CO3	Apply new java features to build optimized java programs.			K ₃
CO4	Analyze java programs with Collection Framework for efficient data management.			K ₂
CO5	Test web and RESTful Web Services with Spring Boot using Spring Framework concepts			K ₅

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

Unit	Topic	Hrs
I	Introduction to Java -History of Java, Features of Java, JVM, JRE, JDK, Java program structure, Compilation and execution process, Basic Programming Concepts- Data types, Variables, Operators, Control statements, Loops, Arrays and Strings(string pool and immutability),Command line arguments Classes and Object -class definition, Object creation, methods, Constructor and its type (Default constructor, Parameterized constructor, Constructor overloading), this keyword, Static keyword, final keyword, access control. OOPS Concept - Encapsulation, Inheritance, Polymorphism, method overloading (Compile-time polymorphism) , method overriding (Runtime polymorphism),super keyword, Abstraction-abstract class, abstract method, Interface, multiple inheritance using interface Package -Packages and its type (Built-in package, User-defined package, import statement, static import, naming convention for packages	09
II	String class, Exception Handling - Exception hierarchy, Types of exceptions, Use of try, catch, finally, throw, throws in exception handling, Checked and unchecked exception, Custom exception Multithreading - Thread life cycle, thread priority, thread synchronization, Inter-thread communication, producer-consumer problem File Handling -Byte stream, Character stream, Buffered streams Wrapper Classes-Autoboxing, Unboxing	09
III	Anonymous Class, Reflection API, Functional interfaces, Lambda expression, Method references, Stream API, Optional class Annotation and its type -marker annotation, single value annotation, multiple value annotation, repeating annotation, custom annotation, Java Module System, LVTI, Records, Sealed class, Switch Expression, forEach method, try-with-resource, CompletableFuture	09
IV	Collection Framework and Hierarchy, Interfaces -Iterator, Collection, List, ArrayList, LinkedList, Vector, Stack, Queue, Priority Queue, Deque, Set, HashSet, LinkedHashSet, SortedSet, TreeSet, Comparable, Comparator, Class - HashMap, LinkedHashMap, TreeMap, Hashtable, Properties class	09
V	Spring Framework: Introduction to Spring Framework and its architecture, Inversion of Control (IoC), Dependency Injection (DI), Types of DI (Constructor, Setter), Spring Container (BeanFactory, ApplicationContext),Spring Beans, Bean Lifecycle, Bean Scopes (Singleton, Prototype, Request, Session),Spring Annotations (@Component, @Autowired, @Configuration, @Bean, @ComponentScan), Aspect-Oriented Programming (AOP), AOP Concepts (Aspect, Advice, Join Point, Pointcut, Target), Types of Advice (Before, After, Around) Spring Boot: Introduction to Spring Boot and its architecture, Auto-configuration, Creating Spring Boot Application, Project Structure, @SpringBootApplication, Spring Boot Annotations (@RestController, @RequestMapping, @GetMapping, @PostMapping), RESTful Web Services, HTTP Methods (GET, POST, PUT, DELETE), Running Spring Boot Application	09

	Spring Data JPA: Introduction to Spring Data JPA, entity mapping using @Entity and @Id, repository interfaces (JpaRepository), basic CRUD operations (save(), findAll(), deleteById()), simple database connectivity concept	
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TEXT BOOKS:

1. Herbert Schildt, "Java The complete reference", McGraw Hill Education
2. Craig Walls, "Spring Boot in Action" Manning Publication
3. Steven Holzner, "Java Black Book", Dreamtech.
4. Balagurusamy E, "Programming in Java", McGraw Hill
5. Java: A Beginner's Guide by Herbert Schildt, Oracle Press
6. Greg L. Turnquist "Learning Spring Boot 2.0 - Second Edition", Packt Publication
7. AJ Henley Jr (Author), Dave Wolf, "Introduction to Java Spring Boot: Learning by Coding", Independently Published

REFERENCE BOOKS:

1. Mark Heckler, "Spring Boot: Up and Running", O'Reilly Media
2. Venkat Subramaniam, "*Functional Programming in Java*", Pragmatic Bookshelf Ken Kousen, "*Modern Java Recipes*", O'Reilly Media

Web Link:

1. <https://www.youtube.com/watch?v=A74TOX803D0&t=6s>
2. <https://www.youtube.com/watch?v=v4o0wyFPwEs>
3. <https://www.youtube.com/shorts/osqBG5bNr2I>

MCS403		Design and Analysis of Algorithm	L T P : 3 1 0	Credits: 3
The students will be able to				BL
CO1	Evaluate algorithm performance and justify the selection of suitable sorting and divide-and-conquer techniques for solving computational problems.			K5
CO2	Understand and apply various advanced data structures concepts like Red Black Tree, B Tree and Fibonacci Heaps, etc.			K3
CO3	Implement and Analyse greedy and graph algorithms for solving optimization and shortest-path problems.			K4
CO4	Analyse dynamic programming, backtracking, and branch-and-bound techniques for solving computational problems.			K4
CO5	Analyse string matching, randomized, and approximation algorithms, and classify NP-complete problems.			K4

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

Unit	Topic	Hrs.
I	Algorithm Analysis & Foundations: Introduction to Algorithms, Characteristics and Analysis of Algorithms, Time and Space Complexity, Asymptotic Notations, Growth of Functions, Best, Average and Worst-Case Analysis, Recurrence Relations and their Solutions. Sorting Algorithms: Heap Sort and Sorting in Linear Time (Counting Sort, Radix Sort and Bucket Sort). Divide and Conquer Algorithms - Quick Sort, Merge Sort, Strassen's Matrix Multiplication.	10
II	Advanced Data Structures: Red-Black Trees, B – Trees, Binomial Heaps, Fibonacci Heaps, Tries and Skip List.	08
III	Greedy Algorithms: Introduction, Activity Selection Problem, Fractional Knapsack, Huffman Coding, and Minimum Spanning Tree (Prim's and Kruskal's Algorithms), Single Source Shortest Paths - Dijkstra's algorithm.	08
IV	Dynamic Programming - Introduction, 0/1 Knapsack, Matrix Chain Multiplication, Longest Common Subsequence, Single Source Shortest Path - Bellman Ford Algorithm, All Pair Shortest Paths – Floyd-Warshall Algorithm. Backtracking Algorithms - Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of Subsets. Branch and Bound Algorithm - Traveling Salesman Problem (TSP).	10
V	String Matching & Computational Complexity: String Matching algorithms (Naïve, Rabin-Carp and Knuth-Morris-Pratt (KMP) Algorithms), Complexity Classes, Approximation Algorithms and Randomized Algorithms.	08

Text Books:

1. Introduction to Algorithms – Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, MIT Press.
2. Fundamentals of Computer Algorithms – Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran.
3. Algorithm Design Manual – Steven S. Skiena, Springer
4. Algorithm Design – Jon Kleinberg, Éva Tardos, Pearson.
5. Introduction to the Design and Analysis of Algorithms – Anany Levitin, Pearson.

Reference Books:

1. Algorithm Design – Jon Kleinberg, Éva Tardos.
2. The Design and Analysis of Computer Algorithms – Aho, Hopcroft, Ullman.
3. Introduction to the Design and Analysis of Algorithms – Anany Levitin.
4. Algorithms – Robert Sedgewick, Kevin Wayne, Addison-Wesley.
5. Data Structures and Algorithms in C++ – Michael T. Goodrich et al.

Links:

1. https://onlinecourses.nptel.ac.in/noc26_cs67/preview
2. <https://nptel.ac.in/courses/106106131>

Subject Code: MAS303		Subject Name: LINEAR ALGEBRA AND STATISTICS	L T P: 3-1-0	Credit: 4
The students will be able to				BL
CO-1:	Apply algebraic, geometric, and analytic properties of the real Euclidean space to solve various types of computational problems			K3
CO-2:	Apply linear transformations and some matrix decompositions techniques to solve higher dimensional optimization problems			K3
CO-3:	Model data related problems using discrete, continuous, and joint probability distributions, and solve complex problems using theorems like Bayes'			K3
CO-4:	Formulate, implement, and evaluate predictive models using simple linear regression, optimised via the method of least-squares			K3
CO-5:	Conduct rigorous inferential statistical analyses using t-test, Z-test, and Chi-square test for hypothesis testing, and interpret confidence intervals to assess model reliability.			K3
Unit	Topic			Hrs.
I	The Real Euclidean Space: Real Vector spaces, Subspaces; Linear Independence, Basis, and Dimension; Important ℓ_p -norms (Manhattan, Euclidean), Inner product, lengths and distances; Important properties (Cauchy-Schwarz inequality); Angles and orthogonality, orthonormal basis, Gram-Schmidt procedure			10
II	Linear Mapping and Matrices: 2D and 3D Rotations; Linear transformations, matrix representations, basis change; Image and kernel; Matrix Decompositions: Eigen decomposition, and singular value decompositions			10
III	Probability and Distributions: Overview of axiomatic probability; Random variables, Discrete and Continuous Probabilities; Joint probabilities; Expectation and variance, properties; Standard Distributions (Binomial, Poisson and Gaussian)			10
IV	Statistical Modeling: Overview of Descriptive statistics; Central Moments, skewness, kurtosis; Method of Least Squares, Curve Fitting (lines, parabola, exponential), Pearson correlation, Spearman rank correlation, covariance matrix (2×2), properties; Simple linear regression.			8
V	Inferential Statistics: Random Sampling, Sampling distributions; Hypothesis Testing, Null vs. Alternative hypothesis; Level of significance, Confidence limits; Statistical Tests of Significance: t-test (mean, difference of means), Z-test (single proportion, difference of proportions and SDs), Chi-square (comparison of categorical data)			10

TEXT BOOKS:

1. M. P. Deisenroth, A. A. Faisal, and C. S. Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
2. G. Strang, Introduction to Linear Algebra (5/e), Wellesley-Cambridge Press, 2016.
3. J. L. Devore, Probability and Statistics for Engineering and the Sciences (9/e), Cengage Learning, 2012.
4. R.E. Walpole, R.H. Myers, S. L. Myers, Probability and Statistics for Engineers & Scientists (9/e), Pearson, 2010.

REFERENCE BOOKS:

1. R. Bronson, G.B. Costa, Linear Algebra - An introduction (2/e), Academic press, 2007.
2. H. Anton, C. Rorres, Elementary linear algebra: Applications Version (9/e), Wiley.
3. S. C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S Chand Publishers.
4. S. M. Ross, Probability and Statistics for Engineers and Scientists, Academic Press.

MCS451	Operating System Lab	L T P : 0 0 2	Credits: 1
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The students will be able to		BL
CO1	Understand and implement to develop application programs using system calls in Unix.	K4
CO2	Understand and implement the scheduling algorithms.	K4
CO3	Understand and implement replacement algorithms.	K4

List of Experiments

Minimum ten experiments out of the following:

1. Study Hardware and Software requirements of latest Operating System.
2. File and directory management commands in Unix/Linux.
3. Execute various System calls.
4. Simulate the following CPU scheduling algorithms.
a) FCFS b) SJF c) Round Robin d) Priority.
5. Write a C program to simulate producer-consumer problem using Semaphores
6. Write a C program to simulate the concept of Dining-philosophers problem
7. Simulate Bankers Algorithm for Dead Lock Avoidance.
8. Implementation of resource allocation graph RAG)
9. Write a program to simulate the following file organization techniques. (Any one)
a) Single level directory b) Two level directory c) Hierarchical.
10. Write a C program to simulate the following contiguous memory allocation Techniques
a) Worst fit b) Best fit c) First fit.
11. Simulate all page replacement algorithms
a) FIFO b) LRU c) OPTIMAL
12. Write a C program to simulate disk scheduling algorithms.
a) FCFS b) SCAN
13. Write a program to simulate the following file allocation strategies. (Any one)
a) Sequential b) Indexed c) Linked

Industry Oriented Experiments:

1. Process Scheduling Analysis using Real-Time Workloads.
2. Automated Backup and Log Management using Shell Scripting.

Subject Code: MCS452		OOPS with Java Lab	L T P : 0 0 2	Credits: 1
The student will be able to				BL
CO 1	Understand and implement OOP concepts such as classes, objects, inheritance, polymorphism, abstraction, and encapsulation, along with exception handling, multithreading, packages, and Java I/O streams in Java applications.			K4
CO 2	Understand and implement advanced Java features such as functional interfaces, lambda expressions, method references and java collection framework to develop efficient and concise Java applications.			K4
CO 3	Understand and implement enterprise-level applications using Spring Framework concepts including dependency injection, bean management, and test RESTful web services			K4
DETAILED SYLLABUS				
1. WAP to create class Number with only one private instance variable as a double primitive type, include the following methods isZero(), isPositive(), isNegative(), isOdd(), isEven(), isPrime . In this class and all above methods should return boolean primitive type like for isPositive() should return “Positive = True”. 2. WAP to Create a class Employee having members as follows: private int empNo private String empName private int empBasic, then use Parameterized constructor to initialize members. Apply Getter methods for all instance variables to fetch out details of each employee. 3. WAP to create a class Employee with a method called calculateSalary(). Create two subclasses Manager and Programmer. In each subclass, override the calculateSalary() method to calculate and return the salary based on their specific roles. WAP to create a file object of a file in the path c:/Java/abc.txt and check whether that file exists or not. Using the commands exists (), isDirectory(), isFile(), getName() and getAbsolutePath(). And if the file exists, then display the contents of a file on console output screen. 4. WAP to Implement three classes: Storage, Counter and Printer. The Storage class should store an integer. The Counter class should create a thread and start counting from 0 (0,1,2, 3 ...) and store each value in the Storage class. The Printer class should create a thread that keeps reading the value in the Storage class and printing it. Write a program that creates an instance of the Storage class and set up a Counter and Printer object to operate on it. 5. Program to demonstrate Exception Handling for the following scenarios like Divide-by-zero (ArithmeticException), Accessing an invalid index in an array (ArrayIndexOutOfBoundsException), Using a method on a null object (NullPointerException). 6. Program to demonstrate Custom Exception for voting eligibility based on age. If the age is below 18 or above 60, throw a custom exception; otherwise, display “Eligible to vote. 7. Program to demonstrate the life cycle of a thread using the methods isAlive() and join(). 8. Write a Java program to implement the Producer-Consumer problem using multithreading and synchronization. 9. Java program using functional interface and lambda expression to check if the input word is a palindrome. 10. Implement the CubeDigitSum functional interface using a method reference to calculate and display the sum of digits of the cube of a given integer. 11. Program that takes two ArrayLists of song IDs as input and returns a single ArrayList containing the merged playlist with song IDs. 12. Program to reverse the order of elements in a deque using only the Deque interface provided by Java. The program should take input from the user for the initial deque where elements are space-separated, and then print the reversed deque. 13. Program to demonstrate the concept of HashMap that takes input for participant IDs and their corresponding points represented as HashMap, and then finds and prints the participant ID with the maximum points. 14. Program to count the frequency of elements in a TreeSet and remove elements with a frequency greater than a specified value. 15. Program to demonstrate all type of Dependency Injection (Constructor Injection, Setter Injection, and variable Injection). Create suitable classes where one class depends on another service class, and inject the dependency.				

16. Program to demonstrate a Spring Boot application for a Student Management System that performs basic CRUD (Create, Read, Update, Delete) operations using RESTful APIs.

Industry Oriented Experiments Syllabus:

1. Develop a car rental system using JSP.
2. Develop a system using JSP and MySQL in backend to calculate the fine on books which were issued by students and over due.

MCS453	Design and Analysis of Algorithm Lab	L T P : 0 0 2	Credits: 1
The students will be able to			BL
CO1	Implement and apply searching and sorting algorithms to solve computational problems efficiently.		K3
CO2	Apply algorithm design techniques such as greedy and divide-and-conquer to develop solutions for optimization problems.		K3
CO3	Implement graph, dynamic programming, and backtracking algorithms to solve complex real-world problems.		K3

List of Experiments

Minimum 10 experiments are to be performed from the following list.

1. Write a program to implement Recursive Binary Search.
2. Write a program to implement Selection sort and Insertion sort.
3. Write a program to implement Quick sort and Merge sort.
4. Write a program to implement Heap sort.
5. Write a program to implement Fractional Knapsack problem.
6. Write a program to implement Traveling Salesman problem using Branch and Bound.
7. Write a program to implement MST using Prim's and Kruskal's algorithms.
8. Write a program to implement N Queen problem using Backtracking.
9. Write a program to implement graph traversal (BFS & DFS).
10. Write a program to implement Subset Sum Problem using Dynamic Programming.
11. Write a program to implement Dijkstra's algorithm for shortest path (single source).
12. Write a program to implement Floyd-Warshall algorithm (all pairs shortest path).
13. Write a program to implement Huffman coding for data compression.
14. Write a program to implement Activity Selection problem (greedy approach).
15. Write a program to implement Longest Common Subsequence (LCS) using dynamic programming.

Two Industry-Based Experiments:

1. Given a city map with nodes (restaurants/customers) and weighted edges (distance/time), find the shortest route from a delivery partner to multiple destinations.
2. Given a list of products with ratings and prices, use heap sort to arrange them by priority score, then extract top K products for recommendation using a max-heap.

MSE451		Competitive <u>Coding</u> workshop-II	L T P : 0 0 2	Credits: 1
The students will be able to				BL
CO1	Apply efficient problem-solving techniques using arrays, two-pointer approach, sliding window, prefix sum, sorting, and binary search to solve computational problems with optimized time and space complexity.			
CO2	Implement and analyze solutions using linked lists, recursion, backtracking, stacks, queues, heaps/priority queues, and monotonic stack concepts to solve intermediate and advanced programming problems.			
CO3	Design and develop efficient algorithms using binary trees, binary search trees (BSTs), and graph data structures to solve traversal, searching, and graph-based problems through coding challenges.			
S.No	Class	Topics	# of problems	
1	4	Array (Advance Problems on leetcode) 2 Pointer Approach Sliding Window (fixed) and Prefix Sum	10	
2	4	Binary Search and Sorting	5	
3	4	Linklist (Advance Problems on leetcode) Singly vs Doubly, Reversing a List, Middle of List (Tortoise/Hare)/Cycle detection, Intersection point, Merge two sorted lists.	8	
4	4	Recursion and BackTracing basics	8	
5	4	Stack and Queue (Advance Problems on leetcode) Monotonic Stack Concepts/Heap / Priority Queue	9	
6	6	Binary Tree and BST	6	
7	4	Graph	4	

MNC301/MNC401		ENVIRONMENT SCIENCES	L T P : 2 0 0	Credits: NC
The students will be able to-				BL
CO-1	Understand the basic concepts of environment and ecosystem Emphasizing on structural and functional aspects.			K2
CO-2	Understand the important concepts of biodiversity, its significance and conservation.			K2
CO-3	Understand the concept and classification of Natural Resources Emphasizing on associated problems and conservation strategies.			K2
CO-4	Understand the causes and effects of environmental pollution and Contribute to the preventive measures in the immediate society.			K2
CO-5	Understand the role of Government and legal aspects related to Protection of environment and control of environmental pollution.			K2

UNIT-1: ENVIRONMENT & ECOSYSTEM

[07]

The Multidisciplinary nature of environmental studies: Definition, scope and importance of environment, need for public awareness and environmental education, Concept of an ecosystem: Structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow and nutrient cycling (carbon, nitrogen and sulphur) in the ecosystem, food chains, food webs and ecological pyramids, Types of ecosystems: Introduction, types and characteristic features of desert, grassland, forest and pond ecosystems.

UNIT-2: BIODIVERSITY AND ITS CONSERVATION

[05]

Introduction to biodiversity definition: genetic, species and ecosystem diversity, bio geographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local levels, India as a mega-diversity nation, hot-spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, endangered and endemic species of India, Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity and conservation through legal aspects.

UNIT-3: NATURAL RESOURCES

[06]

Natural Resources: Classification, causes of depletion, Forest resources: Use and over-exploitation, deforestation, practices for conservation, Water resources: Use and overutilization of surface and ground water, floods, drought, conservation strategies, water related diseases, Mineral resources: Use and exploitation, environmental effects of mineral extraction (mining), Food resources: World food problems, Ill effects of Modern agriculture on environment, sustainable agriculture, Energy Resources: Growing energy needs, renewable and non-renewable energy sources, use of alternative energy sources.

UNIT-4: ENVIRONMENTAL POLLUTION & GLOBAL ENVIRONMENTAL ISSUES [07]

Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and radiation pollution, Solid waste Management: causes, effects and control measures of urban and industrial waste; E-Waste management, Human population and environment: Characteristics, population growth; causes, impacts and control measures of population explosion in India, role of individual in prevention of pollution, Global Environmental issues: Climate change, Global warming, Acid rain, Ozone layer depletion, chemical and nuclear accidents.

UNIT-5: ENVIRONMENTAL POLICY, LEGISLATION & EIA [05]

Role of Government in environmental protection, Environmental Protection Act-1986, Air (prevention and control of pollution) Act- 1981, Water (prevention and control of pollution) Act-1974, Forest Conservation Act-1980, Wild life Protection Act-1972, EIA: Objective and process; EIA in India, Towards Sustainable Future: Concept of Sustainable Development.

Recommended Text Book:

1. A Text Book of Environmental Studies for Undergraduate Courses, Third Edition (2021), by Erach Bharucha, University Press (India) Private Limited.
2. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers (2018).
3. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 3rd edition, Pearson Education (2015).
4. Environmental Chemistry (Ninth Multicolour Edition, 2018) by Anil K DE, New Age International Publishers

Reference Books:-

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007