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

(Affiliated Colleges)

Department of Computer Engineering

Dr. Babasaheb Ambedkar Technological University, Lonere - 402103

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Second Year 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	24AF2000BS301	Engineering Mathematics-III	3	-	20	20	60	3
PCC1	24AFAIPC302	Artificial Intelligence	3	-	20	20	60	3
PCC2	24AF1245PC303	Discrete Mathematics	3	-	20	20	60	3
PCC3	24AFAIPC304	Data Structures	2	-	20	20	60	2
Open Elective	24AFAIOE305	A) Prompt Engineering B) Elective from Other Dept.	2	-	20	20	60	2
MDM	24AFAIMD306	Introduction to Python	2	-	20	20	60	2
HSSM	24AF1245AE307	Business Economics	2	-	20	20	60	2
VEC	24AF1245AE308A	Life of Chhatrapati Shivaji Maharaj	1	-	50	-	-	1
PCC Lab	24AFAIPCL309	Data Structures and Python Programming Laboratory	1	2	60	-	40	2
VSEC	24AF1VE310	UHV - II	3	-	20	20	60	3
PCC Lab	24AFAIPCL311	Artificial Intelligence Laboratory	-	2	60	-	40	1
CEP/FP	24AFAICP312	Seminar	-	2	60	-	40	1
		Total	**22**	**6**	**390**	**160**	**600**	**25**

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,
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CR - Credit

Second Year in B.Tech in Artificial Intelligence and Allied
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(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	24AFAIPC401	Introduction to Operating Systems	3	-	20	20	60	3
PCC2	24AFAIPC402	Data Analytics	3	-	20	20	60	3
PCC3	24AF1245PC403	Probability and Statistics	3	-	20	20	60	3
HSSM	24AFAIAE404	Database Management	2	-	20	20	60	2
Open Elective	24AFAIOE405	A. Algorithm Design and Analysis B. Elective from Other Departments	2	-	20	20	60	2
MDM	24AFAIMD406	Data Analytics	2	-	20	20	60	2
VSEC	24AF1COIVE407	Constitution of India	2	-	60	-	40	Audit
VSEC	24AF1000VE408B	Life of Bharat Ratna Dr. Babasaheb Ambedkar	1	-	50	-	-	1
VSEC	24AFAIS409	Introduction to Operating Systems Laboratory	-	2	60	-	40	1
AEC	24AF1000AE410	Modern Indian Languages A) Marathi B) Hindi C) Sanskrit	2	-	20	20	60	2
VSEC	24AFAIS411	Full Stack Development	1	2	60	-	40	2
PCC Lab	24AF1245PCL412	Database Management System Laboratory	-	2	60	-	40	1
		Total	**21**	**6**	**430**	**140**	**580**	**22**
	Exit Requirements for Certificate Program							
VSEC	23AF1245VE412	LLM Course with Programming	-	16	60	-	40	8

Course Type and Acronyms used

1. Basic Science Course (BSC)
2. Engineering Science Course (ESC)
3. Program Core Course (PCC)
4. Vocational Skill Enhancement Course (VSEC)
5. Co-curricular Course (CC)
6. Ability Enhancement Course (AEC)
1. Indian Knowledge System (IKS)

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

Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
		L	P	CA	MSE	ESE	
PCC1	Machine Learning	3	-	20	20	60	3
PCC2	Theory of Computations	4	-	20	20	60	4
PCC3	Software Engineering	3	-	20	20	60	3
PCC4	Operating System	3	-	20	20	60	3
PEC	**Elective I:** A. Computer Graphics B. Embedded Systems	3	-	20	20	60	3
MDM	AI Ethics	2	-	20	20	60	2
PCC Lab		-	2	40	-	60	1
PCC Lab	Software Engineering Laboratory	-	2	40	-	60	1
PCC Lab	Operating System Laboratory	-	2	40	-	60	1
Total							21

Course Type and Acronyms used

1. Basic Science Course (BSC)
2. Engineering Science Course (ESC)
3. Program Core Course (PCC)
4. Vocational Skill Enhancement Course (VSEC)
5. Co-curricular Course (CC)
6. Ability Enhancement Course (AEC)
7. Indian Knowledge System (IKS)

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

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

Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
		L	P	CA	MSE	ESE	
PCC1	Compiler Design	3	-	20	20	60	3
PCC2	Computer Networks	3	-	20	20	60	3
PEC	**Elective II:** A. Internet of Things B. Advanced Algorithms	3	-	20	20	60	3
PEC	**Elective III:** A. Distributed Systems B. Big Data Analytics	3	-	20	20	60	3
OE	**Open Elective I:** A. Human Computer Interaction B. Object Oriented Analysis and Design	3	-	20	20	60	3
MDM	ICT for Sustainable Development (ICT4SD)	2	-	40	-	60	2
PCC Lab	Compiler Design Laboratory	-	2	40	-	60	1
PCC Lab	Computer Networks Laboratory	-	2	40	-	60	1
VSEC	Mini Project	-	4	40	-	60	2
	Total	**16**	**12**	**460**	**100**	**540**	**21**
Exit Requirements for Certificate program (any two courses from following courses)							
	A Data Analysis Project		16	60	-	40	8

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

Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
		L	P	CA	MSE	ESE	
PCC1		3	-	20	20	60	3
PCC2	Cloud Computing	3	-	20	20	60	3
PEC	**Elective IV:** A. Natural Language Processing B. Research Methodology C. Software Testing	2	-	20	20	60	2
MDM	Deep Learning	2	-	20	20	60	2
Internship / OJT	Project Phase - I	-	24	60	-	40	12
	Total						22

Course Type and Acronyms used

1. Basic Science Course (BSC)
2. Engineering Science Course (ESC)
3. Program Core Course (PCC)
4. Vocational Skill Enhancement Course (VSEC)
5. Co-curricular Course (CC)
6. Ability Enhancement Course (AEC)
7. Indian Knowledge System (IKS)

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

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

Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
		L	P	CA	MSE	ESE	
PCC1	Software Architecture	3	-	20	20	60	3
PCC2	Cryptography and Network Security	3	-	20	20	60	3
PEC	**Elective V:** A. Blockchain Technology B. Virtual Reality C. Social Network Analysis	3	-	20	20	60	3
MDM	System Administration	2	-	40	-	60	2
Open Elective	Information Theory & Coding	3	2	20	20	60	4
Entrepreneurship / Economics / Management	Intellectual Property Rights	2	-	40	-	60	2
VSEC	Foreign Language Studies	-	2	40	-	60	1
AEC	Project Phase - II	-	4	40	-	60	2
	Total	**16**	**12**	**460**	**100**	**540**	**22**

Teaching Scheme		Semester III Engineering Mathematics - III	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	Introduction, Vectors in R^n, Vector Addition and Scalar Multiplication, Dot (Inner) Product, Located Vectors, Hyperplanes, Lines, Curves in R^n, Vectors in R^3 (Spatial Vectors), ijk Notation, Complex Numbers, Vectors in C^n.	05 Hrs
2	Introduction, Matrix Addition and Scalar Multiplication, Summation Symbol, Matrix Multiplication, Transpose of a Matrix, Square Matrices, Powers of Matrices, Polynomials in Matrices, Invertible (Nonsingular) Matrices, Special Types of Square Matrices, Complex Matrices, Block Matrices.	06 Hrs
3	Introduction, Basic Definitions, Solutions, Equivalent Systems, Elementary Operations, Small Square Systems of Linear Equations, Systems in Triangular and Echelon Forms, Gaussian Elimination, Echelon Matrices, Row Canonical Form, Row Equivalence, Gaussian Elimination, Matrix Formulation, Matrix Equation of System of Linear Equations, Systems of Linear Equations and Linear Combinations of Vectors, Homogeneous Systems of Linear Equations, Elementary Matrices, LU Decomposition. Applications: Linear Programming, Fourier series: Linear Algebra for Functions, Computer Graphics, Linear Algebra for Cryptography.	07 Hrs
4	**Determinants:** Introduction, Determinants of Orders 1 and 2, Determinants of Order 3, Permutations, Determinants of Arbitrary Order, Properties of Determinants, Minors and Cofactors, Evaluation of Determinants, Classical Adjoint, Applications to Linear Equations, Cramer‘s Rule, Submatrices, Minors, Principal Minors, Block Matrices and Determinants, Determinants and Volume, Determinant of a Linear Operator, Multilinearity and Determinants.	07 Hrs
5	Diagonalization Introduction, Polynomials of Matrices, Characteristic Polynomial, Cayley–Hamilton Theorem, Diagonalization, Eigenvalues and Eigenvectors, Computing Eigenvalues and Eigenvectors, Diagonalizing Matrices, Diagonalizing Real Symmetric Matrices and Quadratic Forms, Minimal Polynomial, Characteristic and Minimal Polynomials of Block Matrices. Applications: Graphs and Networks, Matrices in Engineering, Markov Matrices, Population, and Economics.	07 Hrs

Text Books:

1. Linear Algebra, Seymour Lipschutz, Schaum's outlines, 4th Edition, McGraw-Hill Publication.

Reference Books:

1. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Wellesley - Cambridge Press.
2. K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Prentice-Hall of India, 2005.
3. M. Artin, Algebra, Prentice-Hall of India, 2005.

Teaching Scheme		Semester III Artificial Intelligence	Examination Scheme	
TH	3	**Course Objectives:** 1.	CA	20
PR	-		MSE	20
CR	3		ESE	60

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.	06 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 & fuzzy logics, Planning: Overview, Components of a planning system, Goal stack planning, Hierarchical planning and other planning techniques.	03 Hrs
5	**Natural Language Processing:** Introduction, Syntactic processing, Semantic analysis, Discourse & pragmatic processing. Learning: Forms of learning, Inductive learning, Learning decision trees, explanation-based learning, Learning using relevance information, Neural net learning & genetic learning. Expert Systems: Representing and using domain knowledge, Expert system shells, and knowledge acquisition	03 Hrs

Text / Refference 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	-		MSE	20
CR	3		ESE	60

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	2	**Course Objectives:**	CA	20
PR	-	1. 2.	MSE	20
CR	2		ESE	60

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.	07 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.	07 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	-		MSE	20
CR	2		ESE	60

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.	06 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	06 Hrs
3	**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).	06 Hrs
4	**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	06 Hrs
5	**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)	06 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	2	**Course Objectives:** 1.	CA	20
PR	-		MSE	20
CR	2		ESE	60

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 Business Economics	Examination Scheme	
TH	2	**Course Objectives:** 1. .	CA	20
PR	-		MSE	20
CR	2		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	Nature and scope of Business Economics; Microeconomics vs. Macroeconomics; Basic concepts: scarcity, choice, opportunity cost; Economic systems: capitalism, socialism, mixed economy; Role of economists in business decision-making; Law of demand and supply: determinants and graphical representation; Elasticity: price, income, and cross elasticity of demand.	03 Hrs
2	**Consumer Behavior and Demand Forecasting:** Cardinal and ordinal utility approaches; Law of diminishing marginal utility; Indifference curve analysis and consumer equilibrium; Budget constraint and consumer choice; Demand estimation techniques; Objectives and methods of demand forecasting; Factors influencing demand forecasting in business.	04 Hrs
3	**Production, Cost, and Revenue Analysis:** Factors of production; Laws of production: Law of variable proportions and Returns to Scale; Isoquants and producer equilibrium; Cost concepts: fixed, variable, total, marginal, average; Short-run and long-run cost curves; Revenue analysis: Total, Average, and Marginal Revenue; Break-even analysis and cost-volume-profit analysis.	03 Hrs
4	**Market Structures and Pricing Practices:** Market structures: perfect competition, monopoly, monopolistic competition, oligopoly; Price and output determination under different market forms; Pricing strategies: cost-plus pricing, penetration pricing, price skimming; Price discrimination; Game theory basics and strategic behavior in oligopoly; Kinked demand curve theory; Government regulation of markets and anti-trust policies	03 Hrs
5	**Macroeconomic Environment and Business Decisions:** National income: concepts, methods of measurement; Business cycles: phases, features, and causes; Inflation and deflation: causes, consequences, and control measures; Monetary and fiscal policy: tools and impact on business; Balance of payments and exchange rates; Globalization and its impact on business; Economic indicators and business forecasting	03 Hrs

Text/Reference Books:

1. R. Paneerselvam, Engineering Economics, PHI publication.
2. Robbins S.P. and Decenzo David A., Fundamentals of Management: Essential Concepts and Applications, Pearson Education.
3. L. M. Prasad, Principles and Practices of Management.
4. K. K. Dewett & M. H. Navalur, Modern Economic Theory, S. Chand Publications

Teaching Scheme		Semester III Life of Chhatrapati Shivaji Maharaj	Examination Scheme	
TH	1	**Course Objectives:**	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	**Course Objectives:**	CA	60
PR	2		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	-		MSE	20
CR	3		ESE	60

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	-	**Course Objectives:**	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.

Teaching Scheme		Semester III Seminar	Examination Scheme	
TH	-	**Course Objectives:**	CA	60
PR	2		MSE	–
CR	1		ESE	40

Guidelines:

1. Choose a topic related to your course, recent technological advancement, or emerging research area.
2. Select a topic that genuinely interests you so that you can invest time and effort in understanding and presenting it.
3. Avoid selecting overly common or outdated topics. Instead, try to find a niche or unexplored aspect of a broader subject.
4. Ensure availability of sufficient resources such as research papers, technical documentation, books, and online references.
5. The selected topic must be approved by the seminar guide or course coordinator before proceeding further.
6. Seminar Report Writing in LaTeX
7. Presentation Guidelines:
    - Use 12–15 slides for a 10–15 minute presentation.
    - Maintain clarity and visual appeal: minimal text, use diagrams and bullet points.
    - Be prepared for a brief Q&A session after your presentation.

Semester - IV

Teaching Scheme		Semester IV Introduction to Operating Systems	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction and Operating System Structures:** Definition, Types of Operating system, Real-Time operating system, 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).	06 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.	06 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:** 1.	CA	20
PR	-		MSE	20
CR	3		ESE	60

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** **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.	07 Hrs

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 Database Management	Examination Scheme	
TH	2	**Course Objectives:**	CA	20
PR	-		MSE	20
CR	2		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction:** Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture	05 Hrs
2	**Data Modeling using the Entity Relationship Model:** ER model concepts, notation for ER diagram, Constraints, keys, E-R Diagrams, Mapping Cardinality, Concepts of Super Key, candidate key, primary key, weak entity sets, Codd's rules, Extended ER model, Generalization, Aggregation, Reduction of an ER diagrams to tables.	05 Hrs
3	**Relational Data Model, Relational Algebra:** Structure of Relational Databases, Database Schema, Keys Relational algebra: Fundamental Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations.	07 Hrs
4	**Introduction to SQL:** Overview of SQL, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operators, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database. Intermediate SQL: Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schema, Authorization. Advanced SQL: Assessing SQL from Programming Language, JDBC, ODBC, Embedded SQL, Functions and Procedures, Triggers.	10 Hrs
5	**Normalization:** Features of good relational designs, Functional dependencies, Normal forms, First, Second, Third normal forms, BCNF, Functional Dependency Theory, Multivalued Dependencies, Fourth Normal Form, Database Design Process.	05 Hrs

Text Books:

1. Henry Korth, Abraham Silberschatz & S. Sudarshan, Database System Concepts, McGraw-Hill Publication, 6th Edition, 2011.

Reference Books:

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill Publication, 3rd Edition, 2003.
2. Joel Murach, Murach's Oracle SQL and PL/SQL for Developers, Mike Murach & Associates, 2nd Edition, 2014.
3. Wiederhold, Database Design, McGraw-Hill Publication, 2nd Edition, 1983.

4. Navathe, Fundamentals of Database System, Addison-Wesley Publication, 6th Edition, 2012.
5. Mark L. Gillenson, Fundamentals of Database Management System, Wiley Publication, 2nd Edition, 2011.
6. Serge Abiteboul, Richard Hull, Victor Vianu, Foundations of Databases, Reprint by Addison-Wesley.

Teaching Scheme		Semester IV Algorithm Design and Analysis	Examination Scheme	
TH	2	**Course Objectives:**	CA	20
PR	-		MSE	20
CR	2		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Algorithms:** Definition, Properties of Algorithms, Expressing Algorithm, Flowchart, Algorithm Design Techniques, Performance Analysis of Algorithms, Types of Algorithm's Analysis, Order of Growth, Asymptotic Notations, Master Theorem, Changing Variable, Heap Sort.	07 Hrs
2	**Divide and Conquer:** Introduction, Binary Search, Merge Sort, Quick Sort, Strassen‘s Matrix Multiplication.	07 Hrs
3	**Backtracking:** Backtracking Concept, N–Queens Problem, Four–Queens Problem, Eight–Queen Problem, Hamiltonian Cycle, Sum of Subsets Problem, Graph Coloring Problem, Branch and Bound: Introduction, Traveling Salesperson Problem, 15-Puzzle Problem, Comparisons between Backtracking and Branch and Bound.	07 Hrs
4	**Greedy Algorithms:** Introduction to Greedy Technique, Greedy Method, Optimal Merge Patterns, Huffman Coding, Knapsack Problem, Activity Selection Problem, Job Sequencing with Deadline, Minimum Spanning Tree, Single-Source Shortest Path Algorithm.	07 Hrs
5	**Dynamic Programming:** Introduction, Characteristics of Dynamic Programming, Component of Dynamic Programming, Comparison of Divide-and-Conquer and Dynamic Programming Techniques, Longest Common Subsequence, matrix multiplication, shortest paths: Bellman Ford, Floyd Warshall, Application of Dynamic Programming. **NP Completeness:** Introduction, the Complexity Class P, the Complexity Class NP, Polynomial-Time Reduction, the Complexity Class NP-Complete.	07 Hrs

Text Books:

1. T. Cormen, Introduction to Algorithms, PHI Publication, 4th Edition, 2022.

Reference Books:

1. Aho, Ullman, Data Structure and Algorithms, Addison-Wesley Publication, 1st Edition, 1983.
2. Michel Goodrich, Roberto Tamassia, Algorithm Design – Foundation, Analysis & Internet Examples, Wiley Publication, 2nd Edition,2006.
3. George T. Heineman, Gary Pollice, Stanley Selkow, Algorithms in a Nutshell, A Practical Guide, O'Reilly Media, 2nd Edition, 2016.

4. Ellise Horowitz, Sartaj Sahni, S. Rajasekaran, Fundamentals of Computer Algorithms, University Press (India) Private Ltd, 2nd Edition, 2008.
5. Sara Base, Computer algorithms: Introduction to Design and Analysis, Addison-Wesley Publication, 2nd Edition, 1988.

Teaching Scheme		Semester IV Constitution of India	Examination Scheme	
TH	2	**Course Objectives:**	CA	60
PR	-		MSE	-
CR	AU		ESE	40

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:**	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	-	**Course Objectives:**	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 का 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		MSE	-
CR	2		ESE	40

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.

Teaching Scheme		Semester IV Database Management Systems Laboratory	Examination Scheme	
TH	-	**Course Objectives:**	CA	40
PR	2		MSE	-
CR	1		ESE	60

List of Experiments:

1. Defining a schema for applications.
2. Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), Data insertion into a table.
3. Grouping data, aggregate functions, Oracle functions (mathematical, character functions).
4. Sub-queries, Set operations, Joins.
5. Creation of databases, writing SQL and PL/SQL queries to retrieve information from the databases.
6. Assignment on Triggers & Cursors.
7. Normal Forms: First, Second, Third, and Boyce-Codd Normal Forms.
8. Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, and hospital management.
9. Deployment of Forms, Reports Normalization, and Query Processing Algorithms in the above application project.
10. Large objects – CLOB, NCLOB, BLOB, and BFILE.