B. Tech. (Computer Engineering / Computer Science and Engineering / Computer Technology and Allied) Syllabus Aligned with the New Education Policy 2020 Effective from AY 2025 - 2026 (All Years)

(Affiliated Colleges)

Note: Refer this Syllabus for Second Year in Computer Engineering / Computer Technology / Computer Science and Engineering / Computer Science and Cyber Security with branch codes (11242, 11245,)

Department of Computer Engineering

Dr. Babasaheb Ambedkar Technological University, Lonere - 402103

www.cse.dbatu.ac.in

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

Course Category	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
BSC	25AF1000BS301	Engineering Mathematics-III	3	-	20	20	60	3
PCC1	25AF1245PC302	Data Structures	3	-	20	20	60	3
PCC2	25AF1245PC303	Discrete Mathematics	3	-	20	20	60	3
PCC3	25AF1245PC304	Object-Oriented Programming	2	-	20	20	60	2
PCC4	25AF1245PC305	Digital Electronics	2	-	20	20	60	2
MDM	25AF1245MD306	Multi-Disciplinary Minor* Bucket	-	-	20	20	60	-
OE-I+	25AF1245OE307	Any Course from OE Bucket	2	-	20	20	60	2
VSEC	25AF1000VE308A	Life of Chhatrapati Shivaji Maharaj	1	-	50	-	-	1
PCC Lab	25AF1245PCL309	Data Structures Laboratory	-	2	60	-	40	1
VSEC	25AF1000VE310	Universal Human Values - II	2	-	20	20	60	2
PCC Lab	25AF1245PCL311	Object-Oriented Programming in Java Laboratory	-	2	60	-	40	1
PCC Lab	25AF1245PCL312	Digital Electronics Laboratory	-	2	60	-	40	1
		Total	**18**	**06**	**390**	**160**	**600**	**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,
P / PR - Practical,
CA - Continuous Assessment, TH - Theory,
MSE - Mid-Semester Examination,
ESE - End Semester Examination,
CR - Credit

*****A student must select a course or courses from the minor degree program s/he wishes to pursue.*

\+ *A student needs to select a course from the list of open elective courses attached to the Open Elective (OE) Bucket*

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

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC1	25AF1245PC401	Design and Analysis of Algorithms	3	-	20	20	60	3
PCC2	25AF1245PC402	Computer Architecture and Organisation	3	-	20	20	60	3
PCC3	25AF1245PC403	Probability and Statistics	3	-	20	20	60	3
OE-II	25AF1245OE404	Any Course from OE Bucket List	2	-	20	20	60	2
PCC Lab	25AF1245PCL05	Python Programming	1	2	60	-	40	2
MDM	25AF1245MD406	Multi-Disciplinary Minor* Bucket	-	-	20	20	60	-
VSEC	25AFCOIAE407	Constitution of India	2	-	60	-	40	Audit
VSEC	25AF1000VE308B	Life of Bharat Ratna Dr. Babasaheb Ambedkar	1	-	50	-	-	1
PCC Lab	25AF1245PCL409	Design and Analysis of Algorithms Laboratory	-	2	60	-	40	1
AEC	25AF1000VE410	Modern Indian Languages A) Marathi B) Hindi C) Sanskrit	2	-	20	20	60	2
Total			**17**	**4**	**350**	**120**	**480**	**17**
	Exit Requirements for Certificate Program							
VSEC	23AF1245VE411	Full Stack Development Project	-	16	60	-	40	8

** A student must select a course or courses from the minor degree program s/he wishes to pursue.*

+ A student must select a course from the list of open elective courses attached to the Open Elective (OE) Bucket.

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

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC1	26AF1245PC501	Machine Learning	3	-	20	20	60	3
PCC2	26AF1245PC502	Theory of Computations	3	-	20	20	60	3
PCC3	26AF1245PC503	Operating Systems	3	-	20	20	60	3
PCC4	26AF1245PC504	Database Management	3	-	20	20	60	3
PEC	26AF1245PE505	**Program Elective** A. Computer Graphics B. Introduction to Quantum Technologies	3	-	20	20	60	3
MDM	26AF1245MD506	**MDM Bucket***	-	-	20	20	60	-
OE-3	26AF1000OE507	**Open Elective Bucket**	2	-	20	20	60	2
PCC Lab	26AF1245PCL508	Machine Learning Laboratory	-	2	60	-	40	1
PCC Lab	26AF1245PCL509	Operating System Laboratory	-	2	60	-	40	1
PCC Lab	26AF1245PCL510	Database Management System Laboratory	-	2	60	-	40	1
AEC	25AF1245SEM511	Seminar	-	2	60	-	40	1
		Total	**17**	**8**	**380**	**140**	**580**	**21**

**A student must select a course or courses from the minor degree program s/he wishes to pursue. A student must select a course from the list of open elective courses attached to the Open Elective (OE) Bucket.*

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

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC	25AF1245PC601	Compiler Design	3	-	20	20	60	3
PCC	25AF1245PC602	Data Communication & Computer Networks	3	-	20	20	60	3
PCC	25AF1245PC603	Software Engineering	3	-	20	20	60	3
PEC	25AF1245PE604	**Program Elective** A. Internet of Things B. Big Data Analytics	3	-	20	20	60	3
PEC	25AF1245PE605	**Program Elective** A. Human Computer Interaction B. Deep Learning	3	-	20	20	60	3
MDM	25AF1245MD606	**MDM Bucket**	-	-	20	20	60	-
PCC Lab	25AF1245PCL607	Computer Network Lab	-	2	60	-	40	1
PCC Lab	25AF1245PCL608	Full Stack Development	1	2	60	-	40	2
PCC Lab	25AF1245PCL609	Prompt Engineering	1	2	60	-	40	2
Total			**17**	**6**	**300**	**120**	**480**	**20**

**A student must select a course or courses from the minor degree program s/he wishes to pursue.*
A student must select a course from the list of open elective courses attached to the Open Elective (OE) Bucket.

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

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC	27AF1245PC701	Distributed Computing	3	-	20	20	60	3
PEC	27AF1245PE702	**Program Elective:** A. Natural Language Processing B. Advanced Algorithms C. Optimization Techniques	2	-	20	20	60	2
PCC Lab	27AF1245MD703	Distributed Computing-Lab	-	2	60	-	40	1
Project	27AF1245P704	Project-Phase	-	4	60	-	40	2
MDM	27AF1245PC705	MDM Bucket	-	-	20	20	60	-
Internship	27AF1000O706	Internship	-	24	60	-	40	12
		Total	**5**	**30**	**240**	**60**	**300**	**20**

**A student must select a course or courses from the minor degree program s/he wishes to pursue.*
A student must select a course from the list of open elective courses attached to the Open Elective (OE) Bucket.

B.Tech in Computer Engineering and Allied Programs
Course Curriculum Aligned with New Education Policy 2020
(Effective from Academic Year 2027 - 2028)
Eigth Semester

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC	25AF1245PC801	Artificial Intelligence	3	-	20	20	60	3
PCC	25AF1245PE802	**Program Elective** 1. Cryptography and Network Security 1. Computer Vision 2. ICT for Sustainable Development	3	-	20	20	60	3
PEC	25AF1245PE803	**Program Elective** A. Blockchain Technology B. Virtual Reality C. AI Ethics	3	-	20	20	60	3
MDM	25AF1245MD804	**MDM Bucket**	2	-	40	-	60	2
RM	25AF1245RM805	Research Methodology	3	2	40	-	60	4
PCC Lab	25AF1245PL806	Project Phase - II	-	4	40	-	60	2
		Total	**14**	**6**	**180**	**60**	**360**	**17**

**A student must select a course or courses from the minor degree program s/he wishes to pursue. A student must select a course from the list of open elective courses attached to the Open Elective (OE) Bucket.*

MDM Bucket List for Minor in B.Tech. (Computer Engineering Program)

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

Sem	Course Code	Course Name	L	P	CA	MSE	ESE	CR
III	25AF1245MD306A	Data Structures	3	2	20	20	60	4
III	25AF1245MD306B	Object-Oriented Programming	2	2	20	20	60	3
IV	25AF1245MD406A	Design and Analysis of Algorithms	3	2	20	20	60	4
IV	25AF1245MD406B	Python Programming	1	2	60	-	40	2
Proposed Courses to be offered in V and VI Semesters								
V	25AF1245MD506A	Operating Systems	3	2	20	20	60	4
V	25AF1245MD506B	Database Management System	3	2	20	20	60	4
V	25AF1245MD506C	Theory of Computation	3	-	20	20	60	3
VI	25AF1245MD606A	Software Engineering	3	-	20	20	60	3
VI	25AF1245MD606B	Data Communication & Computer Networks	3	-	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 (IIB)	P. C. Narayan	https://onlinecourses.swayam2.ac.in/imb23_mg59/preview

List of Open Electives for Faculty of Law

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

List of Open Electives for Faculty of Humanities and Arts

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

List of Open Electives for Faculty of Architecture and Planning

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

List of Open Electives for Faculty of Science

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

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

COURSE CONTENT

Unit No.	Topic	Hours
1	**Laplace Transform:** Definition – conditions for existence; Transforms of elementary functions; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.	08 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	08 Hrs

to find solutions of one-dimensional flow equation ($ie.\ \frac{\partial u}{\partial t} = C^2 \frac{\partial^2 u}{\partial t^2}$), and one-dimensional wave equation ($ie.\ \frac{\partial^2 y}{\partial t^2} = C^2 \frac{\partial^2 y}{\partial x^2}$).

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

COURSE CONTENT

Unit No.	Topic	Hours
1	Data, Data types, Data structure, Abstract Data Type (ADT), representation of Information, characteristics of an algorithm, program, analysing programs. **Arrays and Hash Tables:** Concept of sequential organisation, 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 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:**	CA	20
PR	-	1. Apply principles of propositional and predicate logic to model, analyze, and validate logical arguments using truth tables, standard forms, rules of inference, and quantifiers.	MSE	20
CR	3	2. Use set theory, functions, and relations to represent, manipulate, and reason about mathematical structures and their properties.	ESE	60
		3. Solve combinatorial problems using counting principles, recurrence relations, and graph theory concepts, including paths, connectivity, colouring, and spanning trees.		
		4. Implement algorithms for graph and tree problems such as shortest paths, minimal spanning trees, Huffman coding, and topological sorting.		
		5. Analyse and apply algebraic structures, including groups, rings, fields, and Boolean algebras, to formulate and solve problems in computer science and related domains.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Propositional Logic:** Propositions, truth values, Truth tables for operators, Truth Tables of Compound Propositions, Precedence of Logical Operators. **Propositional Equivalences:** Logical Equivalences, Constructing New Logical Equivalences, Normal Forms. **Predicates and Quantifiers:** Predicates, Quantifiers: Universal and Existential, Quantifiers with Restricted Domains, Precedence of Quantifiers, Binding Variables, Logical Equivalences Involving Quantifiers, Negating Quantified Expressions, Translating from English into Logical Expressions, Examples from Lewis Carroll, Nested Quantifiers: Understanding Statements Involving Nested Quantifiers, The Order of Quantifiers, Negating Nested Quantifiers. **Rules of Inference:** Valid Arguments in Propositional Logic, Rules of Inference for Propositional Logic, Using Rules of Inference to Build Arguments, Resolution, Fallacies.	09 Hrs
2	**Basic notions in set Theory:** Sets, Venn Diagrams, Subsets, The Size of a Set, Power Sets, Cartesian Products, Set operations, Set Identities, Generalized Unions and Intersections, Cardinality of Sets. **Functions:** Introduction, Subjective, Injective, Bijective, inverse functions, Composition of functions. **Relations:** Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Equivalence classes and partitions, Partial Ordering, Hasse Diagram, Topological Sort.	09 Hrs
3	**Combinatorics:** Applications of Recurrence Relations, Solving Linear Recurrence Relations.	06 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 Object-Oriented Programming	Examination Scheme	
TH	2	**Course Objectives:**	CA	20
PR	-	1. To explain the fundamental properties of OOP. 2. To describe the usefulness of basic OO abstractions like class, Methods, and Interfaces. 3. To apply code reuse techniques through inheritance. 4. To apply design OO libraries for designing UI and other programmatic features.	MSE	20
CR	2		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Classes and Objects** (Java)**:** Introduction, Java Class Libraries, Typical Java Development Environment, Memory Concepts, Arithmetic. Classes, Objects, Methods and Instance Variables, Declaring a Class with a Method and Instantiating an Object of a Class, Declaring a Method, Instance variables, set Methods and get Methods, Primitive Types vs. Reference type double Types, Initializing Objects with Constructors, floating point numbers. Contro Statements and Array	05 Hrs
2	**Modulization in Java: Java Package, importing packages,** Methods: static methods, static Fields, scope of declaration, method overloading, and Java API packages.	05 Hrs
3	**Inheritance and Polymorphism in Java:** Inheritance: Super classes and Subclasses, protected members, relationship between super classes and subclasses, constructors in subclasses, object class. Polymorphism: Abstract classes and methods, final methods and classes, polymorphism examples, and Interfaces.	05 Hrs
4	**Exception-handling:** Exception-handling overview, handling Arithmetic Exceptions and Input Mismatch Exceptions, when to use exception handling, Java exception hierarchy, finally block. Java Iterator Methods Parametrized Classes in Java.	06 Hrs

Text Books:

1. Paul Deitel and Harvey Detail, Java: How to Program, Pearson's Publication, 9th Edition.

Reference Books:

1. Joel Murach and Michael Urban, Murach's Beginning Java with Eclipse, Murach's Publication, 1st Edition, 2016. Doug Lowe, Java All-in-One For Dummies, Wiley Publication, 4th Edition,2014.

2. Herbert Schildt, Java: The Complete Reference, McGraw-Hill Publication, 9th Edition.
3. Patrick Niemeyer, Daniel Leuck, Learning Java, O'Reilly Media, 4th Edition, 2013.
4. JavaScript: The Good Parts‖, Douglas Crockford, O‘Reilly, ISBN: 9782744055973.

Teaching Scheme		Semester III Digital Electronics	Examination Scheme	
TH	2	**Course Objectives:**	CA	20
PR	-	1. To acquaint the students with the fundamental principles of two-valued logic and various devices to implement logical operations on variables.	MSE	20
CR	2	2. To lay the foundation for further studies in areas such as communication, VHDL, and computer.	ESE	60
		3. Understand the principles of asynchronous counters and design them to meet specific counting requirements.		
		4. Solve real-world problems related to arithmetic operations, code conversion, counter applications, and other digital logic scenarios.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction:** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR, and Exclusive-OR operations, Boolean algebra, examples of IC gates.	05 Hrs
2	**Number Systems:** binary, signed binary, octal hexadecimal number, binary arithmetic, one‘s and two‘s complements arithmetic, codes, error detecting and correcting codes.	05 Hrs
3	**Combinational Logic Design:** Standard representations for logic functions, K-map representation of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms (upto four variables), and don’t care conditions.	05 hrs
4	**Design Examples:** Arithmetic Circuits, BCD-to-7 segment decoder, Code converters. Adders and their use as subtractors, look-ahead carry, ALU, Digital Comparator, Parity generators/checkers, Design of Multiplexers and Demultiplexers, and Decoders.	05 Hrs
5	**Sequential Circuits and Systems:** 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J-K-T, and D-types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, a special counter IC‘s, asynchronous sequential counters, applications of counters.	06 Hrs

Text/Reference Books:

1. R. P. Jain, Modern Digital Electronics, McGraw-Hill Education, 2009.
2. M. Morris Mano, Digital Logic and Computer Design, 4th edition, Prentice Hall of India, 2013.

3. Anand Kumar, Fundamentals of digital circuits, 1st edition, Prentice Hall of India, 2001.
4. Pedroni V. A., Digital Circuit Design with VHDL, Prentice Hall India, 2nd Edition, 2001.

Teaching Scheme		Semester III Universal Human Values - II	Examination Scheme	
TH	3	**Course Objectives:** 1. Explain the concept of value education, self-exploration, and the relationship between happiness, prosperity, and basic human aspirations. 2. Distinguish between the needs of the self and the body, and apply methods to achieve harmony within the individual and between the self and the body. 3. Demonstrate understanding of harmony in the family and society by applying foundational values such as trust and respect in human relationships. 4. Analyse the interconnectedness and mutual fulfilment among the four orders of nature and relate it to sustainable living and coexistence. 5. Apply a holistic understanding of human values to professional ethics, decision-making, and strategies for value-based life and profession.	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,	05 Hrs

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

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

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 Structures Laboratory	Examination Scheme
PR: 2 CR:1		CA: 60 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) 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.
12. Write a program to implement hashing with (a) Separate Chaining and (b) Open addressing methods.
13. Implement the following sorting algorithms: (a) Insertion sort, (b) Merge sort, (c) Quick sort, (d) Heap sort.
14. Write programs for the implementation of graph traversals by applying: (a) BFS, (b) DFS.

Teaching Scheme	Semester III Object-Oriented Programming in Java Laboratory	Examination Scheme
PR: 2 CR: 1		CA: 60 ESE:40

List of Experiments:

1. Programs on Operators, Arithmetic Promotion, and Method Calling.
2. Programs on Classes: String and Math.
3. Write a program to demonstrate the following Function concepts
   i. Function overloading
   ii. Constructors of all types
   iii. Default parameters, returning by reference
4. Programs on dealing with Arrays.
5. Programs on Classes: String and Math.
6. Programs on Inheritance and Polymorphism.
7. Programs on Interfaces, block initializers, final Modifier, as well as static and dynamic binding.
8. Programs on Exception Handling.
9. Write a Java program that illustrates the following
   a) Creation of a simple package.
   b) Accessing a package.
   c) Implementing interfaces.
10. Create a simple GUI using JFrame, JButton, JLabel, and JTextField. Handle user events using action listeners.
11. Demonstrate usage of List, Set, and Map. Iterate using an enhanced for-loop and an Iterator.

Teaching Scheme	Semester III Digital Electronics Laboratory	Examination Scheme
PR: 2 CR: 1		CA: 60 ESE: 40

List of Experiments

1. Study of gates – AND; OR; NOT; NAND; NOR; EX-OR; EX-NOR
2. Verification of Boolean Theorems using basic gates.
3. Design a circuit to convert a binary number to its two's complement representation.
4. Design and realize a given function using K-maps and verify its performance.
5. Verify
    a. Demorgan's Theorem for 2 variables.
    b. The sum-of product and product-of-sum expressions using universal gates.
6. Design and implement
    a. Full Adder using basic logic gates.
    b. Full subtractor using basic logic gates.
7. Implementation of 4x1 multiplexer using Logic Gates.
8. To verify the truth tables of S-R; J-K; T and D type flip flops.
9. Design, and Verify the 4- Bit Synchronous Counter.
10. Design, and Verify the 4-Bit Asynchronous Counter.
11. Design and implementation of a simple digital system (Mini Project).

Semester - IV

Teaching Scheme		Semester IV Design and Analysis of Algorithms	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Explain fundamental algorithm design, analysis, and performance evaluation concepts using asymptotic notations and recurrence solving techniques.	MSE	20
CR	3	2. Solve computational problems by applying algorithmic paradigms such as divide-and-conquer, greedy, dynamic programming, backtracking, and branch-and-bound.	ESE	60
		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.		

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:**	CA	20
PR	-	1. Explain the structure, function, and interconnection of computer components, including CPU, memory, and I/O systems.	MSE	20
CR	3	2. Interpret instruction set architectures, addressing modes, and execution flow, and compare RISC and CISC architectures.	ESE	60
		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.		

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:**	CA	20
PR	-	1. To explain basic concepts in statistics and probability. 2. To describe various probabilistic distributions.	MSE	20
CR	3	3. To apply regression and correlation techniques.	ESE	60

COURSE CONTENT

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

Text Books:

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

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

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

COURSE CONTENT

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

Text/Reference Books:

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

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

COURSE CONTENT

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

Teaching Scheme		Semester 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		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		CA	20
PR	-		MSE	20
CR	2		ESE	60

COURSE CONTENT

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

Text / Reference Books:

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

Teaching Scheme		Semester IV Modern Indian Languages (C) Sanskrit	Examination Scheme	
TH	2		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 Python Programming	Examination Scheme	
TH	1	**Course Objectives:** 1. Understand algorithms, data structures, and core programming concepts while setting up Python and running your first programs.Work with variables, operations, control flow, functions, strings, and file handling to create interactive and robust applications. 2. Apply object-oriented programming principles and efficiently use Python's built-in collections like lists, tuples, sets, and dictionaries. 3. Use SQLite and SQL queries to store, retrieve, and manage data, including practical projects like spidering Twitter and joining multiple tables.	CA	60
PR	2		MSE	-
CR	2		ESE	40

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, Statements, Expressions. Strings: String processing. Exception handling, Basic input/output, handling files.	02 Hrs
3	Class and Object, Data Structure: List, Tuple and Sequences, Set, Dictionaries.	04 Hrs
4	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.