B. Tech. (Artificial Intelligence and Data Science / Artificial Intelligence and Machine Learning and Allied) Syllabus Aligned with the New Education Policy 2020 Effective from 2025 - 2026 (All Years)

(Affiliated Colleges)

Note: Refer to this syllabus for the Second year in Artificial Intelligence and Data Science, Artificial Intelligence and Machine Learning, Computer Engineering and Data Science, Data Science with Program Codes (11263, 11911, 11912, 11913, 11917, 11921, 11925, 11995)

Department of Computer Engineering

Dr. Babasaheb Ambedkar Technological University, Lonere - 402103

www.cse.dbatu.ac.in

B.Tech in Artificial Intelligence and Allied
Course Curriculum Aligned with New Education Policy 2020
(Effective from Academic Year 2025 - 2026)
Third Semester

Course Category	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
BSC	25AF1000BS301	Engineering Mathematics-III	3	-	20	20	60	3
PCC1	25AF1245PC302	Data Structures	3	-	20	20	60	3
PCC2	25AF1245PC303	Discrete Mathematics	3	-	20	20	60	3
PCC3	25AFAIPC304	Artificial Intelligence	2	-	20	20	60	2
OE-I	25AF1XXXOEM305X	Any Course from the Open Elective Bucket	2	-	20	20	60	2
MDM	25AFAIMD306	Multi-Disciplinary Minor Course* **(For Examination Refer MDM Bucket)**	-	-	20	20	60	-
PCC4	25AFAIPC307	Prompt Engineering	2	-	20	20	60	2
VEC	25AF1000VE308A	Life of Chhatrapati Shivaji Maharaj	1	-	50	-	-	1
PCC Lab	25AFAIPCL309	Data Structures Laboratory with Python	1	4	60	-	40	3
VEC	25AF1000VE310	Universal Human Values-II	3	-	20	20	60	3
VEC	25AFAIPCL311	Artificial Intelligence Laboratory	-	2	60	-	40	1
		Total	**20**	**6**	**330**	**160**	**560**	**23**

Course Type and Acronyms used

Basic Science Course (BSC)
Engineering Science Course (ESC)
Program Core Course (PCC)
Vocational Skill Enhancement Course (VSEC)
Co-curricular Course (CC)
Ability Enhancement Course (AEC)
Indian Knowledge System (IKS)

L - Lecture,
P / PR - Practical,
CA - Continuous Assessment,
TH - Theory,
MSE - Mid Semester Examination,
ESE - End Semester Examination,
CR - Credit

B.Tech in Artificial Intelligence and Allied
Course Curriculum Aligned with New Education Policy 2020
(Effective from Academic Year 2025 - 2026)
Fourth Semester

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC1	25AFAIPC401	Introduction to Operating Systems	3	-	20	20	60	3
PCC2	25AFAIPC402	Data Analytics	3	-	20	20	60	3
PCC3	25AF1245PC403	Probability and Statistics	3	-	20	20	60	3
PCC Lab	25AFAIPCL404	Full Stack Development	1	2	60	-	40	2
OE-II	25AF1XXXOEM405X	Any Course from the Open Elective Bucket	2	-	20	20	60	2
MDM	25AFAIMD406	Multi-Disciplinary Minor Course* **(For Examination Refer MDM Bucket)**	-	-	20	20	60	-
VSEC	25AFCOIAE407	Constitution of India	2	-	50	-	-	Audit
VSEC	25AF1000VE308B	Life of Bharat Ratna Dr. Babasaheb Ambedkar	1	-	50	-	-	1
PCC Lab	25AFAIPCL409	Introduction to Operating Systems Laboratory	-	2	60	-	40	1
AEC	25AF1000VE410	Modern Indian Languages A) Marathi B) Hindi C) Sanskrit	2	-	20	20	60	2
Total			**17**	**4**	**340**	**120**	**380**	**17**
	Exit Requirements for Certificate Program							
VSEC	23AFAIVE411	LLM Course with Programming	-	16	60	-	40	8

B.Tech in Artificial Intelligence and Allied
Course Curriculum Aligned with New Education Policy 2020
(Effective from Academic Year 2026 - 2027)
Fifth Semester

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC1	26AFXXXXPC501	Machine Learning	3	-	20	20	60	3
PCC2	26AFXXXXPC502	Software Engineering (MLOps)	2	-	20	20	60	2
PCC3	25AFXXXXPC503	Theory of Computation	4	-	20	20	60	4
PCC4	25AFXXXXPC504	Database Management Systems	3	-	20	20	60	3
PEC	26AFXXXXPC505	**Program Elective:** A. Vector Databases B. Human Computer Interaction C. Computer Graphics	2	-	20	20	60	2
OE-III	26AFXXXXOE506	Open Elective Bucket	2	-	20	20	60	2
MDM	26AFXXXXMD507	MDM Bucket	-	-	20	20	60	-
PCC LAb	26AFXXXXAE508	Machine Language Lab	2	-	20	20	60	2
PCC Lab	26AFXXXXPCL509	MLOps	-	2	60	-	40	1
CEP/FP	25AFXXXXAE510	Seminar	-	2	60	-	40	1
		Total	**18**	**4**	**220**	**160**	**540**	**20**

B.Tech in Artificial Intelligence and Allied
Course Curriculum Aligned with New Education Policy 2020
(Effective from Academic Year 2026 - 2027)
Sixth Semester

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC1	26AFXXXXPC601	Deep Learning	3	-	20	20	60	3
PCC2	26AFXXXXPC602	Natural Language Processing	3	-	20	20	60	3
PCC3	26AFXXXXPC603	Computer Vision	3	-	20	20	60	3
PEC	26AFXXXXPC604	**Program Elective:** A. Data Communication B. Cyber Physical Systems	3	-	20	20	60	3
OE-IV	26AFXXXXOE605	Open Elective Basket	2	-	20	20	60	2
MDM	26AFXXXXMD606	MDM Bucket	-	-	20	20	60	-
PCCLab	26AFXXXXAE607	Deep Learning Lab		4	20	20	60	2
PCC Lab	26AFXXXXVE608	NLP Lab	1	2	50	-	-	2
PCC Lab	26AFXXXXPCL609	Computer Vision Lab	1	2	60	-	40	2
Total			**22**	**8**	**490**	**140**	**620**	**20**
Exit Requirements for Certificate Program								
VSEC	23AFAIVE610		-	16	60	-	40	8

B.Tech in Artificial Intelligence and Allied
Course Curriculum Aligned with New Education Policy 2020
(Effective from Academic Year 2027 - 2028)
Seventh Semester

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC	27AFXXXXPC701	Internet of Things	3	-	20	20	60	3
PEC	27AFXXXXPC702	**Program Elective:** A. Graphical Neural Networks B. Quantum Computing C. Optimization Techniques	2	-	20	20	60	2
PCC Lab	27AFXXXXMD703	IoT Lab	-	2	60	-	40	1
Project	27AFXXXXP704	Project-Phase	-	4	60	-	40	2
MDM	27AFXXXXPC705	MDM Bucket	-	-	20	20	60	-
Internship	27AFXXXXO706	Internship	-	24	60	-	40	12
PCC Lab	27AFXXXXPCL707	Mobile Application Development	1	2	40	-	60	2
		Total	**22**	**10**	**490**	**140**	**620**	**22**

Fourth Year in B.Tech in Artificial Intelligence and Allied
Course Curriculum Aligned with New Education Policy 2020
(Effective from Academic Year 2026 - 2027)

Eigth Semester

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC	27AXXXXPC801	AI Ethics	3	-	20	20	60	3
PCC	27AFXXXXPE802	**Program Elective** A. Generative AI B. Graphical Neural Networks C. AI for Social Good	3	-	20	20	60	2
PEC	27AXXXXPE803	**Program Elective** A. Quantum Machine Learning B. Business Analytics C. Learning Analytics	3	-	20	20	60	2
MDM	27AFXXXXMD804	**MDM Bucket**	2	-	40	-	60	2
RM	27AFXXXXRM805	Research Methodology	3	2	40	-	60	4
PCC Lab	27AFXXXXPL806	Project Phase - II	-	4	40	-	60	2
		Total	**22**	**10**	**490**	**140**	**620**	**20**

List of Open Electives (OE)

In the vertical of Multidisciplinary courses, students need to cover Open Elective Courses (OE) of 08 credits. These 08 credits over semesters III to V are included in the basic minimum of 160-max.176 Credits. It is offered in the Second and/or Third year. Refer to the wise credit distribution table given below. Faculty-wise baskets of OE are prepared by the university. They are chosen from faculty other than that of the Major Faculty, i.e., in this case, the Major Faculty is the Faculty of Engineering. Other Faculties considered are as follows:

1. Faculty of Management and Commerce
2. Faculty of Law
3. Faculty of Humanities and Arts
4. Faculty of Architecture and Planning
5. Faculty of Health Sciences
6. Faculty of Science

Students must take up three courses of 08 credits over semesters III to V.

List of Open Electives for Faculty of Management and Commerce

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor/ Resource Person	Link
1	Advanced Algorithmic Trading and Portfolio Management	4 Hrs / Week	8	2	IIT, Kanpur	Prof. Abhinava Tripathi	https://nptel.ac.in/courses/110104169
2	Business Analytics & Text Mining Modeling using Python	4 Hrs / Week	8	2	IIT, Roorkee	Prof. Gaurav Dixit	https://nptel.ac.in/courses/110107129
3	Commodity Derivative & Risk Management	4 Hrs / Week	12	3	IIT, Kharagpur	Prof. Prabina Rajib	https://nptel.ac.in/courses/110105168
4	E-Business	4 Hrs / Week	12	3	IIT, Kharagpur	Prof. Mamata Jenamani	https://nptel.ac.in/courses/110105083
5	Econometric Modelling	4 Hrs / Week	8	2	IIT, Roorkee	Prof. Sujata Kar	https://nptel.ac.in/courses/110107153
6	Introduction to Marketing Essentials	4 Hrs / Week	12	3	IIT, Roorkee	Prof. Zillur Rahman	https://nptel.ac.in/courses/110107147
7	Security Analysis & Portfolio Management	4 Hrs / Week	12	3	IIT, Roorkee	Prof. J. P. Singh	https://nptel.ac.in/courses/110107154
8	Equity Stock Market		6	3	Indian Institute of Management, Bangalore (IIB)	P. C. Narayan	https://onlinecourses.swayam2.ac.in/imb23_mg59/preview

List of Open Electives for Faculty of Law

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor / Resource Person	Link
1	Introduction to Law on Electricity	4 Hrs / Week	8	2	IIT, Kharagpur	Prof. Uday Shankar	https://nptel.ac.in/courses/129105004
2	New Labour Codes of India	4 Hrs / Week	12	3	IIT, Kharagpur	Prof. K. D. Raju	https://nptel.ac.in/courses/129105006
3	Right to Information and Good Governance	4 Hrs / Week	12	3	National Law School of India University	Prof. Sairam Bhat	https://nptel.ac.in/courses/129106001
4	Conflict Management through Mediation	4 Hrs / Week	8	2	Vice-Chancellor, National University of Study and Research in Law, Ranchi (NUSRL)	Prof. (Dr.) Ashok R. Patil	https://nptel.ac.in/courses/129106008
5	Biodiversity Protection, Farmers and Breeders Rights	4 Hrs / Week	8	2	IIT, Kharagpur	Prof. Padmavati Manchikanti Prof. Narendran Thiruthy	https://nptel.ac.in/courses/129105008

List of Open Electives for Faculty of Humanities and Arts

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor / Resource person	Link
1	Developing Soft Skills and Personality	4 Hrs / Week	8	2	IIT, Kanpur	Prof. T. Ravichandran	https://nptel.ac.in/courses/109104107
2	Folk and Minor Art in India	4 Hrs / Week	8	2	IIT, Kanpur	Prof. Shatarupa Thakurta Roy	https://nptel.ac.in/courses/109104106
3	Sustainable Happiness	4 Hrs / Week	8	2	IIT, Kharagpur	Prof. Atasi Mohanty	https://nptel.ac.in/courses/109105493
4	Soft Skill Development	4 Hrs / Week	8	2	IIT, Kharagpur	Prof. Priyadarshi Patnaik, Prof. V. N. Giri, Prof. D. Suar	https://nptel.ac.in/courses/109105110
5	Introduction to Market Structures	4 Hrs / Week	12	3	IIT, Guwahati	Prof. Amarjyoti Mahanta	https://nptel.ac.in/courses/109103187
6	Human Resource Development	4 Hrs / Week	12	3	IIT, Kharagpur	Prof. KBL Srivastava	https://nptel.ac.in/courses/109105121
7	Educational Leadership	4 Hrs / Week	12	3	IIT, Kharagpur	Prof. Atasi Mohanty	https://nptel.ac.in/courses/109105122

List of Open Electives for Faculty of Architecture and Planning

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor / Resource person	Link
1	Architectural Approaches to Decarbonization of Buildings	4 Hrs / Week	12	3	School of Planning and Architecture, Vijayawada, An Institute of National Importance under the Ministry of Education Govt. of India	Prof. Iyer Vijayalaxmi Kasinath	https://nptel.ac.in/courses/124106454
2	Building Materials and Composites	4 Hrs / Week	8	2	IIT, Kharagpur	Prof. Sumana Gupta	https://nptel.ac.in/courses/124105013
3	Building Materials as a Cornerstone to Sustainability	4 Hrs / Week	12	3	School of Planning and Architecture, Vijayawada, An Institute of National Importance under the Ministry of Education Govt. of India	Prof. Iyer Vijayalaxmi Kasinath	https://nptel.ac.in/courses/124106455
4	Modern Indian Architecture	4 Hrs / Week	8	2	IIT, Roorkee	Prof. P. S. Chani	https://nptel.ac.in/courses/124107161

List of Open Electives for Faculty of Science

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor / Resource Person	Link
1	Quantum Computing	4 Hrs / Week	12	3	IIT, Kanpur	Prof. Debabrata Goswami	https://onlinecourses.nptel.ac.in/noc19_cy31/preview#:~:text=Building%20up%20on%20the%20digital,the%20laws%20of%20quantum%20mechanics.
2	Introduction to Quantum Computing: Quantum Algorithms and Qiskit	4 Hrs / Week	4	1	IIT Madras, IBM Research, IBM Systems	Prof. Prabha Mandayam, Prof. Anupama Ray, Prof. Sheshashayee Raghunathan	https://onlinecourses.nptel.ac.in/noc24_cs67/preview
3	Quantum Information and Computing	4 Hrs / Week	8	2	IIT, Bombay	Prof. Dipan Ghosh Department of Physics	https://archive.nptel.ac.in/courses/115/101/115101092/
4	Dynamics of Classical and Quantum Fields	4 Hrs / Week	12	3	IIT, Guwahati	Prof. Girish S. Setlur	https://onlinecourses.nptel.ac.in/noc22_ph29/preview

Teaching Scheme		Semester III Engineering Mathematics - III	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Able to comprehend the fundamental knowledge of the Laplace and inverse Laplace transforms and their derivatives for elementary functions	MSE	20
CR	3	2. Able to apply the properties of Laplace and inverse Laplace transforms to solve simultaneous linear and linear differential equations with constant coefficients.	ESE	60
		3. Able to conceptualize the definitions and properties of Fourier transforms and to solve boundary value problems using Fourier transforms.		
		4. Able to find the solutions of partial differential equations governing real-world problems.		
		5. Able to conceptualize limit, continuity, derivative and integration of complex functions, complex integrals useful in real-world problems.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Laplace Transform:** Definition – conditions for existence; Transforms of elementary functions; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.	07 Hrs
2	**Inverse Laplace Transform:** Introductory remarks; Inverse transforms of some elementary functions; General methods of finding inverse transforms; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.	07 Hrs
3	**Fourier Transform:** Definitions – integral transforms; Fourier integral theorem (without proof); Fourier sine and cosine integrals; Complex form of Fourier integrals; Fourier sine and cosine transforms; Properties of Fourier transforms; Parseval's identity for Fourier Transforms.	07 Hrs
4	**Partial Differential Equations and Their Applications:** Formation of Partial differential equations by eliminating arbitrary constants and functions; heat Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one-dimensional flow equation ($ie.\ \frac{\partial u}{\partial t} = C^2 \frac{\partial^2 u}{\partial t^2}$), and one-dimensional wave equation ($ie.\ \frac{\partial^2 y}{\partial t^2} = C^2 \frac{\partial^2 y}{\partial x^2}$).	07 Hrs

5	**Functions of Complex Variables:** Analytic functions; Cauchy-Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).	07 Hrs

Text Books:

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & Co. Pvt. Ltd., New Delhi.
3. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd., Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, McGraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill , New York.

Teaching Scheme		Semester III Artificial Intelligence	Examination Scheme	
TH	2	**Course Objectives:**	CA	20
PR	-	1. Explain the foundations, history, and scope of artificial intelligence, and describe the structure and behavior of intelligent agents in various environments.	MSE	20
CR	2	2. Apply problem-solving techniques, including uninformed, informed, and adversarial search strategies, to develop optimal solutions for well-defined problems.	ESE	60
		3. Represent and reason with knowledge using predicate logic, rules, and inference methods, and apply these to solve reasoning problems.		
		4. Implement probabilistic reasoning, planning techniques, and natural language processing methods to handle uncertainty and language-based tasks.		
		5. Apply machine learning approaches, including decision trees, neural networks, genetic algorithms, and expert system design, to develop intelligent applications.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction:** What Is AI? The Foundations of Artificial Intelligence, the History of Artificial Intelligence, the State of the Art. Intelligent Agents: Agents and Environments Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.	04 Hrs
2	**Problem-solving**: Solving Problems by Searching, Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems. Adversarial Search, Games, Optimal Decisions in Games, Alpha–Beta Pruning.	07 Hrs
3	**Knowledge & Reasoning:** Knowledge representation issues, Representation & mapping, Approaches to knowledge representation, Issues in knowledge representation. Using predicate logic: Representing simple facts in logic, Representing instant & ISA relationship, Computable functions & predicates, Resolution, Natural deduction. Representing knowledge using rules: Procedural verses declarative knowledge, Logic programming, Forward verses backward reasoning, Matching, Control knowledge.	07 Hrs
4	**Probabilistic Reasoning:** Representing knowledge in an uncertain domain, The semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets &	04 Hrs

fuzzy logics, Planning: Overview, Components of a planning system, Goal stack planning, Hierarchical planning and other planning techniques.

Text / Reference Books:

1. Rich, E. and Knight K.: Artificial Intelligence, Tata McGraw- Hill
2. Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition.
3. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison-Wesley.

Teaching Scheme		Semester III Discrete Mathematics	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Apply principles of propositional and predicate logic to model, analyze, and validate logical arguments using truth tables, standard forms, rules of inference, and quantifiers.	MSE	20
CR	3	2. Use set theory, functions, and relations to represent, manipulate, and reason about mathematical structures and their properties.	ESE	60
		3. Solve combinatorial problems using counting principles, recurrence relations, and graph theory concepts, including paths, connectivity, colouring, and spanning trees.		
		4. Implement algorithms for graph and tree problems such as shortest paths, minimal spanning trees, Huffman coding, and topological sorting.		
		5. Analyse and apply algebraic structures, including groups, rings, fields, and Boolean algebras, to formulate and solve problems in computer science and related domains.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Propositional Logic:** Propositions, truth values, Truth tables for operators, Truth Tables of Compound Propositions, Precedence of Logical Operators. **Propositional Equivalences:** Logical Equivalences, Constructing New Logical Equivalences, Normal Forms. **Predicates and Quantifiers:** Predicates, Quantifiers: Universal and Existential, Quantifiers with Restricted Domains, Precedence of Quantifiers, Binding Variables, Logical Equivalences Involving Quantifiers, Negating Quantified Expressions, Translating from English into Logical Expressions, Examples from Lewis Carroll, Nested Quantifiers: Understanding Statements Involving Nested Quantifiers, The Order of Quantifiers, Negating Nested Quantifiers. **Rules of Inference:** Valid Arguments in Propositional Logic, Rules of Inference for Propositional Logic, Using Rules of Inference to Build Arguments, Resolution, Fallacies.	09 Hrs
2	**Basic notions in set Theory:** Sets, Venn Diagrams, Subsets, The Size of a Set, Power Sets, Cartesian Products, Set operations, Set Identities, Generalized Unions and Intersections, Cardinality of Sets. **Functions:** Introduction, Subjective, Injective, Bijective, inverse functions, Composition of functions. **Relations:** Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Equivalence classes and partitions, Partial Ordering, Hasse Diagram, Topological Sort.	09 Hrs
3	**Combinatorics:** Applications of Recurrence Relations, Solving Linear Recurrence Relations.	07 Hrs

4	**Graph:** Some Special Simple Graphs, Bipartite Graphs, New Graphs from Old, Shortest path problems, Euler and Hamiltonian paths, Isomorphic graphs, Planar graphs, Connectivity, Matching Coloring. **Trees:** Prefix Codes, Huffman coding, Spanning trees and cut sets, Minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning trees.	07 Hrs
5	**Algebraic Structures and Morphism:** Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields, Boolean Algebra and Boolean Ring.	05 Hrs

Text Books:

1. C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2008.

Reference Books:

1. Lipschutz, Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2009.
2. V. K. Balakrishnan, Schaum's Outline of Graph Theory, McGraw-Hill Publication, 1st Edition, 1997.
3. Eric Gossett, Discrete Mathematics with Proof, Wiley Publication, 2nd Edition, 2009.
4. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw-Hill Publication, 6th Edition, 2010.
5. Y. N. Singh, Discrete Mathematical Structures, Wiley Publication, 1st Edition, 2010.
6. Dr. Sukhendu Dey, Graph Theory with Applications, SPD Publication, 1st Edition, 2012.

Teaching Scheme		Semester III Data Structures	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Explain fundamental concepts of data, data types, data structures, and Abstract Data Types (ADT), and analyse algorithms in terms of time and space complexity.	MSE	20
CR	3	2. Solve computational problems by applying appropriate data structures such as arrays, hash tables, stacks, queues, and linked lists.	ESE	60
		3. Implement tree and graph data structures, including binary trees, binary search trees, heaps, and adjacency matrix representations, and perform related operations and traversals.		
		4. Demonstrate proficiency in searching and sorting algorithms, including sequential, binary search, skip lists, insertion sort, selection sort, and radix sort, along with file handling techniques.		
		5. Select and implement suitable data structures and algorithms to develop efficient, maintainable, scalable software solutions.		

COURSE CONTENT

Unit No.	Topic	Hours
1	Data, Data types, Data structure, Abstract Data Type (ADT), representation of Information, characteristics of algorithm, program, analyzing programs. **Arrays and Hash Tables:** Concept of sequential organization, linear and non-linear data structures, storage representation, array processing, sparse matrices, transpose of sparse matrices, Hash Tables, Direct address tables, Hash tables, Hash functions, Open addressing, Perfect hashing.	06 Hrs
2	**Stacks and Queues:** Introduction, stack and queue as ADT, representation and implementation of stack and queue using sequential and linked allocation, Circular queue and its implementation, Application of stack for expression evaluation and expression conversion, recursion, priority queue.	06 Hrs
3	**Linked Lists:** Concept of linked organization, singly and doubly linked list, and dynamic storage management, circular linked list, operations such as insertion, deletion, concatenation, traversal of linked list, dynamic memory management, garbage collection.	06 Hrs
4	**Trees and Graphs:** Basic terminology, binary trees and their representation, insertion and deletion of nodes in binary trees, binary search tree and its traversal, threaded binary tree, Heap, Balanced Trees, Terminology and representation of graphs using adjacency matrix, Warshall's algorithm.	06 Hrs
5	**Searching and Sorting:** Sequential, binary searching, skip lists – dictionaries, linear list representation, skip list representation, operations – insertion, deletion, and searching. Insertion sort, selection sort, radix sort, and File handling.	06 Hrs

Reference Books:

1. Horowitz and Sahani, Fundamentals of Data Structures, Universities Press, 2nd Edition, 2008.
2. Thomas Cormen, Introduction to Algorithms, PHI Publication, 2nd Edition, 2002.
3. Venkatesan & Rose, Data Structures, Wiley Publication, 1st Edition, 2015.
4. Goodrich & Tamassia, Data Structures & Algorithms in C++, Wiley Publication, 2nd Edition, 2011.
5. R. G. Dromey, How to Solve it by Computer, 2nd Impression, Pearson Education.
6. Kyle Loudon, Mastering Algorithms with C: Useful Techniques from Sorting to Encryption, O'Reilly Media, 1st Edition, 1999.

Text Books:

1. Mark Allen Weiss, Data structures and algorithms analysis in C++, Pearson Education, 4th Edition, 2013.
2. S. Lipschutz, Data Structures, McGraw-Hill Publication, Revised 1st Edition, 2014.
3. Y. Langsm, M. Augenstin, A. Tanenbaum, Data Structures using C and C++, Prentice Hall India Learning Private Limited, 2nd Edition, 1998.
4. Trembley and Sorenson, Introduction to Data Structures, PHI Publication, 2nd Revised Edition, 1983.
5. Vishal Goyal, Lalit Goyal, A Simplified Approach To Data Structure, SPD Publication, 1st Edition, 2014.

Teaching Scheme		Semester III Prompt Engineering	Examination Scheme	
TH	2	**Course Objectives:**	CA	20
PR	-	1. Explain the evolution of NLP to large language models, their architecture, and the role of prompt engineering in AI/ML applications.	MSE	20
CR	2	2. Design and evaluate effective prompts using various prompting types, patterns, and debugging techniques.	ESE	60
		3. Apply advanced prompting methods, including Chain-of-Thought, ReAct, and multimodal prompting, using tools such as LangChain and OpenAI SDK.		
		4. Develop domain-specific prompts for tasks such as coding assistance, conversational agents, and data analysis, including low-resource language applications.		
		5. Assess prompt safety, bias, and ethical considerations, and implement best practices for secure and responsible LLM usage.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Prompt Engineering & LLMs:** Evolution of NLP to Large Language Models, Anatomy of LLMs: Tokens, embeddings, context windows, Why prompt engineering matters, Prompt engineering applications in AI/ML systems, Introduction to GPT, Claude, PaLM, Mistral, etc., Prompting vs fine-tuning.	04 Hrs
2	**Foundations of Prompt Design:** Types of prompting: Zero-shot, One-shot, Few-shot, Prompt patterns: Instructional, Delimiting, Role-based, Socratic, Prompt evaluation metrics: accuracy, relevance, hallucination, safety, Prompt debugging techniques. **Advanced Prompting Techniques:** Chain-of-Thought Prompting, Self-Ask Prompting, ReAct (Reason + Act) prompting, Multimodal prompting (text + image), Prompt templates using Python APIs (LangChain, OpenAI SDK).	04 Hrs
3	**Prompt Engineering for Domain-Specific Tasks:** Coding assistance and code generation prompts, Conversational agents and dialogue design, Legal, educational, medical prompts, Data wrangling and analysis via prompting, Prompting in low-resource languages.	04 Hrs
4	**Prompt Safety, Bias, and Ethics:** Bias, toxicity, misinformation in model outputs, Adversarial prompting and jailbreak attempts, Safety best practices in prompt design, Evaluation frameworks (BLEU, ROUGE, BERTScore, human evals), Future directions: function calling, tool use, retrieval-augmented generation (RAG)	04 Hrs

Text/Reference Books:

1. "The Art of Prompt Engineering with OpenAI APIs" by Nathan Hunter.
2. "Prompt Engineering for Everyone" by Isa Fulford & Andrew Ng (DeepLearning.AI short course).
3. "Building AI Applications with OpenAI API" by Yash Sheth.

Teaching Scheme		Semester III Introduction to Python	Examination Scheme	
TH	-	**Course Objectives:** 1. Demonstrate the ability to set up a Python programming environment and execute basic programs using the Python interpreter. 2. Apply variables, operators, control structures, and functions to implement program logic and modular solutions. 3. Manipulate strings, handle exceptions, perform basic input/output operations, and work with files in Python. 4. Implement object-oriented programming concepts and use Python data structures such as lists, tuples, sets, and dictionaries for problem solving. 5. Integrate Python programs with databases using SQL, including creating, querying, and joining tables to manage structured data.	CA	-
PR	-		MSE	-
CR	-		ESE	-

COURSE CONTENT

Unit No.	Topic	Hours
1	Informal introduction to programming, algorithms and data structures, downloading and installing Python, run a simple program on Python interpreter.	02 Hrs
2	Variables, operations, control flow – assignments, conditionals, loops, functions: optional arguments, default values, passing functions as arguments.	02 Hrs
3	Statements, Expressions, Strings: String processing. Exception handling, Basic input/output, handling files.	02 Hrs
4	Class and Object, Data Structure: List, Tuple and Sequences, Set, Dictionaries.	04 Hrs
5	Using Database and Structured Query Languages (SQL): SQLite manager, Spidering Twitter using a Database, Programming with multiple tables, JOIN to retrieve data.	04 Hrs

Text/Reference Books:

1. Michael Urban and Joel Murach, Murach‘s Python Programming, Murach's Publication, 2016
2. Charles Severance, Python for Informatics: Exploring Information, University of Michigan, Version 2.7.0, 2014.
3. Dr. R. Nageswara Rao, Core Python Programming, Dreamtech Press, 1st Edition, 2016.
4. Mark Lutz, Learning Python, O'Reilly Media, 5th Edition, 2013.
5. Mark Pilgrim, Dive into Python 3, A press Publication, 2nd Edition, 2009.
6. Allen B. Downey, Think Python, O'Reilly Media, 2nd Edition, 2012.

7. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson Education, 1st Edition, 2006.

Teaching Scheme		Semester III Life of Chhatrapati Shivaji Maharaj	Examination Scheme	
TH	1	**Course Objectives:** 1. Analyse Shivaji Maharaj's military strategies, including guerrilla warfare, fortress defence, naval power, and intelligence networks, in historical and tactical contexts. 2. Evaluate Shivaji Maharaj's leadership, management practices, and innovations in logistics, fortifications, and military technology. 3. Interpret Shivaji Maharaj's views on women's rights, religious tolerance, democracy, and nationalism, and relate them to contemporary socio-political values.	CA	50
PR	-		MSE	-
CR	1		ESE	-

COURSE CONTENT

Unit No.	Topic	Hours
1	Shivaji Maharaj as a Great Conqueror, Master Strategist and innovator in Military Tactics Guerrilla Warfare (Ganimi Kava), Fortress Strategy, Avoidance of Direct Confrontation, Diplomacy and Alliances, Naval Power.	05 Hrs
2	Shivaji Maharaj's Management and leadership strategies, Architecture and metallurgy of Raigad Fort, Use of Light Cavalry, Intelligence Network, Asymmetric Warfare, Logistics and Supply Chains, Fortifications and Military Architecture	05 Hrs
3	Shivaji Maharaj's views about Women's rights, their dignity and religious views. His views on Democracy & Nationalism	05 Hrs

Teaching Scheme		Semester III Data Structure and Python Programming Laboratory	Examination Scheme	
TH	1		CA	60
PR	4		MSE	–
CR	2		ESE	40

List of Experiments (Data Structures):

1. Write a program to implement a stack using arrays.
2. Write a program to implement a circular queue using arrays.
3. Write programs to implement the following data structures: (a) Single linked list, (b) Double linked list, (c) Circular linked list
4. Write a program to implement a stack using a linked list such that the push and pop operations of the stack still take O (1) time.
5. Write a program to create a binary search tree (BST) by considering the keys in given order and perform the following operations on it. (a) Minimum key (b), Maximum key, (c) Search for a given key, (d) Find predecessor of a node, (e) Find successor of a node, (f) Delete a node with given key.
6. Write a program to implement hashing with (a) Separate Chaining and (b) Open addressing methods.
7. Implement the following sorting algorithms: (a) Insertion sort, (b) Merge sort, (c) Quick sort, (d) Heap sort.

List of Experiments (Python Programming):

1. Program to calculate the area of triangle, rectangle, circle.
2. Program to find the union of two lists.
3. Program to find the intersection of two lists.
4. Program to remove the —i‖ th occurrence of the given word in a list where words repeat.
5. Program to count the occurrences of each word in a given string sentence.
6. Program to check if a substring is present in a given string.
7. Program to map two lists into a dictionary.
8. Program to count the frequency of words appearing in a string using a dictionary.
9. Program to create a dictionary with key as first character and value as words starting with that character.
10. Program to find the length of a list using recursion.
11. Write a Program to compute the diameter, circumference, and volume of a sphere using class.
12. Program to read a file and capitalize the first letter of every word in the file.

Teaching Scheme		Semester III Universal Human Values - II	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Explain the concept of value education, self-exploration, and the relationship between happiness, prosperity, and basic human aspirations.	MSE	20
CR	3	2. Distinguish between the needs of the self and the body, and apply methods to achieve harmony within the individual and between the self and the body.	ESE	60
		3. Demonstrate understanding of harmony in the family and society by applying foundational values such as trust and respect in human relationships.		
		4. Analyse the interconnectedness and mutual fulfilment among the four orders of nature and relate it to sustainable living and coexistence.		
		5. Apply a holistic understanding of human values to professional ethics, decision-making, and strategies for value-based life and profession.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Value Education:** Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity, the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity, Current Scenario, Method to Fulfill the Basic Human Aspirations.	05 Hrs
2	**Harmony in the Human Being:** Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to Ensure self-regulation and Health.	05 Hrs
3	**Harmony in the Family and Society:** Harmony in the Family, the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order	04 Hrs
4	**Harmony in the Nature (Existence):** Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.	05 Hrs
5	Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics- Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession	05 Hrs

Text Books:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Teaching Scheme		Semester III Artificial Intelligence Laboratory	Examination Scheme	
TH	-		CA	60
PR	2		MSE	–
CR	1		ESE	40

List of Experiments:

1. Study of Lisp/ PROLOG.
2. Existing AI Application (e.g. Recommendation system, Carpooling, OTT channels etc.)
3. Solve any problem using depth first search.
4. Solve any problem using breadth first search.
5. Solve an 8-puzzle problem using the best first search.
6. Write a program to solve Tic-Tac-Toe using Min-Max search.
7. Solve traveling salesman problems.
8. Write a program for Alpha–Beta Pruning.
9. Write a program to solve 8 queens problems.
10. Write a program to solve map coloring problems using CSP.

Semester - IV

Teaching Scheme		Semester IV Introduction to Operating Systems	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Explain the structure, components, and types of operating systems, including process, memory, file, and I/O management.	MSE	20
CR	3	2. Apply CPU scheduling algorithms and multithreading models to improve process performance and system throughput.	ESE	60
		3. Implement process synchronization techniques, and analyze deadlock conditions with appropriate prevention, avoidance, and recovery strategies.		
		4. Evaluate memory management schemes, including paging, segmentation, and virtual memory, using various page replacement algorithms.		
		5. Analyze file system organization, storage allocation methods, and disk scheduling techniques for efficiency and reliability.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction and Operating System Structures:** Definition, Types of Operating system, Real-Time Operating Systems, System Components: System Services, Systems Calls, System Programs, System Structure, Virtual Machines, System Design and Implementation, System Generations.	06 Hrs
2	**Processes and CPU Scheduling:** Process Concept, Process Scheduling, Operation on process, Inter-process Communication, Cooperating processes, Threads, Multithreading model, Scheduling criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling, Scheduling Algorithms evaluation.	06 Hrs
3	**Process Synchronization:** The critical-section problem, Critical regions, Peterson‘s Solution, Synchronization Hardware, Semaphores, Classical Problems of synchronization, and Monitors Deadlocks: Systems Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling.	06 Hrs
4	**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Continuous Memory Allocation, Fixed and variable partition, Internal and external fragmentation and compaction, Paging: Principle of operation, Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging; Segmentation. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page / Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).	10 Hrs

5	**File Management:** File Concept, Access methods, File types, File operation, Directory and disk structure, File System Structure, File System Implementation, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Mass-Storage Structure: Disk Structure, Disk attachment, Disk scheduling, Disk management, Swap Space Management.	08 Hrs

Text/Reference Books:

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, Wiley Publication, 8th Edition, 2008.
2. Andrew S. Tanenbaum, Modern Operating System, PHI Publication, 4th Edition, 2015.
3. D. M. Dhamdhere, Systems Programming and Operating Systems, McGraw-Hill, 2nd Edition, 1996.
4. Garry Nutt, Operating Systems Concepts, Pearson Publication, 3rd Edition, 2003.
5. Harvey M. Deitel, An Introduction to Operating Systems, Addison Wesley Publication, 2nd Edition, 1990.
6. Thomas W. Doeppner, Operating System in Depth: Design and Programming, Wiley Publication, 2011.

Teaching Scheme		Semester IV Data Analytics	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Apply statistical concepts and methods for data collection, preparation, cleaning, and exploratory data analysis, addressing bias and errors.	MSE	20
CR	3	2. Compute and interpret descriptive statistics, measures of central tendency, spread, and distribution shape to summarize datasets.	ESE	60
		3. Perform data transformation and standardization techniques to prepare data for statistical modeling and hypothesis testing.		
		4. Conduct classical statistical tests, including Z-tests, t-tests, ANOVA, and non-parametric tests, to analyze and compare datasets.		
		5. Interpret the results of statistical analyses, assess significance, and evaluate model robustness and validity for data-driven decision-making.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Statistical Data and Concepts:** The statistical Methods, Misuse, Misinterpretation, and bias, Sampling and sampling size, Data preparation and cleaning, Missing data and data errors, Exploratory Data Analysis, Statistical error, Statistical Modeling, Computational Statistics, Inference, Bias, Cofounding, Hypothesis testing, Types of error, Statistical significance, Confidence Interval, Power and robustness, Degrees of freedom, Non parametric analysis.	07 Hrs
2	**Descriptive Statistics:** Counts and specific values, Measure of central tendency, Measure of spread, Measure of distribution shape, Statistical indices, Moments, Key functions, Measures of complexity and model selection.	05Hrs
3	**Data Transformation and Standardization:** Box-Cox and power transforms, Freeman-Tukey (square root and arcsine) transforms, Log and Exponential transforms, Logit transforms, Normal transform.	05 Hrs
4	**Classical Tests and Contingency Tables:** Goodness of fit tests: Anderson-Darling, Chi-square test, Kolmogorov-Smirnov, Ryan-Joiner, Shapiro-Wilk, Jarque-Bera, Lilliefors. **Z-test:** Test of single mean, standard deviation known, Test of the difference between two means, standard deviation known, test for proportions. **T-tests:** Test of single mean, standard deviation not known, Test of the difference between two means, standard deviation not known, Test of regression coefficients	07 Hrs

5 **Analysis of Variance and Covariance** 07 Hrs

Variance test: Chi square test of single variable, F-test of two variables, test of homogeneity; Wilcoxon rank-sum/Mann-Whitney U test; Sign test.

Contingency Tables: Chi-square contingency table test, G contingency table test, Fisher's exact test, Measures of association, McNemar's test.

ANOVA: Single factor or one way ANOVA, Two factor or two-way and higher-way ANOVA, MANOVA, ANCOVA; Non Parametric ANOVA: Kruskal Wallis ANOVA, Friedam ANOVA test, Mood's median.

Text/Reference Books:

1. Dr. Michael J de Smith, Statistical Analysis Handbook: A Comprehensive Guide to Statistical Concepts, Methods and Tools, The Winchelsea Press, Drumlin Security Ltd, Edinburgh, 2018 edition. https://www.statsref.com/HTML/index.html
2. Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Sixth Edition, Wiley, 2013.
3. Dr.J.Ravichandran, Probability And Statistics For Engineers, First Edition, Wiley, 2010.
4. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. V2.1, Cambridge University Press. 2014. (free online)
5. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020, 2013.
6. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
7. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline, O'Reilly. 2014.

Teaching Scheme		Semester IV Probability and Statistics	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. To explain basic concepts in statistics and probability. 2. To describe various probabilistic distributions.	MSE	20
CR	3	3. To apply regression and correlation techniques.	ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Probability Theory** Definition of probability: classical, empirical, and axiomatic approach of probability, Addition theorem of probability, Multiplication theorem of probability, Bayes' theorem of inverse probability, Properties of probabilities with proofs, Examples.	10 Hrs
2	**Random Variable and Mathematical Expectation:** Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Join and marginal probability distributions, Properties of expectation and variance with proofs.	06 Hrs
3	**Theoretical Probability Distributions:** Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, Poisson, and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.	10 Hrs
4	**Correlation:** Introduction, Types of correlation, Correlation and causation, Methods of studying correlation, Karl Pearson's correlation coefficient, Spearman's rank correlation, Coefficient, Properties of Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient, Probable errors.	06 Hrs
5	**Linear Regression Analysis:** Introduction, Linear and non-linear regression, Lines of regression, Derivation of regression lines of y on x and x on y, Angle between the regression lines, Coefficients of regression, Theorems on regression coefficient, Properties of regression coefficient.	06 Hrs

Text Books:

1. S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 7th Revised and Enlarged Edition, 2016.
2. G. V. Kumbhojkar; Probability and Random Processes, C. Jamnadas and Co., 14th Edition, 2010.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

4. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2010.
5. G. Haribaskaran; Probability, Queuing Theory and Reliability Engineering, Laxmi Publications, 2nd Edition, 2009.
6. Murray Spiegel, John Schiller, R. ALU Srinivasan, Probability And Statistics, Schaum's Outlines, 4th Edition, 2013.

Teaching Scheme		Semester IV Constitution of India	Examination Scheme	
TH	2	**Course Objectives:**	CA	60
PR	-	1. Explain the historical background, sources, features, and key provisions of the Indian Constitution, including citizenship, fundamental rights, duties, and directive principles.	MSE	-
CR	AU	2. Describe the structure, roles, and functions of the Union and State governments, and analyze the relationship between the Centre and States.	ESE	40
		3. Interpret the organization and functioning of local self-government institutions and evaluate their role in strengthening grassroots democracy.		
		4. Analyze the functions of the Election Commission and other constitutional bodies related to the welfare of marginalized communities and women.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction:** Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive, Principles of State Policy.	05 Hrs
2	**Union Government and its Administration:** Structure of the Indian Union: Federalism, Centre- State, relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha.	05 Hrs
3	**State Government and its Administration** Governor: Role and Position, CM and Council of Ministers, State Secretariat: Organisation, Structure and Functions.	04 Hrs
4	**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati Raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.	05 Hrs
5	**Election Commission:** Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.	05 Hrs

Text/Reference Books:

1. Sastry, T. S. N., (2005). India and Human Rights: Reflections, Concept Publishing Company India (P Ltd.).
2. Nirmal, C.J., (1999). Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

Teaching Scheme		Semester IV Life of Bharat Ratna Dr. Babasaheb Ambedkar	Examination Scheme	
TH	1	**Course Objectives:** 1. Analyze the socio-political context of Dr. Ambedkar's era and his role in the Indian freedom struggle and social reform movements. 2. Evaluate Dr. Ambedkar's contributions to the framing of the Indian Constitution and his vision for social justice and empowerment. 3. Interpret Dr. Ambedkar's views on Marxism, class struggle, and caste, and assess their relevance to contemporary Indian society and economic policy.	CA	50
PR	-		MSE	-
CR	1		ESE	-

COURSE CONTENT

Unit No.	Topic	Hours
1	Introduction to the socio-political context of Ambedkar's era, British Colonialism, Indian National Movement, Caste Hierarchy, Untouchability, Social Reform Movements, Role in the Indian freedom struggle.	05 Hrs
2	Contributions to the Constitution of India, Vision for social justice and empowerment.	05 Hrs
3	Dr. Ambedkar and Marxism: An Exploration of His Thoughts on Marxism, Common ground with Marxism, Focus on class struggle, Caste vs. Caste, Primacy of Caste in Indian Society, Economic ideas and policies	05 Hrs

Teaching Scheme		Semester V Introduction to Operating System Laboratory	Examination Scheme	
TH	-		CA	40
PR	2		MSE	–
CR	1		ESE	60

List of Experiments:

1. Hands on Unix Commands
2. Shell programming for file handling.
3. Shell Script programming using the commands grep, awk, and sed.
4. Implementation of various CPU scheduling algorithms (FCFS, SJF, Priority).
5. Implementation of various page replacement algorithms (FIFO, Optimal, LRU).
6. Concurrent programming; use of threads and processes, system calls (fork and v-fork).
7. Study pthreads and implement the following: Write a program which shows the performance.
8. Improvement in using threads as compared with process.(Examples like Matrix Multiplication.
9. Hyper Quick Sort, Merge sort, Traveling Sales Person problem).
10. Implementation of Synchronization primitives – Semaphore, Locks and Conditional Variables.
11. Implementation of Producer-Consumer problem, Bankers algorithm.
12. Implementation of various memory allocation algorithms, (First fit, Best fit and Worst fit), Disk.
13. Scheduling algorithms (FCFS, SCAN, SSTF, C-SCAN).
14. Kernel reconfiguration, device drivers and systems administration of different operating systems.
15. Writing utilities and OS performance tuning.

Teaching Scheme		Semester IV Modern Indian Languages (A) Marathi	Examination Scheme	
TH	2	**Course Objectives:**	CA	20
PR	-		MSE	20
CR	2		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	मराठीचा उगम आणि विकास: मराठीचा उगम आणि विकास, मराठी भाषेवर संत परंपरेचा प्रभाव- ज्ञानेश्वर, तुकाराम, नामदेव आणि एकनाथ यांच्या रचनांचा अभ्यास, मराठीत बखरी लेखन व इतिहास दर्शन, आधुनिक मराठी आणि सुधारणा चळवळी- टिळक, फुले, आणि आगरकर यांचे योगदान.	02 Hrs
2	स्वातंत्र्यानंतरची मराठी भाषा: महाराष्ट्र राज्य निर्मिती व मराठीचा अधिकृत दर्जा, डिजिटल युगातील मराठी भाषा : ब्लॉग, सोशल मीडिया आणि ई-साहित्य, मराठी भाषा संरक्षणासाठी उपाययोजना, शिक्षण व्यवस्थेतील मराठीचा वापर, जागतिक स्तरावर मराठी भाषेचा प्रभाव.	02 Hrs
3	मराठी लेखनाचे नियम आवण व्याकरण: संधि, वाक्यप्रकार (विधानार्थी वाक्य, प्रश्नार्थी वाक्य, आज्ञार्थी वाक्य इ.), विरामचिन्हे आणि त्यांचे उपयोग, शुद्धलेखन, समानाथी शब्द (पर्यायवाची शब्द), विरुद्धाथी शब्द.	02 Hrs
4	लेखन कौशल्य: लेखन कौशल्याचा परिचय, लेखन कौशल्याचे महत्त्व आणि आवश्यकता ▪ पत्रलेखन ▪ निबंध लेखन ▪ वृत्तलेखन (वृत्तपत्रीय लेखन) ▪ इतिवृत्त लेखन ▪ सारांश लेखन	02 Hrs
5	भाषांतर (मराठीतून इंग्रजी आणि इंग्रजीतून मराठी): भाषांतराचा मूलभूत परिचय- भाषांतराची व्याख्या आणि स्वरूप, महत्त्व आणि उपयोग, भाषांतराचे प्रकार इ. ▪ पारिभातषक शब्दावली, मराठीतून इंग्रजी आणि इंग्रजीतून मराठी भाषांतर.	02 Hrs

Text / Reference Books:

1. प्रशासनिक लेखन, भाषा संचालनालय , महाराष्ट्र शासन, मुंबई १९६६
2. सुगम मराठी व्याकरण व लेखन - मो.रा. वाळंबे
3. "अनुवाद तसद्धांत आणि प्रयोग" – डॉ. भालचंद्र नेमाडे (लोकवाङ्मय गृह प्रकाशन)
4. मराठी भाषा आणि साहित्याचा इतिहास – वि.का. राजवाडे प्रकाशक : राजवाडे संशोधन मंडळ, धुळे
5. भाषांतर : सिद्धांत आणि प्रयोग – डॉ. अशोक केळकर प्रकाशक : लोकवाङ्मय गृह, मुंबई

Teaching Scheme		Semester IV Modern Indian Languages (B) Hindi	Examination Scheme	
TH	2	**Course Objectives:**	CA	20
PR	-		MSE	20
CR	2		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	हिंदी भाषा का उद्भि और स्रोत: ▪ हिंदी भाषा की उत्पत्ति और स्वरूप ▪ संस्कृत, प्राकृत और अपभ्रंश से हिंदी का विकास ▪ हिंदी की प्रमुख बोलियाँ (ब्रज, अवधी, खडी बोली, भोजपुरी, राजस्थानी आदी) ▪ हिंदी पर फारसी, अरबी और अंग्रेजी भाषा का प्रभाव.	02 Hrs
2	स्वातंतंत्र्योत्तर काल में हिंदी भाषा ▪ प्रशासन, शिक्षा और संचार माध्यमों में हिंदी की भूमिका ▪ राजभाषा के रूप में हिंदी – संवैधानिक स्थिति और व्यावहारिक उपयोग ▪ हिंदी को वैश्विक विस्तार और डिजिटल माध्यमों में हिंदी की उपस्थिति ▪ प्रशासन और संचार माध्यमों में हिंदी	02 Hrs
3	हिंदी भाषा लेखन के नियम और व्याकरण ▪ वणिमाला ▪ शब्द-भेद ▪ संधि ▪ वाक्य रचना ▪ वर्तनी ▪ उपसर्ग, प्रत्यय और शब्द निर्माण की प्रक्रिया ▪ विराम चिन्हों का प्रयोग ▪ पर्यायवाची शब्द ▪ विलोम शब्द.	02 Hrs
4	लेखन कौशल ▪ पत्र लेखन ▪ प्रतिवेदन (रिपोटि) लेखन ▪ विज्ञप्ति, नोटिस और परिपत्र लेखन निबंध लेखन ▪ सार लेखन.	02 Hrs
5	अनुवाद (अंग्रेजी से हिंदी और हिंदी से अंग्रेजी) अनुवाद : सिद्धांत और परंपरा, अनुवाद : क्षेत्र, प्रकार, पारिभाषीक शब्दावली, अंग्रेजी से हिंदी और हिंदी से अंग्रेजी अनुवाद	02 Hrs

Text / Reference Books:

1. "हिंदी भाषा का उद्भव और विकास" – डॉ. हरीशचंद्र वर्मा (लोकभारती प्रकाशन)
2. "हिंदी भाषा का इतिहास" – डॉ. रामविलास शर्मा (राजकमल प्रकाशन)
3. "भारत में राजभाषा हिंदी" – डॉ. विश्वनाथ प्रसाद (भारतीय राजभाषा पररषद)
4. "हिंदी व्याकरण और रचना" – डॉ. हरीशचंद्र वर्मा (लोकभारती प्रकाशन)
5. "हिंदी लेखन कौशल" – डॉ. रमेश गुप्ता (सातहत्य भवन)
6. "अनुवाद विज्ञान और सिद्धांत" – डॉ. ओमप्रकाश (राजकमल प्रकाशन)

Teaching Scheme		Semester IV Modern Indian Languages (C) Sanskrit	Examination Scheme	
TH	2	**Course Objectives:**	CA	20
PR	-		MSE	20
CR	2		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Sanskrit:** Importance and history of Sanskrit, Sanskrit alphabets (Varnamala), Swaras (Vowels), Vyanjanas (Consonants), Pronunciation and script (Devanagari).	02 Hrs
2	**Basic Grammar:** Nouns, pronouns, Grammatical numbers, Grammatical genders, Grammatical person, Verbs, Tenses, Sandhi (Combination of letters), Karaka (Case system) – Nominative, Accusative, Instrumental, etc., Vibhakti (Declensions of nouns and pronouns), Linga (Gender: Masculine, Feminine, Neuter), Vakya Rachana (Sentence construction).	02 Hrs
3	**Simple Vocabulary and Sentence Formation:** Basic words and their meanings (nature, family, animals, objects, etc.), Greetings and basic conversational phrases, Formation of simple sentences	02 Hrs
4	**Selected Sanskrit Shlokas and Subhashitas:** Recitation and meaning of simple verses from Bhagavad Gita, Hitopadesha, or Panchatantra, Common proverbs (Subhashitas)	02 Hrs
5	**Reading and Writing Practice:** Reading simple Sanskrit texts, Writing small paragraphs in Sanskrit	02 Hrs

Teaching Scheme		Semester IV Full Stack Development	Examination Scheme	
TH	1	**Course Objectives:**	CA	60
PR	2	1. Apply Bootstrap components, grid systems, and themes to design responsive and mobile-first web interfaces.	MSE	-
CR	2	2. Use JavaScript for DOM manipulation, event handling, string processing, and form validation to enhance user interaction.	ESE	40
		3. Implement interactive features using jQuery for effects, traversal, and AJAX-based asynchronous operations.		
		4. Develop server-side applications using PHP and MySQL for dynamic content generation, form handling, and database management.		
		5. Build and deploy complete full-stack applications using the Laravel MVC framework, integrating front-end, back-end, and database functionalities.		

COURSE CONTENT

Unit No.	Topic	Hours
1	Bootstrap: Introduction to Bootstrap, Bootstrap Basics, Bootstrap Grids, Bootstrap Themes, Bootstrap CSS, Bootstrap JS.	02 Hrs
2	Javascripts: Introduction to JavaScript, JavaScript Language Basics, JavaScript Events, JavaScript Strings, JavaScript Type Conversion, JavaScript RegExp, JavaScript Error, JavaScript Hoisting,	02 Hrs
3	jQuery: jQuery Events, jQuery Effects, jQuery HTML, jQuery Traversing, jQuery AJAX & Misc.	02 Hrs
4	PHP & Mysql: Embedding PHP in HTML, Adding Dynamic Content, Accessing Form Variables, Storing and retrieving data, Using Arrays perform different operations, String Manipulation and Regular Expressions.	02 Hrs
5	MVC with Laravel: Laravel Installation, Working with Forms, Working with Controller, Laravel Blade Template with Bootstrap, Responses with Html, Laravel Migration, Laravel Requests, Models; Laravel Eloquent ORM, Build a Complete App in Laravel.	02 Hrs

Text / Reference Books:

1. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites by Robin Nixon.
2. Full-Stack JavaScript Development by Eric Bush.
3. Web Design with HTML, CSS, JavaScript, and JQuery Set Book by Jon Duckett Professional JavaScript for Web Developers Book by Nicholas C. Zakas.
4. “Laravel: Up and Running" by Matt Stauffer.
5. Title: Head First jQuery by Ryan Benedetti, Ronan Cranley, September 2011, O'Reilly Media, Inc.

Lab Assignments:

1. Create a responsive webpage using Bootstrap classes for typography, buttons, alerts, and tables. Apply proper layout and spacing.
2. Design a multi-column layout using Bootstrap's grid system. Include responsive breakpoints for mobile, tablet, and desktop views.
3. Develop a login/registration page using Bootstrap form controls and implement form validation using Bootstrap's built-in utilities and JavaScript.
4. Write a script to perform simple DOM manipulations like hiding/showing content, changing text, and style on button click using JavaScript events.
5. Create a form where input strings are validated, formatted, and manipulated using string methods and type conversion.
6. Demonstrate function and variable hoisting using examples. Show the difference between `var`, `let`, and `const` with scope illustrations.
7. Create a dynamic webpage that responds to user actions like clicks, hover, and form input using jQuery event listeners and animation effects.
8. Develop a web page that fetches data asynchronously using jQuery AJAX (e.g., weather API or random user data API). Display results dynamically.
9. Write PHP scripts that perform sorting, searching, and merging operations on arrays. Validate input using regular expressions and manipulate strings (e.g., format names or extract domains from emails).
10. Develop a complete Laravel-based CRUD application (e.g., blog, task manager, or product inventory) using routes, controllers, models, migrations, and Blade templates. Include user-friendly error messages and Bootstrap styling.