



B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19
(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF MACHINE LEARNING

**BACHELOR OF ENGINEERING
IN
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**

**SCHEME & SYLLABUS
III - VIII SEMESTERS
From 2020-21 Admitted Batch Onwards**

INSTITUTE VISION

Promoting Prosperity of mankind by augmenting Human Resource Capital through Quality Technical Education & Training.

INSTITUTE MISSION

Accomplish Excellence in the field of Technical Education through Education, Research and Service needs of society.

DEPARTMENT VISION

To achieve excellent standards of quality education in the field of Artificial intelligence and Machine Learning.

DEPARTMENT MISSION

To nurture the students with strong fundamentals for a successful carrier in the field of artificial intelligence and machine learning.

To motivate the students for post-graduation and research.

To create impact in the society with continuous research and innovations.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Acquire fundamentals and expertise data engineering skills for professional career in industry, government, academia as innovative engineers.

PEO2: Pursue higher studies with research potential.

PEO3: Demonstrate professional ethics and attitude as an individual or team member at workplace and function professionally in a global competent world.

PROGRAMME OUTCOMES (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, **and** an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

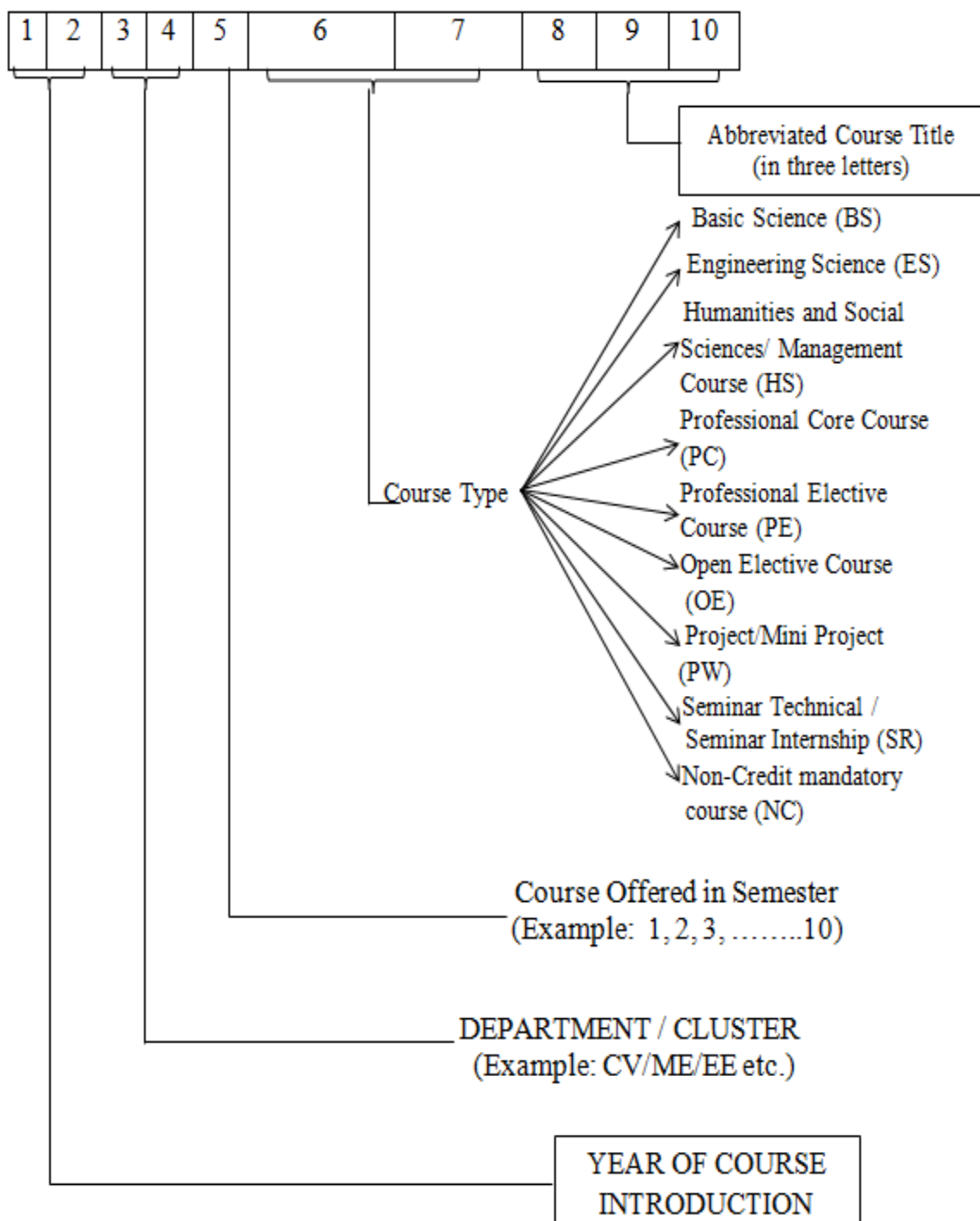
PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Software Systems: Apply the skills of cognitive computing, artificial intelligence and machine learning in the field of data engineering to develop intelligent systems.

PSO2: Recommendation Systems: Demonstrate Computational knowledge, practical competency and innovative ideas in Artificial Intelligence & Machine Learning.

PSO3: Data Driven Systems: Use modern tools and techniques to solve problems in Machine Learning, Deep Learning, Computer Vision and Natural Language Processing.

NOMENCLATURE FOR THE COURSE CODE



B.M.S. College of Engineering, Bengaluru – 19											
(Autonomous Institute, Affiliated to VTU Approved by AICTE)											
Scheme of Instructions Semester – III (With effect from the Academic Year 2020-21)											
Sl. No	Course and Course Code		Course Title	Teaching Hours /Week			Examination				Credits
				Theory Lecture	Tutorial	Practical	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	BS-5	20MA3BSMAI	Mathematical Foundations For AI & ML	3	1	0	05	50	50	100	4
2	ES-1	20AM3ESLDA	Logic Design and Computer Architecture	3	1	0	05	50	50	100	4
3	PC-1	20AM3PCDSC	Data Structures	3	0	1	05	50	50	100	4
4	PC-2	20AM3PCCNS	Computer Networks	3	0	0	03	50	50	100	3
5	ES-2	20AM3PCOPS	Operating Systems	3	0	0	03	50	50	100	3
6	PC-3	20AM3PCTFC	Theoretical Foundations of Computations	3	1	0	05	50	50	100	4
7	PW-1	20AM3PWWAD	Web Programming	0	0	2	04	50	50	100	2
8	HS-3	20HS3ICEVS	Environmental Studies	1	0	0	01	50	50	100	1
Total				19	3	3	31	400	400	800	25

B.M.S. College of Engineering, Bengaluru – 19 (Autonomous Institute, Affiliated to VTU Approved by AICTE)											
Scheme of Instructions Semester – IV (With effect from the Academic Year 2020-21)											
Sl. No	Course and Course Code		Course Title	Teaching Hours /Week			Examination				Credits
				Theory Lecture	Tutorial	Practical	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	BS-6	20MA4BSLAC	Linear Algebra and Calculus	3	1	0	05	50	50	100	4
2	PC-4	20AM4PCDAA	Design and Analysis of Algorithms	3	0	1	05	50	50	100	4
3.	PC-5	20AM4PCDMS	Database Management Systems	3	0	1	05	50	50	100	4
4	PC-6	20AM4PCIAI	Introduction to Artificial Intelligence	3	0	0	03	50	50	100	4
5	PC-7	20AM4PCPML	Probability and Statistics for Machine Learning	3	1	0	05	50	50	100	3
6	SR-1	20AM4SRSLT	Seminar on Latest Trends	0	0	2	02	50	50	100	2
7	PW-2	20AM4PCPML	Python Programming	0	0	2	04	50	50	100	2
8	HS-4	20HS4ICCIP	Constitution of India, Professional Ethics and Human Rights	1	0	0	01	50	50	100	1
9	HS-5	20HS4ICSAK / 20HS4ICBAK	SAMSKRUTHIKA KANNADA / BALAKE KANNADA	1	0	0	01	50	50	100	1
Total				17	2	5	31	450	450	900	25

B.M.S. College of Engineering, Bengaluru – 19 (Autonomous Institute, Affiliated to VTU Approved by AICTE)											
Scheme of Instructions Semester – V (With effect from the Academic Year 2020-21)											
Sl. No	Course and Course Code		Course Title	Teaching Hours /Week			Examination				Credits
				L	T	P	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PC-8	20MA5BSOOP	Object Oriented Programming	3	0	1	05	50	50	100	4
2	PC-9	20AM5PCIML	Introduction to Machine Learning - I	3	0	0	03	50	50	100	3
3	PC-10	20AM5PCSEP	Software Engineering and Design Patterns	3	0	0	03	50	50	100	4
4	PC-11	20AM5PCDCN	Computer Graphics	3	1	0	05	50	50	100	4
5	HS-4	20AM5HSMAE	Management and Entrepreneurship	3	0	0	03	50	50	100	3
6	PE-1	20AM5PEABI	Business Intelligence (AI in Business Intelligence)	3	0	1	05	50	50	100	4
		20AM5PEINS	Data Science								
		20AM5PEPCV	Image Processing								
7	PW-3	20AM5PWPML	Project work on Machine Learning	0	0	2	04	50	50	100	2
8	PC-12	20AM5PCDVL	Data visualization Laboratory (Tableau / Power BI)	0	0	2	04	50	50	100	1
9	NC-1	20AM5NCPAE	Participation in any Activity/Event	Non-credit mandatory Course							
Total				18	1	7	32	400	400	800	25

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Scheme of Instructions Semester – VI (With effect from the Academic Year 2020-21)											
Sl. No	Course and Course Code		Course Title	Teaching Hours /Week			Examination				Credits
				Theory Lecture	Tutorial	Practical	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P					
1	PC-13	20AM6PCNNS	Neural Networks	3	0	1	05	50	50	100	4
2	PC-14	20AM6PCSNA	Social Network Analysis	2	1	0	04	50	50	100	3
3	ES-3	20AM6ESOPR	Operation Research	3	1	0	05	50	50	100	4
4	PE-2	20AM6PESMA	Business Intelligence (AI in Social Media Analytics)	2	0	1	05	50	50	100	3
		20AM6PEBCT	Cybernetics (Block Chain Technology)								
		20AM6PEVAO	Computer Vision (Video Analytics using Open CV)								
5	OE-1	20AM6OEIDM	Open Elective-1 : Introduction to Data Mining	3	0	0	03	50	50	100	3
		20AM6OEIAI	Open Elective-2 : Introduction to Artificial Intelligence								
		20AM6OEIML	Open Elective-3 : Introduction to Machine Learning								
6	SR-2	20AM6SRSMI	Technical Report (LATEX)	0	0	2	01	50	50	100	1
7	PW-4	20AM6PWBCC	Project work based on verticals	0	0	2	04	50	50	100	2
8	HS-4	20AM6HSQAT	Quantitative Ability Training	2	0	0	02	50	50	100	2
Total				16	2	5	29	400	400	800	23

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Scheme of Instructions Semester – VII (With effect from the Academic Year 2020-21)											
Sl. No	Course and Course Code		Course Title	Teaching Hours /Week			Examination				Credits
				Theory Lecture	Tutorial	Practical	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	BS-8	20AM7BSBFE	Biology for Engineers	2	0	0	2	50	50	100	2
2	PC-15	20MA7PCDLT	Deep Learning Techniques	2	0	1	05	50	50	100	3
3	PC-16	20AM7PCNLP	Natural Language Processing	2	0	1	05	50	50	100	3
4	PC-17	20AM7PCICC	Introduction to Cloud Computing	2	0	0	03	50	50	100	2
5	PE-3	20AM7PEECM	Business Intelligence (Ecommerce)	2	0	0	05	50	50	100	2
		20AM7PEMBCN	Blockchain								
		20AM7PEBDA	Big data Analytics								
6	PE-4	20AM7PEISP	Inferential Statistics using python	2	0	1	05	50	50	100	2
		20AM7PEEHP	Ethical Hacking Principles								
		20AM7PEAVR	Augmented Reality and Virtual Reality								
7	OE-2	20AM7OEDMG	Introduction to Data Mining	3	0	0	03	50	50	100	3
		20AM7OESTG	Introduction to Artificial Intelligence								
		20AM7OEIMG	Introduction to Machine Learning								
8	PW-5	20AM7PWMDP	Capstone Project – Phase - I	0	0	3	0	50	50	100	2
9	SR-3	20AM7SRTLS	Industry Motivated Course	0	0	1	0	50	50	100	1
Total				20	0	8	28	400	400	800	20

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Scheme of Instructions Semester – VIII (With effect from the Academic Year 2020-21)

Sl. No	Course and Course Code		Course Title	Teaching Hours /Week			Examination				Credits
				Theory Lecture	Tutorial	Practical	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	HS-5	20AM8HSEMN	Entrepreneur ship and management	2	0	0	02	50	50	100	2
2	OE-3	20AM8OEBDA	Big Data Analytics	3	0	0	03	50	50	100	3
		20AM8OEBCC	Python Programming								
3	PW-6	20AM8PWBDA	Capstone Project – Phase -II	0	0	10	0	50	50	100	10
4	SR-4	20AM8SRINS	Internship	0	0	1	0	50	50	100	1
Total				05	0	11	05	200	200	400	16

Course Title	MATHEMATICAL FOUNDATIONS FOR AI & ML				
Course Code	21MA3BSMAI	Credits	4	L-T-P	3-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36
UNIT – 1					[8L+2T]
Graph-Theory-1: Basic concepts: Types of graphs, order and size of a graph, in-degree and out-degree, connected and disconnected graphs, Eulerian graph, Hamiltonian graphs, sub-graphs, isomorphic graphs. Matrix representation of graphs: adjacency matrix, incidence matrix. Planar Graphs and Coloring.					
UNIT – 2					[6 L + 2T]
GRAPH THEORY-2 Trees: spanning Trees: minimal spanning tree: Kruskal’s algorithm, Prim’s algorithm, Network flows, DFS, BFS, shortest path-Dijkstra’s algorithm, Matchings.					
UNIT – 3					[8 L + 2 T]
COMBINATORICS Principles of counting: The rules of sum and product, permutations. Combinations- Binomial and multinomial theorems. Pigeonhole principle, Catalan numbers, the principle of inclusion and exclusion, Derangements, Rook Polynomials, Generating functions					
UNIT – 4					[7 L + 3T]
INDUCTION AND RECURRENCE RELATIONS Mathematical Induction, Strong Induction and Well-Ordering, Recursive Definitions and Structural Induction, First order recurrence relations, second-order homogeneous recurrence relations, third and higher order linear homogeneous recurrence relations.					
UNIT – 5					[7 L + 3T]
CONGRUENCES AND ITS APPLICATIONS Introduction to Congruences, Linear Congruences, The Chinese Remainder Theorem, Solving Polynomials, System of Linear Congruences, , Applications of Congruences					
Text Books: 1. Kenneth H.Rosen, Discrete Mathematics and its applications, 7 th edition, McGraw Hill Publishers 2. Dr. D.S.C, Graph Theory and Combinatorics, 4 th edition, Prism engineering education series,					
Reference Books: 1. Kenneth H.Rosen, Elementary number theory and its applications, 5 th edition, Pearson publications 2. Discrete Mathematics, Kolman, Busby Ross, 5 th edition, 2004, Prentice Hall. 3. Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo, Eastern Economy Edition, PHI Learning Pvt., Ltd.					
On completion of the course student will have the ability to:					
CO #	COURSE OUTCOMES (CO)				
CO 1	Use graphs as representation tool in optimization techniques.				
CO 2	Demonstrate an understanding of the basic concepts of Combinatorics, Induction and Recurrence relations.				
CO 3	Apply the concepts of congruence’s to various applications.				

E books and online course materials:

1. <http://jlmartin.faculty.ku.edu/~jlmartin/courses/math725-S16/>
2. https://www.whitman.edu/mathematics/cgt_online/cgt.pdf

Online Courses and Video Lectures:

1. <https://www.coursera.org/learn/probability-intro>
2. <https://nptel.ac.in/courses/111104026/> (Discrete Mathematics)
3. <https://nptel.ac.in/courses/111106086/> (Combinatorics)

Question Paper Pattern:

1. Five full questions to be answered.
2. To set one question in Units 1, 2, 5 and two questions each in unit 3 and unit 4.

Course Title	Logic Design and Computer Architecture				
Course Code	20AM4ESLCA	Credits	4	L-T-P	3-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36
UNIT – 1					11Hrs
Basics of Gates: Review of Basic Logic gates, Positive and Negative Logic Combinational Logic Circuits: Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs, Quads, and Octets, Karnaugh Simplifications, Don't-care Conditions, Product-of-Sums Method, Product-of- Sums simplifications, Simplification by Quine-McClusky Method. Data-Processing Circuits: Multiplexers, Demultiplexers, 1-of-16 Decoder, Exclusive-or Gates, Encoders, Parity Generators					
UNIT – 2					9 Hrs
Flip- Flops: RS Flip-Flops, Gated Flip-Flops, Edge-triggered Flip-Flops, Flip-Flop Timing, JK Master-Slave Flip-Flop, Various Representation of FLIP-FLOPs, Analysis of Sequential Circuits. Registers: Types of Registers, Applications of Shift Registers. Counters: Asynchronous Counters, Synchronous Counters, Changing the Counter Modulus, Counter Design as a Synthesis problem. Design of Synchronous Sequential Circuits: Model Selection, State Transition Diagram, State Synthesis Table, Design Equations and Circuit Diagram, State Reduction Techniques					
UNIT – 3					8 Hrs
Basic Structures of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance. Machine instructions and Programs: Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input Output Operations.					
UNIT – 4					11 Hrs
Input/output Organization: Accessing I/O Devices, Interrupts. Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-Operand Multiplication.					
UNIT – 5					9 Hrs
Basic Processing Unit: Concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired and microprogrammed control unit. Memory Organization: Memory Hierarchy, Main Memory- RAM & ROM chips, Memory Address Map, Memory connection to CPU, Cache Memory-Associative Mapping					
Text Books: 1. Donald P Leach, Albert Paul Malvino & Goutam Saha: Digital Principles and Applications, 8th Edition, Tata McGraw Hill, 2015 2. Carl Hamacher, Computer Organization, 5th Edition, McGraw Hill Publishers					
Reference Books: 1. R D Sudhaker Samuel: Illustrative Approach to Logic Design, Sanguine-Pearson, 2010. 2. Morris Mano, Computer System and Architecture, 3rd Edition, Pearson Education. 3. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson, 2015					

Course Title	DATA STRUCTURES				
Course Code	20AM3PCDST	Credits	4	L-T-P	3-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36
UNIT – 1					8 Hrs
Introduction to Data Structures: Definition and its classification, Dynamic Memory allocation.					
Linked Lists: Definition, Basic Operations on Singly Linked List, Singly linked List with Header Nodes, Applications of Singly Linked Lists.					
UNIT – 2					7 Hrs
Linked List: Doubly Linked Lists, Circular Linked List – Implementation and Applications					
Stacks: Definition, Operations, Implementation using Arrays and Linked list, Applications of Stack – Infix to postfix conversion, Evaluation of postfix expression.					
UNIT – 3					6 Hrs
Recursion: Definition, Writing recursive programs, Efficiency of Recursion.					
Queues: Definition, Operations, Implementation using Arrays and Linked list, Types of queues – Circular queue, Deque and priority queue, Applications of queues.					
UNIT – 4					7 Hrs
Binary Trees: Binary Tree properties and representations, traversals and other operations. Binary Search Trees: Definition, Operations on BST, Threaded binary trees, Applications.					
UNIT – 5					8 Hrs
Balanced Trees: AVL Trees, Splay trees, Red- Black Trees – Definitions, Rotation and other basic operations.					
Text Books:					
1. Data Structures using C and C++, Yedidyah, Augenstein, Tannenbaum, 2 nd Edition, Pearson Education, 2007.					
2. Data Structures using C, Reema Thareja, 2 nd Edition, Oxford University Press, 2011					
Reference Books:					
1. Fundamentals of Data Structures in C, by Horowitz, Sahni, Anderson-Freed, 2nd Edition, Universities Press, 2007.					
2. Data Structures A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzan,,Cengage Learning, 2005.					

Course Outcomes	
CO1	Apply principles of linear and nonlinear data structures for solving various problems.
CO2	Analyze the usage of appropriate data structure for a given application.
CO3	Design and implement various operations for organizing data.
CO4	Ability to Conduct experiments to implement operations like searching, insertion, deletion, traversal mechanism on various data structures.

Course Title	COMPUTER NETWORKS				
Course Code	20AM3PCNS	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36
UNIT – 1					8 Hrs.
Introduction to Computer Network: Problem: Building a Network: Application, Network Requirement Network Architecture, Implementation of Network software, performance measures					
UNIT – 2					7 Hrs.
UNIT- 2 Connecting to Network: Perspective on connecting, Encoding, Framing, Error Detection, Reliable transmission, 802.XX protocols.					
UNIT – 3					7 Hrs.
UNIT- 3 Internetworking: switching and bridging, Basic Internetworking, Routing, Global Internet, Routing in mobile device and Deployment of IPv6.					
UNIT – 4					7 Hrs.
End to End Protocols: Simple De-multiplexer(UDP) Reliable Byte stream (TCP), and Transport for real time Application (RTP). Congestion control and Resource Allocation: Issues in resource allocation, TCP congestion control and congestion avoidance.					
UNIT – 5					7 Hrs.
Network Security: Building blocks of cryptography, key pre-distribution, Authentication protocols and Firewalls. Network Applications: Traditional Applications, Multimedia Applications and infrastructure application.					
Text Books:					
1. Computer Networks : A Systems Approach, Larry L Peterson and Bruce S Davie, 5 th Edition, Morgan Kufmann,2010					
Reference Books:					
1. Computer Networking: A Top-Down Approach Featuring the Internet, James Kurose and Keith Ross, Pearson, 7 th Edition, 2010					

Course Outcomes	
CO1	Analyze and recognize the need of network architecture and requirements for building a secure and robust network.
CO2	Apply the concepts of error correcting and detection mechanisms for efficient data transmission.
CO3	Identify and Differentiate various protocols required for different types of data transmissions
CO4	Evaluate the challenges in building networks and solutions to those.

Course Title	OPERATING SYSTEM				
Course Code	20AM3ESOPS	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36
UNIT – 1					5 Hrs
Introductions: Operating System Services, User- Operating System operations and interface, System Calls, Operating System design and implementation, Case Studies.					
UNIT – 2					12 Hrs
Processes & Thread Management: Process Overview, Process Scheduling algorithms, Inter-process communication. PCB, Multithreading models, Threading issues. Process Synchronization: The critical section problem, Peterson’s solution, Mutex locks, Semaphores, problems using synchronization.					
UNIT – 3					6 Hrs
Deadlocks: System Model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection and recovery from deadlock.					
UNIT – 4					8 Hrs
Main Memory: Background, swapping, Contiguous memory allocation, Segmentation, Paging, Structure of page table. Virtual Memory: Background, Demand paging, Copy on write, Page replacement algorithms, Allocation of frames, Thrashing.					
UNIT – 5					6 Hrs
Disk performance optimization: Introduction, Disk scheduling strategies, rotational optimization File Access Controlling mechanisms					
Text Books: 1. Operating System Concepts, by Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, 9 th Edition, Wiley India, 2012. 2. Operating systems, by H.M.Deitel, D.J.Deitel, D.R.Choffnes, 3rd edition, Pearson Education.					
Reference Books: 1. Operating Systems, A Concept-Based Approach, by DM Dhamdhere, 3rd Edition, Tata Mcgraw-Hill, 2012. 2. Modern Operating Systems, by Andrew S. Tanenbaum and Herbert Bos, 4th Edition, Pearson, 2014.					

CO1	Understand the core fundamental concepts of Operating Systems
CO2	Differentiate between multiprocessing, multiprogramming, and multitasking
CO3	Apply various process CPU scheduling algorithms to manage processes
CO4	Analyze dead lock identification and prevention mechanisms.
CO5	Apply segmentation and paging techniques

Course Title	Theoretical Foundations of Computations				
Course Code	20AM3PCTFC	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36
UNIT – 1					8 Hrs
Introduction to Finite Automata: Introduction to Finite Automata, Central Concepts of Automata Theory, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Finite Automata with Epsilon Transition, An Application Text Search					
UNIT – 2					7 Hrs
Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, Proving Languages Not to Be Regular, Closure Properties of Regular Languages, Equivalence and Minimization of Automata					
UNIT – 3					7 Hrs
Context Free Grammars and Languages Parse Trees: Applications of Context Free Grammars, Ambiguity in Grammars and Languages, Eliminating Useless Symbols, Computing the Generating and Reachable Symbols, Eliminating Epsilon Productions, Eliminating Unit Productions.					
UNIT – 4					7 Hrs
Context Free Grammars and Languages: Chomsky Normal Form, Greibach Normal Form, The Pumping Lemma for Context Free Languages, Closure Properties of Context Free Languages Pushdown Automata: Introduction to Pushdown Automaton, The Languages of a PDA, Deterministic Pushdown Automata					
UNIT – 5					7 Hrs
Pushdown Automata: Equivalence of PDA's and CFG's Introduction to Turing Machines: The Turing Machine, Multitape Turing Machine, Introduction to Post's Correspondence Problem, Undecidable Problems.					
Text Books: 1. Introduction to Automata Theory, Languages and Computation, John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman: education,3rd Edition, Pearson, 2007.					
Reference Books: 1. Introduction to Languages and Automata Theory, John C Martin, 3rd Ed, Tata McGraw-Hill, 2007. 2. Introduction to Computer Theory, Daniel I.A. Cohen,John Willy & Son Inc, 2nd Edition, 2000. 3. An Introduction to formal Languages and Automata,Peter Linz , Narosa publishing house, 1997.					

CO1	Apply the knowledge of automata theory, grammars & regular expressions.
CO2	Represent the language by analysing the given Automata, Regular Expression & Grammar.
CO3	Analyze patterns and syntax checking.
CO4	Design the Automata & Grammar for formal languages.

Course Title	WEB APPLICATION DEVELOPMENT				
Course Code	20AM3PWWAD	Credits	2	L-T-P	0-0-2
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	4	Total Lecture Hours			48
About the Course: The students should develop websites using modern web technologies. The course will be executed in two cycles and a project work. During this project phase, the students would be able to design responsive web portals using HTML, CSS and JS functionality. The student will design and develop complete end to end web portals based on requirements and design considerations.					
Text Books:					
1. Ben Frain, Responsive Web Design with HTML5 and CSS3, 2nd Revised Edition, Packt Publishing Limited, 2015.					
2. Ethan Brown, Learning JavaScript, 3rd Edition, Oreilly Publishers, 3rd Edition, 2016.					
3. Laura Thomson, Luke Welling, PHP and MySQL Development, 5th Edition, Pearson Education, 2016.					
Reference Books:					
1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, Internet & World Wide Web How to Program, 5/e , Prentice Hall, , 2013.					
2. Elisabeth Robson, Eric Freeman, Head First Java Script Programming: A Brain-friendly Guide, Oreilly Publishers, 2014.					

	Course Outcomes
CO 1	Apply the knowledge of modern web languages, scripting languages and latest Web frameworks to develop interactive web applications
CO 2	Analyze front-end web coding languages to add dynamic content, animation and effects to websites
CO 3	Differentiate client side and server side scripting technologies.
CO 4	Design an interactive website(s) in team using modern integrated tools.

Course Title	LINEAR ALGEBRA AND CALUCLUS				
Course Code	19MA4BSLIA	Credits	4	L-T-P	3-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36
UNIT – 1					11 Hrs
SYSTEM OF LINEAR EQUATIONS AND VECTOR SPACES: Elementary row operations, echelon forms, rank of matrix. System of Linear Equations: solution of homogeneous equations, consistency of non- homogeneous system of linear equations. Gauss elimination method, LU decomposition method. Vector spaces: Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Coordinates.					
UNIT – 2					9 Hrs
LINEAR TRANSFORMATIONS: Introduction, Linear Mappings, Geometric linear transformation of Kernel and Image of a linear transformations, Matrix representation of linear transformations, Rank-Nullity Theorem(No proof), Singular and Nonsingular linear transformations, Invertible linear transformations.					
UNIT – 3					10 Hrs
EIGENVALUES AND EIGENVECTORS: Introduction, Polynomials of Matrices, Characteristic polynomial, Cayley-Hamilton Theorem, eigenvalues and eigenvectors, eigen spaces of a linear transformation, Diagonalization, Minimal Polynomial, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form, Solving differential equations in Fundamental form.					
UNIT – 4					10 Hrs
INNER PRODUCT SPACES: Inner product, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt process, QR-factorization, least squares problem and least square error.					
UNIT – 5					8 Hrs
SYMMETRIC MATRICES AND QUADRATIC FORMS: Diagonalization of real symmetric matrices, Orthogonal diagonalization of real symmetric matrices, quadratic forms and its classifications, Singular value decomposition.					
Text Books:					
1. Linear Algebra and its applications, David C. lay, Steven R. lay, Judi J Mc. Donald, 5 th Edition, 2015, Pearson Education.					
2. Linear Algebra and its applications, Gilbert Strang, 4 th edition, 2005, Brooks Cole.					
Reference Books:					
1. Schaum's outline series-Theory and problems of linear algebra, Seymour Lipschutz, 5 th edition, 2012, McGraw-Hill Education					
2. Linear Algebra an Introduction, Richard Bronson & Gabriel B. Costa, 2 nd edition.					

Course Title	DESIGN AND ANALYSIS OF ALGORITHMS				
Course Code	20AM4PCADA	Credits	4	L-T-P	3-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36
UNIT – 1					7 Hrs
Fundamentals of Algorithm Analysis: Definition of algorithm, Algorithmic Problem Solving, Framework for Analysis of algorithm efficiency, Asymptotic Notations, Mathematical Analysis of Non recursive algorithms and Recursive algorithms.					
UNIT – 2					7 Hrs
Brute Force: Sorting techniques, String Matching, Exhaustive search Divide and Conquer: Master Theorem, Merge sort, Quicksort. Greedy Technique: Minimum Spanning tree and its application.					
UNIT – 3					8 Hrs
Decrease and conquer: Depth First Search (DFS), Breadth First Search (BFS), Applications of DFS and BFS, Topological Sorting, Algorithms for Generating Combinatorial Objects Space and Time Trade-offs: Horspool Algorithm, Hashing					
UNIT – 4					7 Hrs
Transform and Conquer: Pre-sorting, 2-3 Trees, Heaps and Heapsort Dynamic Programming: Computing a Binomial Coefficient, Floyd’s Algorithm, Knapsack Problem and Memory functions.					
UNIT – 5					7 Hrs
Limitations of Algorithm Power: Decision Trees, P, NP and NP-Complete Problems. Backtracking: N queens problem, Sum of subset problem Branch and bound: Travelling Salesman problem, Assignment problem					
Text Books: 1. Introduction to the design and analysis of algorithms, by Anany Levitin, 3 rd Edition, Pearson Education, 2011. 2. Computer Algorithms, by Horowitz E., Sahani S., Rajasekharan S., 2 nd Edition, Universities Press, 2008.					
Reference Books: 1. Introduction to Algorithms, Cormen T.H, Leiserson C. E, Rivest R.L, Stein C, 3 rd Edition, PHI 2010. 2. Data Structures and Algorithm Analysis in C++, by Mark Allen Weiss, PHI, 2013.					

Course Outcomes

CO1	Perform time complexity analysis of Recursive and Non-recursive algorithms using asymptotic notations.
CO2	Design efficient algorithms using various design techniques.
CO3	Apply the knowledge of complexity classes P, NP, and NP-Complete and prove certain problems are NP-Complete.
CO4	Solve problems using an appropriate designing method and find time efficacy by practical programming experiments.

Course Title	DATABASE MANAGEMENT SYSTEM				
Course Code	20AM4PCDBM	Credits	4	L-T-P	3-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36
UNIT – 1					7 Hrs
Introduction to Databases: Characteristics of Database approach, Advantages. Database Architecture: Data models, Schemas and instances, Three schema architecture and data independence Database languages and interfaces, The database system environment, SQL: SQL Data Definition and Data Types specifying basic constraints in SQL, Basic retrieval queries in SQL, Insert, Delete and Update statements in SQL, Additional features of SQL, More complex SQL Queries, Specifying Constraints as Assertions and Triggers, Views (Virtual Tables) in SQL, Schema Change Statement in SQL.					
UNIT – 2					7 Hrs
Entity-Relationship(ER) model: Using High-Level conceptual Data Models for Database Design, A sample Database Application, Entity types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles and Structural Constraints, Weak Entity types, Refining the ER Design, ER Diagrams, Naming Conventions and Design Issues, Relationship Types of Degree Higher than two, Relational Database Design using ER-to-Relational Mapping					
UNIT – 3					7 Hrs
Relational Data Model and Relational Database Constraints: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations. Relational Algebra: Unary Relational Operations, SELECT and PROJECT, Relational Algebra Operations from Set Theory Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations					
UNIT – 4					7 Hrs
Database Design Theory and Normalization: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Multi-valued Dependencies and a Fourth Normal Form, Join Dependencies, Fifth Normal Form.					
UNIT – 5					8 Hrs
Transaction Processing, Concurrency Control, and Recovery: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability, Two-Phase Locking Techniques for Concurrency Control, Recovery Concepts ,NO-UNDO/REDO Recovery Techniques based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging, The ARIES Recovery Algorithm.					
Text Books: 1. Database Systems: The Complete Book Hector Garcia-Molina Jeffrey D. Ullman Jennifer Widom, 2 nd edition. 2. Getting Started with NoSQL by Gaurav Vaish.					
Reference Books: 1. Fundamental of Database Systems by Elmasri and Navathe, 6 th Edition, Addison-Wesley, 2011.					

	Course Outcomes
CO1	Apply the concepts of database management system for various applications
CO2	Analyse the given database concepts to its correctness
CO3	Design and demonstrate conceptual models, query and optimization
CO4	Conduct experiments to demonstrate the various SQL query processing

Course Title	INTRODUCTION TO ARTIFICIAL INTELLIGENCE				
Course Code	20AM4PCIAI	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36
UNIT – 1					7 Hrs
Introduction: What is AI? Intelligent Agents: How agent should act, Structure of Intelligent Agents, Environments Problem Solving: Formulating problems, Example problems Uniformed-search strategies: Breadth-First Search, Uniform Cost Search, Depth-First Search, Depth Limited Search, Iterative Deepening Search					
UNIT – 2					8 Hrs
Heuristic Search Strategies: Generate-and-Test, Hill Climbing, Best-first Search, Problem Reduction, Constraint Satisfaction, Means-ends Analysis					
UNIT – 3					8 Hrs
Knowledge Representation: Propositional Logic – Syntax and Semantics, Using Propositional Logic, First-Order Logic – Syntax and Semantics, Using First-Order Logic Representing Knowledge using Rules: Procedural Versus Declarative Knowledge, Forward Versus Backward Reasoning, Semantic Knowledge, Ontology Based representation.					
UNIT – 4					8 Hrs
Uncertain Knowledge & Reasoning: Acting under Uncertainty, Basic Probability notation, The Axioms of Probability, Bayes’ Rule and its Use, Where do Probabilities come from?, Representing Knowledge in an Uncertain Domain, The Semantics of Belief Networks..					
UNIT – 5					6 Hrs
Introduction to Expert Systems: Definition, Features of an Expert System, Organization, Characteristics, Prospector, Knowledge Representation in Expert Systems, Expert System tools – MYCIN, EMYCIN.					
Text Books: 1. Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, Third edition, Pearson, 2014.					
Reference Books: 1. Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B Nair, Third edition, McGraw-Hill Education, 2015. 2. Introduction to Artificial Intelligence and Expert Systems, Dan W Patterson, Pearson, 2015.					

Course Title	PROBABILITY AND STATISTICS FOR MACHINE LEARNING				
Course Code	20AM3PCPSM	Credits	3	L-T-P	3-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36
UNIT – 1					6 Hrs
Probability and Random Variables: Events and their probabilities, outcomes, sample space, set operations, rules of Probability, Axioms of Probability, Computing probabilities of events, Combinatorics.					
UNIT – 2					10 Hrs
Discrete Random Variables: Distribution of a random variable, Types of random variables, Joint and marginal distribution, Independence of random variables Expectation and variance, function , properties, standard deviation, Covariance and correlation, Properties of discrete Random variables, Bernoulli distribution, Binomial distribution, Geometric distribution Poisson distribution.					
Continuous Random variables: Probability density, Union, Exponential, Normal distributions and Central Limit Theorem.					
UNIT – 3					7 Hrs
Introduction to statistics: Population and sample, parameters and statistics Descriptive statistics, Mean, Median, Quantiles, Percentiles, Quartiles, Variance, Standard Deviation, Standard Errors of Estimates.					
UNIT – 4					7 Hrs
Statistical Inference: Parameter estimation, Method of moments, Method of maximum likelihood, Estimation of standard errors, Confidence intervals, Construction of confidence intervals: a general method, Confidence interval for the population mean, Confidence interval for the difference between two means, Selection of a sample size, Estimating means with a given precision, Hypothesis Testing, Type I and Type II errors: level of significance, Rejection regions, Z-tests for means and proportions, T-tests, Duality: two-sided tests and two-sided confidence intervals.					
UNIT – 5					7 Hrs
Regression: Linear regression, Regression and correlation, Overfitting a model, Analysis of variance, prediction, and further inference, ANOVA and R-square, Tests and confidence intervals Prediction, Multivariate regression, Logistic regression, Dimensionality reduction.					
Text Books:					
1. Michael Baron, Probability and Statistics for Computer Scientists, CRC press, 2019.					
Reference Books:					
1. Kishore S Trivedi, Probability, Statistics, Queuing theory and Computer Science Applications, 2 nd Edition, Willey Publishers, 2008.					

CO1	Apply key concepts of probability, including discrete and continuous random variables, probability distributions, conditioning, independence, expectations, and variances
CO2	Apply the basic rules and theorems in probability including Bayes's theorem and the Central Limit Theorem
CO3	Infer various statistical properties to draw conclusions
CO4	Apply the concepts of hypothesis testing and p-value and regression analysis
CO5	Use R-Programming, explore various statistical analysis.

Course Title	Python For Machine Learning				
Course Code	20AM3PCPML	Credits	2	L-T-P	0-0-2
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	4				
About the Course: The students will be exploring fundamentals to advanced features of python programming that are necessary for AI and ML applications. The students also will explore various tools like anaconda, pytorch to conduct various experiments. At the end of the course project work have to demonstrated in groups.					
Text Books: 1. Python Crash Course: A Hands-On, Project-Based Introduction to Programming, Eric Matthes, 2nd Edition. 2. Learn Python the Hardway by Zeo A Shaw, 3rd Edition.					
Reference Books: 1. Introducing Python by Bill Lubanovic, O'Reilly Media, 2014. 2. Learning with Python: How to Think Like a Computer Scientist, Allen Downey, Jeffrey Elkner and Chris Meyers, Dreamtech Press, 2015. 3. Learning to Program using Python by Cody Jackson, Second Edition, 2014. 4. Programming Python, Mark Lutz, O'reilly Media, 2015					

Course Outcomes:

CO1	Learn and apply core Python scripting elements such as variables, flow control structures, file operations and functions.
CO2	Implement control structures and various data structures for simple to complex operations.
CO3	Demonstrate the usage of python libraries for performing data operations and data visualizations.
CO4	Expertise in using and configuring modern integrated development tools related to python programming.