

B. Tech. in Computer Science and Design Syllabus
Aligned with New Education Policy 2020
Effective from 2025 - 2026
(Only for Second Year)
(Affiliated Colleges)



Department of Computer Engineering
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B.Tech in Computer Science and Design
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	M S E	E S E	
BSC	24AF2000BS301	Engineering Mathematics-III	3	-	20	20	60	3
PCC1	24AF1257PC302	Fundamentals of Data Structures	3	-	20	20	60	3
PCC2	24AF1245PC303	Discrete Mathematics	3	-	20	20	60	3
PCC3	24AF1257PC304	Computer Graphics	2	-	20	20	60	2
OE	24AF1257OE305	Any Course from the Open Elective Bucket	2	-	20	20	60	2
MDM	24AF1257MD306	MDM Bucket*	-	-	20	20	60	-
PCC Lab	24AF1257PCL307	Fundamentals of Data Structures Laboratory	-	2	60	-	40	1
VEC	25AF1000VE308A	Life of Chhatrapati Shivaji Maharaj	1	-	50	-	-	1
PCC Lab	24AF1257PCL309	Computer Graphics Laboratory	-	2	60	-	40	1
VSEC	25AF1000VE310	UHV - II	3	-	20	20	60	3
Total			17	4	310	140	500	19

Course Type and Acronyms used

- | | |
|---|---------------------------------|
| 1. Basic Science Course (BSC) | L - Lecture, |
| 2. Engineering Science Course (ESC) | P / PR - Practical, |
| 3. Program Core Course (PCC) | CA - Continuous Assessment, |
| 4. Vocational Skill Enhancement Course (VSEC) | TH - Theory, |
| 5. Co-curricular Course (CC) | MSE - Mid Semester Examination, |
| 6. Ability Enhancement Course (AEC) | ESE - End Semester Examination, |
| 7. Indian Knowledge System (IKS) | CR - Credit |

B.Tech in Computer Science and Design
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Fourth Semester

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC1	25AF1245PC401	Design and Analysis of Algorithms	3	-	20	20	60	3
PCC2	25AF1245PC402	Computer Architecture and Organization	3	-	20	20	60	3
PCC3	25AF1245PC403	Probability and Statistics	3	-	20	20	60	3
HSSM	25AF1257AE404	Operating Systems	3	-	20	20	60	3
Open Elective	25AF1257OE405	Any Course from the Open Elective Bucket	2	-	20	20	60	2
MDM	25AF1257MD406	MDM Bucket*	-	-	20	20	60	-
VSEC	24AF1COIVE407	Constitution of India	2	-	50	-	-	Audit
VSEC	25AF1000VE408B	Life of Bharat Ratna Dr. Babasaheb Ambedkar	1	-	50	-	-	1
PCC Lab	25AF1245PC409	Design and Analysis of Algorithms Laboratory	-	2	60	-	40	1
AEC	25AF1000AE410	Modern Indian Languages A) Marathi B) Hindi C) Sanskrit	2	-	20	20	60	2
PCC Lab	24AF1257PCL411	Object-Oriented Modelling Laboratory	1	2	60	-	40	2
PCC Lab	25AF1257PCL412	Operating Systems Laboratory	-	2	60	-	40	1
Total			20	6	420	140	540	21
Exit Requirements for Certificate Program								
VSEC	23AF1245VE414	Full Stack Development Project	-	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)
8. Indian Knowledge System (IKS)

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

Third Year in B.Tech in Computer Science and Design
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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	Database Management	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	Machine Learning Laboratory	-	2	60	-	40	1
PCC Lab	Full Stack Development (SE Lab)	1	2	60	-	40	2
AEC	Seminar	-	2	-	-	-	1
PCC Lab	Database Management System Laboratory	-	2	60	-	40	1
Total		19	8	300	120	480	23

Course Type and Acronyms used

- | | |
|---|--|
| 1. Basic Science Course (BSC) | L - Lecture, |
| 2. Engineering Science Course (ESC) | P / PR - Practical, |
| 3. Program Core Course (PCC) | CA - Continuous Assessment, TH - Theory, |
| 4. Vocational Skill Enhancement Course (VSEC) | MSE - Mid Semester Examination, |
| 5. Co-curricular Course (CC) | ESE - End Semester Examination, |
| 6. Ability Enhancement Course (AEC) | CR - Credit |
| 7. Indian Knowledge System (IKS) | |

Third Year in B.Tech in Computer Science and Design
Course Curriculum Aligned with New Education Policy 2020
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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		17	8	260	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 Computer Science and Design
Course Curriculum Aligned with New Education Policy 2020
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Seventh Semester

Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
		L	P	CA	MSE	ESE	
PCC1	Artificial Intelligence	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		10	24	140	80	280	22

Course Type and Acronyms used

- | | |
|---|--|
| 1. Basic Science Course (BSC) | L - Lecture, |
| 2. Engineering Science Course (ESC) | P / PR - Practical, |
| 3. Program Core Course (PCC) | CA - Continuous Assessment, TH - Theory, |
| 4. Vocational Skill Enhancement Course (VSEC) | MSE - Mid Semester Examination, |
| 5. Co-curricular Course (CC) | ESE - End Semester Examination, |
| 6. Ability Enhancement Course (AEC) | CR - Credit |
| 7. Indian Knowledge System (IKS) | |

Fourth Year in B.Tech in Computer Science and Design
Course Curriculum Aligned with New Education Policy 2020
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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	8	240	80	480	20

MDM Bucket list for Minor in B. Tech (Computer Science and Design)

A student wishing to pursue a Minor program in B. Tech. (Computer Science and Design) needs to complete a minimum 14 credits from the below list of courses.

Sem	Course Code	Course Name	L	P	CA	MSE	ESE	CR
III	25AF1257MD306A	Computer Graphics	2	2	20	20	60	3
III	25AF1257MD306B	Python Programming	2	2	20	20	60	3
IV	25AF1257MD406A	Data Analytics	3	--	20	20	60	3
IV	25AF1257MD406B	Object-Oriented Modelling and Design	2	2	20	20	60	3

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 (IIM)	P. C. Narayan	https://onlinecourses.swayam2.ac.in/imb23mg59/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. Ravichandran T.	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: 1. Able to comprehend the fundamental knowledge of the Laplace and inverse Laplace transforms and their derivatives for elementary functions 2. Able to apply the properties of Laplace and inverse Laplace transforms to solve simultaneous linear and linear differential equations with constant coefficients. 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.	CA	20
PR	-		MSE	20
CR	3		ESE	60

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. $\frac{\partial u}{\partial t} = C^2 \frac{\partial^2 u}{\partial x^2}$), 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 Fundamentals of Data Structures		Examination Scheme	
TH	3	Course Objectives:	CA	20
PR	-	1. To understand the standard and abstract data representation methods.	MSE	20
CR	3	2. To acquaint with the structural constraints and advantages in usage of the data.	ESE	60
		3. To understand various data structures, operations on it and the memory requirements		
		4. To understand various data searching and sorting methods.		
		5. To understand various algorithmic strategies to approach the problem solution.		

COURSE CONTENT

Unit No.	Topic	Hours
1	Introduction to Algorithms and Data Structures Introduction: From Problem to Program (Problem, Solution, Algorithm, Data Structure, and Program). Data Structures: Data, Information, Knowledge, and Data Structure, Abstract Data Types (ADT), Data Structure Classification (Linear and Non-linear, Static and Dynamic, Persistent and Ephemeral data structures). Algorithms: Problem Solving, Introduction to Algorithm, Characteristics of algorithm, Algorithm design tools: Pseudo-code and flowchart.	06 Hrs
2	Linear Data Structure Using Sequential Organization Concept of Sequential Organization, Overview of Array, Array as an Abstract Data Type, Operations on Array, Merging of two arrays, Storage Representation and their Address Calculation: Row major and Column Major, Multidimensional Arrays: Two-dimensional arrays, n-dimensional arrays. Concept of Ordered List. Single Variable Polynomial: Representation using arrays, Polynomial as array of structure, Polynomial addition, Polynomial multiplication. Sparse Matrix: Sparse matrix representation using array, Sparse matrix addition, Transpose of sparse matrix- Simple and Fast Transpose, Time and Space tradeoff.	06 Hrs
3	Searching and Sorting Searching: Search Techniques-Sequential Search/Linear Search, Binary Search, Fibonacci Search, and Indexed Sequential Search. Sorting: Types of Sorting-Internal and External Sorting, General Sort Concepts-Sort Order, Stability, Efficiency, and Number of Passes, Comparison Based Sorting Methods-Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Shell Sort, Non-comparison Based Sorting Methods-Radix Sort, Comparison of All Sorting Methods and their complexities.	06 Hrs

- 4 Linked List** 07 Hrs
Introduction to Static and Dynamic Memory Allocation, Linked List: Introduction, of Linked Lists, Realization of linked list using dynamic memory management, operations, Linked List as ADT, Types of Linked List: singly linked, linear and Circular Linked Lists, Doubly Linked List, Doubly Circular Linked List, Primitive Operations on Linked List Create, Traverse, Search, Insert, Delete, Sort, Concatenate.
- 5 Stack and Queue** 07 Hrs
Basic concept stack Abstract Data Type Representation of Stacks Using Sequential Organization, stack operations, Multiple Stacks, Applications of Stack Expression Evaluation and Conversion, Polish notation and expression conversion, Need for prefix and postfix expressions, Postfix expression evaluation, Linked Stack and Operations Basic concept Queue as Abstract Data Type Representation of Queue using Sequential organization, Queue Operations, Circular Queue and its advantages, Multi-queues, Linked Queue and Operations. Deque-Basic concept types (Input restricted and Output restricted), Priority Queue-Basic concept, types (Ascending and Descending).

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 Structure & Algorithm 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 Structure 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 Discrete Mathematics	Examination Scheme	
TH	3	Course Objectives: 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. 2. Use set theory, functions, and relations to represent, manipulate, and reason about mathematical structures and their properties. 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.	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. 07 Hrs
Trees: Prefix Codes, Huffman coding, Spanning trees and cut sets, Minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning trees.
- 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 Computer Graphics	Examination Scheme	
TH	2	Course Objectives: 1. To acquaint the learner with the basic concepts of Computer Graphics. 2. To learn the various algorithms for generating and rendering graphical figures. 3. To get familiar with the 2D and 3D transformation techniques.	CA	20
PR	-		MSE	20
CR	2		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	Scan Conversion Algorithms and Display Files Introduction: Graphics Primitives - Pixel, Resolution, Aspect ratio, Frame buffer, Display devices, Applications of computer graphics Scan conversion: Line drawing algorithms: Digital Differential Analyzer (DDA), Bresenham. Circle drawing algorithms: Bresenham, Midpoint Display Files: Structure, Algorithms and Display file interpreter. Primitive operations on display file. Segment: Segment table, Segment creation, closing, deleting and renaming, Visibility	07 Hrs
2	Polygons, Windowing and Clipping Polygons: Introduction to polygons. Inside test: Even-Odd method, Winding number method Polygon Filling: Seed fill, Scan line fill Windowing and clipping: Introduction to windowing, 2-D clipping: Cohen – Sutherland line Clipping algorithm, Sutherland-Hodgeman Polygon clipping algorithm, Weiler-Atherton generalized Polygon Clipping algorithm	07 Hrs
3	2D, 3D Transformations and Projections 2-D transformations: Homogeneous Coordinates, Translation, scaling, rotation and shear, rotation about an arbitrary point 3-D transformations: Translation, scaling, rotation, rotation about an arbitrary axis Projections: Parallel (Oblique: Cavalier, Cabinet and orthographic: isometric, diametric, trimetric) and Perspective (Vanishing Points – 1 point, 2 point and 3 point).	07 Hrs
4	Color Models and Hidden Surface Removal Colour models: Properties of Light, CIE chromaticity Diagram, RGB, HSV, CMY Hidden Surface Removal: Introduction, Back face detection and removal, Algorithms: Depth buffer (z), Depth sorts (Painter), Area subdivision (Warnock).	07 Hrs
5	Curves and Fractals Curves: Introduction, Interpolation and Approximation, Blending function, B-Spline curve, Bezier curve Fractals: Introduction, Fractal generation: Koch curve, Hilbert curve, Applications.	07 Hrs

Text Books:

1. S. Harrington, Computer Graphics: A Programming Approach, Second Edition, McGraw-Hill Publications, 1987, ISBN:0 – 07 – 100472 – 6.
2. D. Rogers, Procedural Elements for Computer Graphics, Second Edition, Tata McGraw-Hill Publication, 2001, ISBN:0 – 07 – 047371 – 4.

Reference Books:

1. D. Rogers, J. Adams, Mathematical Elements for Computer Graphics, Second Edition, Tata McGrawHill Publication, 2002, ISBN:0 – 07 – 048677 – 8.
2. J. Foley, V. Dam, S. Feiner, J. Hughes, —Computer Graphics Principles and Practice, Second Edition, Pearson Education, 2003, ISBN:81 – 7808 – 038 – 9.
3. D. Hearn, M. Baker, —Computer Graphics – C Version, Second Edition, Pearson Education, 2002, ISBN:81 – 7808 – 794 – 4.

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 was 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 Fundamentals of Data Structures Laboratory	Examination Scheme
TH -		CA 60
PR 2		MSE -
CR 1		ESE 40

List of Experiments:

1. Write a program to implement a stack using arrays.
2. Write a program to evaluate a given postfix expression using stacks.
3. Write a program to convert a given infix expression to postfix form using stacks.
4. Write a program to implement a circular queue using arrays.
5. Write a program to implement double ended queue (dequeue) using arrays.
6. Write a program to implement a stack using two queues such that the push operation runs in constant time and the pop operation runs in linear time.
7. Write a program to implement a stack using two queues such that the push operation runs in linear time and the pop operation runs in constant time.
8. Write a program to implement a queue using two stacks such that dequeue operation runs in constant time and dequeue operation runs in linear time.
9. Write programs to implement the following data structures: (a) Single linked list, (b) Double linked list, (c) Circular linked list
10. 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.
11. Write a program to create a binary search tree (BST).
12. Implement the following sorting algorithms: (a) Insertion sort, (b) Merge sort, (c) Quick sort, (d) Heap sort.

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 Computer Graphics Laboratory	Examination Scheme
TH -	Course Objectives:	CA 60
PR 2		MSE -
CR 1		ESE 40

List of Experiments:

1. Write a program to draw a line using the DDA line draw algorithm.
2. Write a program to draw a circle using the midpoint circle algorithm.
3. Write a program to draw the following pattern. Use DDA line and Bresenham's circle drawing algorithm.



4. Write a program to draw a concave polygon and fill it with desired color using Seed Fill /Scan LineFill algorithm.
5. Write a menu-driven program to implement Cohen Southerland line clipping algorithm by accepting a window and a line to be clipped against it.
6. Write a program to draw 2-D object and perform the following basic transformations
a) Scaling, b) Translation, and c) Rotation.
7. Write a program to implement a bouncing ball using the Sine wave form.
8. Write a program to draw a moving wheel.
9. Write a program to generate fractal patterns by using Kochcurves.
10. Write a program to draw a polygon and identify its type, whether convex or concave

Semester - IV

Teaching Scheme		Semester IV Design and Analysis of Algorithms	Examination Scheme	
TH	3	Course Objectives: 1. Explain fundamental algorithm design, analysis, and performance evaluation concepts using asymptotic notations and recurrence solving techniques. 2. Solve computational problems by applying algorithmic paradigms such as divide-and-conquer, greedy, dynamic programming, backtracking, and branch-and-bound. 3. Implement algorithms for searching, sorting, shortest path, matrix operations, and combinatorial optimisation, and evaluate their time and space complexity. 4. Compare algorithmic strategies for problem-solving and justify the choice of technique based on efficiency and problem constraints. 5. Classify problems into complexity classes P, NP, and NP-complete, and apply polynomial-time reductions to analyse computational hardness.	CA	20
PR	-		MSE	20
CR	3		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 Algorithms Analysis, Order of Growth, Asymptotic Notations, Recursion, Recurrences Relation, Substitution Method, Iterative Method, Recursion Tree, 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 Computer Architecture and Organization	Examination Scheme	
TH	3	Course Objectives: 1. Explain the structure, function, and interconnection of computer components, including CPU, memory, and I/O systems. 2. Interpret instruction set architectures, addressing modes, and execution flow, and compare RISC and CISC architectures. 3. Apply principles of computer arithmetic to perform integer and floating-point operations, and analyse ALU design. 4. Evaluate memory organisation techniques, including cache, virtual memory, and external storage systems, for performance and reliability. 5. Analyse control unit design, I/O organisation, pipelining, and parallel processing techniques for improving system performance.	CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	Introduction: Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function.	07 Hrs
2	Instruction Sets: Characteristics, Types of operands, Types of operations, Assembly language, Addressing modes, Instruction format, Types of instruction, Instruction execution, Machine state and processor status, Structure of program, Introduction to RISC and CISC architecture.	07 Hrs
3	Computer Arithmetic: The arithmetic and logic Unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.	08 Hrs
4	Memory Organization Internal Memory: Semiconductor main memory, Error correction, Advanced DRAM organization, Virtual memory systems and cache memory systems. External Memory: Organization and characteristics of magnetic disk, Magnetic tape, Optical memory, RAID, Memory controllers.	08 Hrs
5	Control Unit and Input / Output Organization Control Unit Operation: Micro-operations, Control of the processor, Hardwired implementation, Micro-programmed Control Unit, Basic concepts, Microinstruction sequencing, Microinstruction execution, Applications of micro-programming. Input / Output Organization: External devices, I/O module, Programmed I/O, Interrupt driven I/O, Direct memory access, I/O channels and processors, External interface. Instruction Pipe-lining and Parallel processing: Multiple processor organization, Symmetric multiprocessor, Cache coherence and the MESI protocol.	08 Hrs

Text Books:

1. William Stalling, Computer Organization and Architecture: Designing for Performance, Prentice Hall Publication, 8th Edition, 2009.

Reference Books:

1. Hayes, Computer Architecture and Organization, McGraw-Hill Publication, 3rd Edition, 2012.
2. Zaky, Computer Organization, McGraw-Hill Publication, 5th Edition, 2011.
3. Hennessy and Patterson, Computer Architecture: A Quantitative Approach, Morgan and Kaufmann Publication, 4th Edition, 2007.
4. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition, 2007.
5. Mostafa Abd-El-Barr, Hesham El-Rewini, Fundamentals of Computer Organization and Architecture, Wiley Publication, 1st Edition, 2004.
6. Miles J. Murdocca, Vincent P. Heuring, Computer Architecture and Organization: An Integrated Approach, Wiley Publication, 1st Edition, 2007.
7. Sajjan G. Shiva, Computer Organization: Design, and Architecture, CRC Press, 5th Edition, 2013.

Teaching Scheme		Semester IV Probability and Statistics	Examination Scheme	
TH	3	Course Objectives: 1. To explain basic concepts in statistics and probability. 2. To describe various probabilistic distributions. 3. To apply regression and correlation techniques.	CA	20
PR	-		MSE	20
CR	3		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, Joint 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 Operating Systems	Examination Scheme	
TH	3	Course Objectives: <ol style="list-style-type: none"> 1. Explain the structure, components, and types of operating systems, including process, memory, file, and I/O management. 2. Apply CPU scheduling algorithms and multithreading models to improve process performance and system throughput. 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. 	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).	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),	08 Hrs

efficiency and performance. Mass-Storage Structure: Disk Structure, Disk attachment, Disk scheduling, Disk management, Swap Space Management.

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. Doepfner, Operating System in Depth: Design and Programming, Wiley Publication, 2011.

Teaching Scheme		Semester IV Constitution of India	Examination Scheme	
TH	2	Course Objectives: 1. Explain the historical background, sources, features, and key provisions of the Indian Constitution, including citizenship, fundamental rights, duties, and directive principles. 2. Describe the structure, roles, and functions of the Union and State governments, and analyze the relationship between the Centre and States. 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.	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: 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 IV Design and Analysis of Algorithm Laboratory	Examination Scheme
TH -		CA 60
PR 2		MSE -
CR 1		ESE 40

List of Experiments:

1. Implementation of Binary Search.
2. Implementation of finding maximum and minimum numbers using divide and conquer.
3. Implementation of Merge / Quick sort.
4. Implementation of Selection sort.
5. Implementation of Job Sequencing with deadlines.
6. Program for finding the minimum cost Spanning Tree.
7. Implementation of single-source shortest path.
8. Implementation of all-pairs shortest path.
9. Program for Tree traversal techniques.
10. Program for Graph Traversal Technique.

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, समानार्थी शब्द (पर्यायवाची शब्द), विरुद्धार्थी 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. ▪ पारिभाषक 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, खड़ी बोली, भोजपुरी, राजस्थानी आदी) ▪ हिंदी पर फारसी, अरबी और अंग्रेजी भाषा का प्रभाव.	02 Hrs
2	स्वातंत्र्योत्तर 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 (रिपोर्ट) 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, पारिभाषिक 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 Operating Systems Laboratory	Examination Scheme
TH -		CA 60
PR 2		MSE -
CR 1		ESE 40

Operating Systems Laboratory:

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. Implementation of Synchronization primitives – Semaphore, Locks and Conditional Variables.
8. Implementation of Producer-Consumer problem, Bankers algorithm.
9. Implementation of various memory allocation algorithms, (First fit, Best fit, and Worst fit), Disk.
10. Scheduling algorithms (FCFS, SCAN, SSTF, C-SCAN).

Teaching Scheme	Semester IV Object Oriented Modelling Laboratory	Examination Scheme	
TH	-	CA	60
PR	2	MSE	-
CR	1	ESE	40

List of Experiments:

1. Study of E- R Diagram
2. Study of Use case Diagram
3. Study of Activity Diagram
4. Study of Class Diagram
5. Study of Interaction Diagram
6. Study of Collaboration Diagram
7. Study of State Chart Diagram
8. Study of Package Diagram
9. Study of Component Diagram
10. Study of Deployment Diagram
11. Identify use cases and develop the Use Case model.
12. To develop a mini project for Exam Registration system,

Teaching Scheme	Exit Course Full Stack Development	Examination Scheme
TH -	Course Objectives:	CA 60
PR 16		MSE -
CR 8		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.