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 Science and Engineering / Computer Technology / Computer Science and Engineering (Cyber Security) with branch codes 11242, 11245, 11251, 11260.

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 2024 - 2025)
First Semester

Course Category	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
BSC	24AF1000BS101	Engineering Mathematics - I	3	-	20	20	60	3
BSC	24AF1CHEBS102	Engineering Chemistry	3	-	20	20	60	3
BSC	24AF1CHEBS103L	Engineering Chemistry Lab	-	2	60	-	40*	1
ESC	24AF1EMES104	Engineering Mechanics	3	-	20	20	60	3
ESC	24AF1EMES105L	Engineering Mechanics Lab	-	2	60	-	40*	1
ESC	24AF1000ES106	Programming for Problem Solving	2	-	20	20	60	2
ESC	24AF1000ES107L	Programming for Problem Solving Lab	-	2	60	-	40*	1
VSEC	24AF1000VS108L	Workshop Practices	-	4	60	-	40*	2
AEC-01	24AF1000VS109	Communication Skills	2	-	20	20	60	2
AEC-01	24AF1000VS110L	Communication Skills Lab	-	2	60	-	40*	1
CC	24AF1000CC111	A. Yoga Education B. NSS-I C. NCC	1	2	60	-	40†	2
		Total	**14**	**14**	**460**	**100**	**540**	**21**

***Practical/Oral evaluation of 40 marks at the end of the semester.**
†Presentation/Oral evaluation of 40 marks at the end of the semester.

B.Tech in Computer Engineering and Allied Programs
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Second Semester

Course Category	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
BSC	24AF1000BS201	Engineering Mathematics - II	3	-	20	20	60	3
BSC	24AF2PHYBS202	Engineering Physics	3	-	20	20	60	3
BSC	24AF2PHYBS203L	Engineering Physics Lab	-	2	60	-	40*	1
ESC	24AF2EGRES204	Engineering Graphics	2	-	20	20	60	2
ESC	24AF2EGRES205L	Engineering Graphics Lab	-	2	60	-	40*	1
ESC	24AF1000ES206	Basic Electrical and Electronics Engineering	3	-	20	20	60	3
ESC	24AF1000ES207L	Basic Electrical and Electronics Engineering Lab	-	2	60	-	40*	1
ESC	24AF2CMEES208	Basic Civil and Mechanical Engineering	3	-	20	20	60	3
BSC	24AF1EEEES209	Energy and Environmental Engineering	2	-	20	20	60	AU
IKS	24AF1000IK210	IKS Bucket#	2	-	20	20	60	2
VSEC	24AF1000VS211	Design Thinking	2	-	20	20	60	2
CC	24AF1000CC212	A. Integrated Personality Development B. NSS-II C. Health and Wellness	1	2	60	-	40†	2
		Total	**21**	**08**	**510**	**100**	**540**	**23**

***Practical/Oral evaluation of 40 marks at the end of the semester.**
†Presentation/Oral evaluation of 40 marks at the end of the semester.
 # Refer to the University website for the subjects under IKS bucket

Note: Students can complete online courses of 40% of total credits through online platform NPTEL/SWAYAM/Sector Skill council of India and other online platforms identified by the University time to time. At least 80% contents of the NPTEL/SWAYAM/Sector Skill council of India course should match with syllabus contents of the subject prescribed by the university.

Exit Option I: After completion of first year in engineering
Qualifier for One Year UG Certificate
Students opting for this option, should undergo the well-defined training/internship of 4-6 weeks which is equivalent to 4 Credits (120hrs) in the appropriate /relevant industry or organization.

B.Tech in Computer Engineering and Allied Programs
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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
OE-I	25AF1XXXOEM305X	Any Course from OE Bucket	2	-	20	20	60	2
MDM	25AF1245MD306	Multi-Disciplinary Minor* Bucket **(For Examination Refer MDM Bucket)**	-	-	20	20	60	-
PCC4+	25AF1245PC307	Digital Electronics	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	3	-	20	20	60	3
PCC Lab	25AF1245PCL311	Object-Oriented Programming in Java Laboratory	-	2	60	-	40	1
PCC Lab	25AF1245PCL312	Digital Electronics Laboratory	-	2	60	-	40	1
		Total	**19**	**06**	**390**	**160**	**600**	**22**

Course Type and Acronyms used

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

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

*****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
PCC Lab	25AF1245PCL404	Python Programming	1	2	60	-	40	2
OE-II	25AF1XXXOEM405X	Any Course from OE Bucket List	2	-	20	20	60	2
MDM	25AF1245MD406	Multi-Disciplinary Minor* Bucket **(For Examination Refer MDM Bucket)**	-	-	20	20	60	-
VSEC	25AFCOIAE407	Constitution of India	2	-	50	-	-	Audit
VSEC	25AF1000VE308B	Life of Bharat Ratna Dr. Babasaheb Ambedkar	1	-	50	-	-	1
PCC Lab	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**	**340**	**120**	**440**	**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 Systems	3	-	20	20	60	3
PEC	26AF1245PE505	**Open Elective Bucket**	2	-	20	20	60	2
MDM	26AF1245MD506	**MDM Bucket***	-	-	20	20	60	-
OE-3	26AF1000OE507	**Program Elective** A. Computer Graphics B. Introduction to Quantum Technologies	3	-	20	20	60	3
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	26AF1245AE511	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	26AF1245PC601	Compiler Design	3	-	20	20	60	3
PCC	26AF1245PC602	Data Communication & Computer Networks	3	-	20	20	60	3
PCC	26AF1245PC603	Software Engineering (DevOps)	3	-	20	20	60	3
PEC	26AF1245PE604	**Program Elective:** A. Internet of Things B. Big Data Analytics C. Optimization Techniques	3	-	20	20	60	3
PEC	26AF1245PE605	**Program Elective:** A. Human Computer Interaction B. Deep Learning C. Information Security and Privacy	3	-	20	20	60	3
MDM	26AF1245MD606	**MDM Bucket**	-	-	20	20	60	-
PCC Lab	26AF1245PCL607	Computer Network Laboratory	-	2	60	-	40	1
PCC Lab	26AF1245PCL608	Full Stack Development	1	2	60	-	40	2
PCC Lab	26AF1245PCL609	Prompt Engineering	1	2	60	-	40	2
AEC	26AF1245AE610	Mini Project	-	2	60	-	40	1
		Total	**17**	**6**	**300**	**120**	**480**	**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 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. AI Ethics	2	-	20	20	60	2
PCC Lab	27AF1245PCL703	Distributed Computing Laboratory	-	2	60	-	40	1
Project	27AF1245P704	Project-Phase - I	-	4	60	-	40	2
Internship	27AF1245I705	Internship	-	24	60	-	40	12
MDM	27AF1245MD706	**MDM Bucket**	-	-	20	20	60	-
		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)
Eighth Semester

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC	27AF1245PC801	Artificial Intelligence	3	-	20	20	60	3
PCC	27AF1245PE802	**Program Elective** 1. Computer Vision 2. ICT for Sustainable Development 3. Edge AI	3	-	20	20	60	3
PEC	27AF1245PE803	**Program Elective** A. Blockchain Technology B. Virtual Reality C. AI Ethics	3	-	20	20	60	3
RM	27AF1245RM804	Research Methodology	3	2	40	-	60	4
PCC Lab	27AF1245PL805	Project Phase - II	-	4	40	-	60	2
MDM	27AF1245MD806	**MDM Bucket**	2	-	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	26AF1245MD506A	Operating Systems	3	2	20	20	60	4
V	26AF1245MD506B	Database Management System	3	2	20	20	60	4
V	26AF1245MD506C	Theory of Computation	3	-	20	20	60	3
VI	26AF1245MD606A	Software Engineering	3	-	20	20	60	3
VI	26AF1245MD606B	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:** 1. To acquaint the students with the fundamental principles of two-valued logic and various devices to implement logical operations on variables. 2. To lay the foundation for further studies in areas such as communication, VHDL, and computer. 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.	CA	20
PR	-		MSE	20
CR	2		ESE	60

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

COURSE CONTENT

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

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

COURSE CONTENT

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

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

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 का वैश्विक विस्तार और डिजिटल माध्यमों में हिंदी की उपस्थिति ▪ प्रशासन और संचार माध्यमों में हिंदी	02 Hrs
3	**हिंदी भाषा लेखन के नियम और व्याकरण** ▪ वणिमाला ▪ शब्द-भेद ▪ संधि ▪ वाक्य रचना ▪ वर्तनी ▪ उपसर्ग, प्रत्यय और शब्द निर्माण की प्रक्रिया ▪ विराम चिन्हों का प्रयोग ▪ पर्यायवाची शब्द ▪ विलोम शब्द.	02 Hrs
4	**लेखन कौशल** ▪ पत्र लेखन ▪ प्रतिवेदन (रिपोटि) लेखन ▪ विज्ञप्ति, नोटिस और परिपत्र लेखन निबंध लेखन ▪ सार लेखन.	02 Hrs
5	**अनुवाद (अंग्रेजी से हिंदी और हिंदी से अंग्रेजी)** अनुवाद : सिद्धांत और परंपरा, अनुवाद : क्षेत्र, प्रकार, पारिभाषीक शब्दावली, अंग्रेजी से हिंदी और हिंदी से अंग्रेजी अनुवाद	02 Hrs

Text / Reference Books:

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

Teaching Scheme		Semester IV Modern Indian Languages (C) Sanskrit	Examination Scheme	
TH	2		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.

Semester - V

Teaching Scheme		Semester V Machine Learning	Examination Scheme	
TH	3	**Course Objectives:** 1. Understand core concepts and types of machine learning. 2. Apply supervised learning algorithms and handle overfitting. 3. Implement neural networks and basic deep learning models. 4. Explore probabilistic models and learning theory. 5. Use clustering and recommendation techniques for data analysis.	CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation, Linear regression, Decision trees, over fitting, Instance based learning, Feature reduction, Collaborative filtering based recommendation.	06 Hrs
2	Probability and Bayes learning, Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.	06 Hrs
3	Perceptron, multilayer network, back propagation, introduction to deep neural network.	06 Hrs
4	Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.	06 Hrs
5	Clustering k-means, adaptive hierarchical clustering, Gaussian mixture model.	06 Hrs

Text / Reference Books:

1. Tom Mitchell, Machine Learning, First Edition, McGraw Hill, 1997.
2. Ethem Alpaydin, Introduction to Machine Learning, Prentice Hall India Learning Private Limited; 2nd edition, 2010.

Teaching Scheme		Semester V Theory of Computations	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Learn the fundamentals of finite automata and their applications.	MSE	20
CR	3	2. Understand regular expressions and grammars with their relation to automata.	ESE	60
		3. Analyze context-free grammars and their simplification techniques.		
		4. Study pushdown automata and context-free language recognition.		
		5. Explore Turing machines, undecidability, and the Chomsky hierarchy.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Finite Automata (FA):** Introduction, Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), language of a DFA. Nondeterministic Finite Automata (NFA)- Definition of NFA, language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Minimization of Deterministic Finite Automata, Finite automata with output (Moore and Mealy machines) and Inter conversion.	08 Hrs
2	**Regular Expressions (RE):** Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA‟s to Regular Expressions, Converting Regular Expressions to Automata, applications of Regular Expressions. **Regular Grammars:** Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Proving languages to be non-regular -Pumping lemma, applications, Closure properties of regular languages.	06 Hrs
3	**Context Free Grammar (CFG):** Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG‟s, Minimization of CFG‟s, CNF, GNF, Pumping Lemma for CFL‟s, Enumeration of Properties of CFL (Proof‟s omitted).	06 Hrs
4	**Pushdown Automata:** Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA. **Turing Machines (TM):** Formal definition and behaviour, Languages of a TM, TM as accepters and TM as a computer of integer functions, Types of TMs	08 Hrs
5	**Recursive And Recursively Enumerable Languages (REL):** Properties of recursive and recursively enumerable languages, Universal Turing machine, The Halting problem, Undecidable problems about TMs. Context sensitive language and linear bounded automata (LBA), Chomsky hierarchy, Decidability, Post's correspondence problem (PCP), undecidability of PCP.	06 Hrs

Text / Reference Books:

1. Hopcroft, Ullman, Motwani, Introduction to Automata Theory, Languages, and Computation, Addison Wesley Publication, 2nd Edition, 2001.
2. Daniel I. A. Cohen, Introduction to Computer Theory, Wiley Publication, 1st Edition, 1986.
3. John C. Martin, Introduction to Languages and Theory of Computation, McGraw-Hill Publication, 4th Edition, 2010.
4. Krithivasan Kamala, Introduction to Formal Languages, Automata Theory and Computation, Pearson Education, 1st Edition, 2009.
5. Papadimitriou, Lewis, Elements of the Theory of Computations, PHI Publication, 2nd Edition, 1997.
6. E. V. Krishnamurthy, Introductory Theory of Computer Science, Springer-Velang New York Inc., 1st Edition, 1985.

Teaching Scheme		Semester V Operating Systems	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Understand the structure, types, and components of operating systems, including system calls and virtual machines.	MSE	20
CR	3	2. Learn process management, CPU scheduling algorithms, and multithreading models.	ESE	60
		3. Analyze process synchronization, classical problems, and deadlock handling techniques.		
		4. Explore memory and virtual memory management, including paging and page replacement algorithms.		
		5. Study file systems, disk management, and mass-storage structures for efficient data handling.		

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.	08 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).	08 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),	06 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. Doeppner, Operating System in Depth: Design and Programming, Wiley Publication, 2011.

Teaching Scheme		Semester V Database Management Systems	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction:** Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management. **Database Architecture Data modeling using the Entity Relationship Model:** ER model concepts, notation for ER diagram, Constraints, keys, E-R Diagrams, Mapping Cardinality, Concepts of Super Key, candidate key, primary key, weak entity sets, Codd's rules, Extended ER model, Generalization, Aggregation, Reduction of an ER diagrams to tables.	08 Hrs
2	**Relational Data Model:** Structure of Relational Databases, Database Schema, Keys. **Relational algebra:** Fundamental Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations.	06 Hrs
3	**Calculus:** Tuple relational calculus, Domain relational Calculus, calculus vs. algebra, computational capabilities. **SQL:** Overview of SQL, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operators, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database.	08 Hrs
4	**Intermediate SQL:** Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schema, Authorization. **Advanced SQL:** Assessing SQL from Programming Language, JDBC, ODBC, Embedded SQL, Functions and Procedures, Triggers,.	06 Hrs
5	**Normalization:** Features of good relational designs, Functional dependencies, Normal forms, First, Second, Third normal forms, BCNF, Functional Dependency Theory, Multivalued Dependencies, Fourth Normal Form, Database Design Process.	06 Hrs

Text / Reference Books:

1. Henry Korth, Abraham Silberschatz & S. Sudarshan, Database System Concepts, McGraw-Hill Publication, 6th Edition, 2011.
2. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill Publication, 3rd Edition, 2003.
3. Joel Murach, Murach's Oracle SQL and PL/SQL for Developers, Mike Murach & Associates, 2nd Edition, 2014.
4. Wiederhold, Database Design, McGraw-Hill Publication, 2nd Edition, 1983.

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

Teaching Scheme		Semester V Computer Graphics	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Basic Concepts:** Introduction to computer graphics, lines, line segments, pixels and frame buffers, anti-aliasing techniques and character generation methods. Graphics Display devices (monochrome, color) interactive devices, Scanners and digitizers, touch panels, tablets, mouse, joysticks, trackball, light pen.	04 Hrs
2	**2D Transformation:** Line and circle plotting using Breshemham's and other algorithms, transformation matrices, scaling, rotation, translation, picture transformation, mirror image.	06 Hrs
3	**Window and Clipping:** Introduction, viewing transforms, 2-D clipping, Sutherland Cohen approach, Cyrus Beck Method, Midpoint subdivision algorithm, Liang-Barsky line clipping algorithm, polygon clipping, text clipping, generalized clipping.	06 Hrs
4	**3D Graphics:** Introduction, 3-D geometry, Coordination system, 3D transformation, rotation about an arbitrary axis, orthogonal projections, multiple views, isometric projection, perspective projections, 3-D clipping. **Hidden Surfaces and Lines:** Introduction, Back face removal algorithm, Z-buffers, Scan line and Painter's algorithm hidden surface removal, curved surface generation, generation of solids, sweep method, interpolation.	08 Hrs
5	**Graphical User Interface:** X-Windows, use of graphics tools like OPENGL, DirectX, Windows and Motif, Graphic Standards. **Animation:** Introduction, devices for producing animation, computer assisted animation, real time animation, method for controlling animation (fully explicit control, procedural). **Text / Reference Books:** 1. Peter Shirley, Michael Ashikhmin, Steve Marschner, Fundamental of Computer Graphics, 4th Edition, CRC Press. 2. Newman, Sprouall, Interactive Computer Graphics, McGraw-Hill Publication. 3. Hearn, Baker, Computer Graphics, PHI Publication. 4. Krishnamurthy, Introduction to Computer Graphics, McGraw-Hill Publication. 5. ISRD Group, Computer Graphics, McGraw-Hill Publication.	06 Hrs

Teaching Scheme		Semester V Introduction to Quantum Technologies	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Foundations of Quantum Technologies:** Introduction, Evolution from Classical to Quantum Technologies, Classical Physics versus Quantum Physics, Fundamental Concepts of Quantum Mechanics, Wave–Particle Duality, Quantum States, Superposition Concept, Quantum Measurement, Quantum Coherence and Decoherence, Overview of the First and Second Quantum Revolution, Applications of Quantum Technologies.	05 Hrs
2	**Quantum Materials and Quantum Hardware:** Introduction, Semiconductor Materials for Quantum Devices, Superconducting Materials, Quantum Dots, Color Centers in Diamond, Trapped Ion Systems, Neutral Atom Platforms, Photonic Systems, Cryogenic Systems for Quantum Devices, Fabrication of Quantum Hardware, Challenges in Building Quantum Systems.	05 Hrs
3	**Quantum Communication and Quantum Networks:** Introduction, Classical versus Quantum Communication, Quantum Entanglement Concepts, Quantum Key Distribution (QKD), Quantum Random Number Generation, Quantum Repeaters, Quantum Internet Fundamentals, Quantum Communication Protocols, Secure Communication Applications, Challenges in Quantum Networking.	05 Hrs
4	**Quantum Sensing:** Introduction, Principles of Quantum Sensing, Atomic Clocks, Magnetometers, Gravimeters, Quantum Imaging, Quantum Metrology, Applications in Healthcare, Navigation, Aerospace, Defence, Environmental Monitoring, Industrial Measurement Systems, Emerging Trends in Quantum Sensing.	05 Hrs
5	**Quantum Technology Ecosystem:** Global Quantum Technology Landscape, National Quantum Mission of India, Quantum Research Infrastructure, Quantum Standards and Ethics, Commercial Quantum Technologies, Quantum Startups and Industrial Adoption, Workforce Development in Quantum Technologies, Challenges in Quantum Technology Deployment, Future Trends in Quantum Engineering, Case Studies of Real-World Quantum Applications.	05 Hrs

Text / Reference Books:

1. Bernhardt, C. (2019). Quantum computing for everyone. MIT Press.
2. Auffèves, A. (2022). Quantum technologies: Concepts and applications. ISTE Press–Elsevier.
3. Fox, M. (2006). Quantum optics: An introduction. Oxford University Press.

4. Griffiths, D. J., & Schroeter, D. F. (2018). Introduction to quantum mechanics (3rd ed.). Cambridge University Press.
5. Pirandola, S., & Braunstein, S. L. (Eds.). (2020). Quantum communications and cryptography. CRC Press.
6. National Quantum Mission Secretariat. (2024). National Quantum Mission: Vision and implementation framework. Government of India.

Teaching Scheme		Semester V Machine Learning Laboratory	Examination Scheme	
TH	-		CA	60
PR	2		MSE	-
CR	1		ESE	40

List of Experiments:

1. Implement a toy classification problem using decision boundaries (manual coding). Apply train/test split and k-fold cross-validation to a dataset (e.g., Iris). Compare accuracy, precision, recall, F1-score.
2. Implement simple and multiple linear regression using NumPy and using scikit-learn. Plot regression lines and residuals. Compute RMSE and R^2 values.
3. Train a decision tree classifier and visualize the tree. Analyze performance with/without pruning and depth control. Demonstrate overfitting using synthetic data.
4. Implement and visualize k-Nearest Neighbors classification. Tune k and compare accuracy. Demonstrate curse of dimensionality.
5. Apply PCA and t-SNE for dimensionality reduction. Visualize high-dimensional data in 2D. Measure accuracy before and after feature reduction.
6. Implement a simple user-based and item-based collaborative filter. Use cosine similarity or Pearson correlation. Recommend top-N items for a user.
7. Implement Gaussian Naive Bayes manually and using scikit-learn. Classify spam/ham email or sentiment analysis.
8. Train logistic regression for binary classification. Visualize the sigmoid function and decision boundary. Analyze ROC curve and AUC.
9. Train a linear and kernel (RBF, polynomial) SVM. Visualize margins and support vectors. Tune C and gamma hyperparameters.
10. Implement a single-layer perceptron from scratch. Train a multilayer perceptron using scikit-learn / Keras. Compare performance with different activation functions.
11. Visualize layers, activations, and loss using Keras. Build a 2–3 layer DNN for digit classification.
12. Simulate sample complexity: How performance improves with increasing training size. Discuss PAC model using toy examples. Conceptual lab: VC Dimension estimation for linear classifiers.
13. Compare Bagging (Random Forest) vs Boosting (AdaBoost/XGBoost). Visualize feature importance.
14. Apply K-Means and visualize clusters. Use silhouette score and elbow method to tune K.
15. Fit a Gaussian Mixture Model (GMM) and visualize decision boundaries. Perform Agglomerative Clustering and plot dendrograms.

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

List of Experiments:

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

Teaching Scheme		Semester V Database Management System Laboratory	Examination Scheme	
TH	-		CA	60
PR	2		MSE	-
CR	1		ESE	40

List of Experiments:

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

Teaching Scheme		Semester V Seminar	Examination Scheme	
TH	-		CA	60
PR	2		MSE	-
CR	1		ESE	40

Guidelines for Seminar

The students shall study in group of two members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Computer Science Engineering, Artificial Intelligence, Data Science, or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher. The students shall prepare his report and deliver talk on the topic for other students of his class in the presence of his guide and internal examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

Continues Assessment: The Continues Assessment for this head will consists of the report written in a technical reporting manner and presentation of the talk on the subject and will be assessed by the internal examiner appointed by the Head of concern department of the institution.

Semester - VI

Teaching Scheme		Semester VI Compiler Design	Examination Scheme	
TH	3	**Course Objectives:** 1. Understand the phases of a compiler and tools used in compiler construction. 2. Learn lexical analysis techniques and design of lexical analyzers. 3. Explore syntax analysis methods including top-down, bottom-up, and LR parsing. 4. Apply syntax-directed translation for generating intermediate code and handling expressions. 5. Study code generation techniques, optimization, and runtime storage management.	CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Compiling:** Definition, analysis of the source program, the phases of a compiler, the grouping of phases, Compiler Construction tools, A simple one-pass compiler.	06 Hrs
2	**Lexical Analysis:** The role of the Lexical analyzer, Input buffering, Specification of Tokens, A Language for Specifying Lexical Analyzers, Design of a Lexical Analyzer generator.	06 Hrs
3	**Syntax Analysis:** The role of the Parser, Context-free grammars, Writing a Grammar, Top-Down Parsing, Bottom-Up Parsing, Operator-precedence Parsing, LR Parsers, Using Ambiguous Grammars, Parser Generators.	06 Hrs
4	**Syntax-Directed Translation:** Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S-Attributed definitions, Top-Down Translation, Bottom-Up Evaluation of Inherited attributes, Intermediate Languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, Back patching, Procedure Calls.	06 Hrs
5	**Code Generation:** Issues in the Design of a Code Generator, The target Machine, Run-Time Storage Management, Basic Blocks and Flow Graphs, Next-Use Information, Simple Code Generator, Register allocation and Assignment, The DAG Representation of Basic Blocks, Generating Code from DAGs, Dynamic Programming, Code-Generation Algorithm, Code-Generators. **Text / Reference Books:** 1. Aho, Sethi, Ullman, Compilers Principles, Techniques and Tools, Pearson Education India, 2nd Edition, 2013. 2. Hopcroft, Motwani and Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Publication, 2nd Edition, 2001.	06 Hrs

3. Dick Grune, Kees van Reeuwijk, Henri E. Bal, Ceriel J. H. Jacobs and Koen Langendoen, Modern Compiler Design, Springer, 2nd Edition, 2012.

Teaching Scheme		Semester VI Data Communication and Computer Networks	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Understand the fundamentals of computer networks, reference models, and performance metrics.	MSE	20
CR	3	2. Learn various LAN and wireless technologies including Ethernet, Wi-Fi, Bluetooth, and Wi-MAX.	ESE	60
		3. Explore data link layer design, error detection/correction, and flow control mechanisms.		
		4. Study network layer protocols, routing algorithms, congestion control, and QoS techniques.		
		5. Gain knowledge of application layer protocols and basic network security principles.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Physical Layer:** Data and Signals: Analog and digital data, Analog and digital signals, Periodic and non-periodic signals, Sine wave, Parameters of sine wave, Time and frequency domain, Composite signals, Bandwidth, Digital signal-bit rate, Baseband and broadband transmission, Transmission impairments, Nyquist bit rate, Shannon capacity, Performance: Throughput, Latency, Bandwidth-delay product, Jitter.	06 Hrs
2	**Error Detection and Correction:** Types of errors, Redundancy, Detection versus correction, Forward error correction and retransmission, Modular arithmetic, Block Coding: error detection, error correction, Hamming distance, Minimum hamming distance, Linear block codes, Cyclic Codes: Cyclic Redundancy check, Hardware implementation, Polynomials, Cyclic code analysis, Checksum: Concept, One's component, Internet checksum.	06 Hrs
3	**LAN Technologies:** X5, Frame relay, ATM, Ethernet (802.3), FDDI, Token Rings, Resilient Packet Rings, Wireless LANs: Wi-Fi (802.11), Cell Phone Technologies, Broadband Wireless: Wi-MAX (802.16), Bluetooth (802.15.1), RFID.	06 Hrs
4	**Data Link Layer:** Data Link Layer Design Issues: Service provided to network layer Framing, Error Control, Flow Control, Error Detection and Correction: error correcting codes, error detecting codes. **Network Layer and Congestion Control:** IPv4/IPv6, Routers and Routing Algorithms distance vector link state. TCP UDP and sockets, General principles, Congestion prevention policies, Load shading, Jitter control, Quality of service: Packet scheduling, Traffic shaping, integrated Services.	08 Hrs
5	**Application Layer Protocols:** DNS, SMTP, POP, FTP, HTTP. Network Security: Authentication, Basics of public key and private key cryptography, digital signatures and certificates, firewalls	06 Hrs

Text / Reference Books:

1. A. Tanenbaum, Computer Networks, PHI Publication, 5th Edition, 2011.
2. B. Forouzan, Data Communications and Networking, McGraw Hill Publication, 5th Edition, 2013.
3. Larry Peterson and Bruce Davie, Computer Networks: A Systems Approach, Morgan Kufman Publication, 5th Edition, 2012.
4. D. Comer, Computer Networks and Internet, Pearson Education, 6th Edition, 2014.
5. M. Gallo, W. Hancock, Computer Communications and Networking Technologies, Brooks/Cole Publisher, 2001.
6. Natalia Olifer, Victor Olifer, Computer Networks: Principles, Technologies and Protocols for Network Design, Wiley Publication, 2005.

Teaching Scheme		Semester VI Software Engineering (DevOps)	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**DevOps and Agile Software Engineering:** Software Engineering Evolution, Limitations of Traditional Software Development, Agile Development Principles, DevOps Philosophy, DevOps Lifecycle, Continuous Integration, Continuous Delivery, Continuous Deployment, Collaboration between Development and Operations Teams, DevOps Culture, DevOps Toolchain, Introduction to Version Control Systems, Git Fundamentals, Branching Strategies, DevOps Best Practices.	05 Hrs
2	**Source Code Management and Continuous Integration:** Git Repository Management, Distributed Version Control, GitHub and GitLab Platforms, Branching and Merging, Pull Requests, Code Reviews, Build Automation, Continuous Integration Concepts, CI Pipeline Design, Automated Build Process, Unit Testing in CI Pipelines, GitHub Actions, Jenkins Fundamentals, Build Failure Analysis.	06 Hrs
3	**Containerization and Infrastructure Automation:** Introduction to Virtualization and Containers, Docker Architecture, Docker Images, Containers and Volumes, Dockerfile, Docker Compose, Container Networking, Infrastructure as Code (IaC), Configuration Management Concepts, Ansible Fundamentals, Terraform Overview, Cloud-Native Applications, Container Security Best Practices.	06 Hrs
4	**Continuous Delivery and Cloud Deployment:** Continuous Delivery Workflow, Continuous Deployment Strategies, Deployment Automation, Blue-Green Deployment, Canary Deployment, Rolling Updates, Kubernetes Fundamentals, Pods, Services, Deployments, Helm Basics, Cloud Deployment Concepts, Application Scaling, High Availability, Release Management.	05 Hrs
5	**Monitoring, DevSecOps and Modern DevOps Practices:** Application Monitoring Concepts, Logging and Log Management, Performance Monitoring, Prometheus Fundamentals, Grafana Dashboards, Incident Management, DevSecOps Concepts, Secure Software Delivery Pipeline, Vulnerability Assessment, Secrets Management, Software Quality Metrics, Site Reliability Engineering (SRE) Overview, Emerging Trends in DevOps, AI-assisted DevOps (AIOps).	06 Hrs

Text / Reference Books:

1. Kim, G., Humble, J., Debois, P., & Willis, J. (2021). The DevOps handbook: How to create world-class agility, reliability, & security in technology organizations (2nd ed.). IT Revolution.
2. Forsgren, N., Humble, J., & Kim, G. (2018). Accelerate: The science of lean software and DevOps. IT Revolution.
3. Humble, J., & Farley, D. (2010). Continuous delivery: Reliable software releases through build, test, and deployment automation. Addison-Wesley Professional.
4. Burns, B., Beda, J., Hightower, K., & Evenson, L. (2022). Kubernetes: Up and running (3rd ed.). O'Reilly Media.
5. Turnbull, J. (2014). The Docker book: Containerization is the new virtualization. James Turnbull.
6. Morris, K. (2020). Infrastructure as code: Dynamic systems for the cloud age (2nd ed.). O'Reilly Media.

Teaching Scheme		Semester VI Internet of Things	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Understand the evolution, architecture, and challenges of IoT and its impact on digitization.	MSE	20
CR	3	2. Learn about smart objects, sensors, actuators, and IoT access technologies.	ESE	60
		3. Explore IP networking, transport layers, and application protocols optimized for IoT.		
		4. Apply data analytics, machine learning, and security principles in IoT environments.		
		5. Gain hands-on experience with IoT devices like Arduino and Raspberry Pi and study smart city applications.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**IoT Introduction:** Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.	06 Hrs
2	**Smart Objects:** The ―Things‖ in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.	06 Hrs
3	**IP Layer:** IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.	06 Hrs
4	**Data and Analytics for IoT:** An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of IoT Security, Common Challenges in IoT Security, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment.	08 Hrs
5	**IoT Physical Devices and Endpoints:** Building iot with Arduino: Arduino–Interfaces-Arduino IDE–Programming, RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Wireless Temperature Monitoring System Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.	06 Hrs

Text / Reference Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet Things‖, 1st Edition, Pearson Education.
2. Srinivasa K G, ―Internet of Things‖, CENGAGE Leaning India, 2017.
3. Vijay Madisetti and Arshdeep Bahga, ―Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.
4. Raj Kamal, ―Internet of Things: Architecture and Design Principles, 1st Edition, McGraw Hill Education, 2017.

Teaching Scheme		Semester VI Big Data Analytics	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Understand the fundamentals, challenges, and applications of Big Data and its enabling technologies.	MSE	20
CR	3	2. Learn Big Data platforms like Apache Spark, HDFS, MapReduce, and distributed consistency models.	ESE	60
		3. Explore real-time data processing using streaming platforms such as Spark Streaming and Kafka.		
		4. Apply Big Data machine learning techniques with tools like Mahout and Spark MLlib.		
		5. Gain hands-on knowledge of modern NoSQL databases with MongoDB and query design.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Big Data:** Why Big Data and Where did it come from?, Characteristics of Big, Challenges and applications of Big Data, Enabling Technologies for Big Data, Big Data Stack, Big Data distribution packages.	06 Hrs
2	**Big Data Platforms:** Overview of Apache Spark, HDFS, YARN, MapReduce, MapReduce Programming Model with Spark, MapReduce Example: Word Count, Page Rank etc, CAP Theorem, Eventual Consistency, Consistency Trade-O-s, ACID and BASE, Zookeeper and Paxos, Cassandra, Cassandra Internals, HBase, HBase Internals.	06 Hrs
3	**Big Data Streaming Platforms:** Big Data Streaming Platforms for Fast Data, Streaming Systems, Big Data Pipelines for Real-Time computing, Spark Streaming, Kafka, Streaming Ecosystem.	06 Hrs
4	**Big Data Applications:** Overview of Big Data Machine Learning, Mahout, Big Data Machine learning Algorithms in Mahout-kmeans, Naive Bayes etc. Machine learning with Spark, Machine Learning Algorithms in Spark, Spark MLlib, Deep Learning for Big Data, Graph Processing: Pregel, Giraph, Spark GraphX.	06 Hrs
5	**Database for the Modern Web:** Introduction to mongoDB key features, Core server tools, MongoDB through the JavaScript,, sshell, Creating and querying through Indexes, Document-oriented, principles of schema design, Constructing queries on databases, collections and documents, MongoDB query language.	06 Hrs

Text / Reference Books:

1. Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications‖, Wiley and SAS Business Series.
2. Rajkumar Buyya, Rodrigo N. Calheiros, Amir M Vahid Dastjerdi, Morgan Kaufmann, Big Data Principals and Paradiagram, Elsevier.
3. Kyle Banker, Peter Bakkum and Shaun Verch, ―MongoDB in Action, 2nd Edition Dream tech Press, ISBN: 978-9351199359.

4. Anand Rajaraman, Jeffrey D. Ullman, Mining of Massive Datasets, 3rd edition,Cambridge University Press.
5. Sima Acharya, Subhashini Chhellappan, BIG Data and Analytics, Willey publication, ISBN: 978-8126554782.

Teaching Scheme		Semester VI Optimization Techniques	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Preliminaries:** Proofs, Vector Spaces and Matrices, Linear Transformations, Eigenvalues and Eigenvectors, Orthogonal Projections, Quadratic Forms, Matrix Norms, Concepts from Geometry, Elements of Calculus.	06 Hrs
2	**Unconstrained Optimization:** Basics of Set Constrained and Unconstrained Optimization, One Dimensional Search Methods, Golden Section Search, Fibonacci Search, Newton's Method, Secant Method, Solving Ax = b	06 Hrs
3	**Linear Programming:** Introduction to Linear Programming, Simplex Method, Duality	06 Hrs
4	**Nonlinear Constrained Optimization:** Problems with Equality Constraints, Problems with Inequality Constraints, Karush Kuhn Tucker Condition, Convex Optimization Problems,	06 Hrs
5	**Algorithms for Constrained Optimization:** Projections, Project gradient methods, Penalty methods.	06 Hrs

Text / Reference Books:

1. An Introduction to Optimization, Edwin K.P. Chong, Stanislaw H. Zak, Wiley, 2017.
2. Convex Optimization, Stephen Boyd, LievenVandenberghe, 2004.
3. Modern Optimization with R (Use R), Paulo Cortez, Springer, 2014.

Teaching Scheme		Semester VI Human Computer Interaction	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction:** Course objective and overview, Historical evolution of the field, The Human, The Computer, The Interaction.	06 Hrs
2	**Design Processes:** Interaction Design basics, Concept of usability – definition and elaboration, HCI in the Soft- ware Process, Design Rules.	06 Hrs
3	**Implementation and Evaluation:** Implementation Support, Evaluation Techniques, Universal Design, Use Sup- port.	06 Hrs
4	**Models:** Cognitive Models, Socio – Organizational Issues and Stakeholders Requirements, Communication and Collaboration models. Theories: Task Analysis Dialog notations and Design Models of the system Modeling Rich Interactions.	06 Hrs
5	**Modern Systems:** Group ware, Ubiquitous Computing and Augmented Realities, Hypertext, Multimedia and World Wide Web.	06 Hrs

Text / Reference Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale; Human Computer Interaction‖, Pearson Education, 3rd Edition, 2003.
2. B. Shneiderman, Designing the User Interface, Addison-Wesley Publishing Company.
3. Jenny Preece, Helen Sharp, Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, Wiley Publication, 4th Edition, 2015.
4. Gerard Jounghyun Kim, Human–Computer Interaction: Fundamentals and Practice, CRC Press, 2015.
5. Jenifer Tidwell, Designing Interfaces, Patterns for Effective Interaction Design, O'Reilly Media, 2nd Edition, 2010.

Teaching Scheme		Semester VI Deep Learning	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	Traditional Machine Learning Basics: Linear Regression, Logistic, Regression, k Nearest Neighbors, Classifier with Probability Theory, Decision Trees, Random Forest, Support Vector Machine, Artificial Neural Network: Artificial Neuron, Perceptron, Stochastic Gradien Descent, and Back Propagation Neural Network, Neural Network Architecture, NN with One Hidden Layer, NN with One Hidden Layer and Multiple Outputs, Neura Network Hyper-parameters	06 Hrs
2	Deep Architecture: need, applications, Hyper-parameters in Deep Neural Networks (Encoding, Layers, Loss function, Learning Rate, Momentum and Optimization Regularization and dropout, Batch Norms) , vanishing gradient problem, and way to mitigate it. Convolution Neural Network: from Dense Layers to Convolutions, pooling layers CNN Architectures (AlexNet, VGG, NiN, GoogLeNet, ResNet, DensNet), Application in Image segmentation, Automated Object Detection models.	06 Hrs
3	Deep Sequence Models: Sequence Modeling Problems, Motivation and Applications, Traditional Models: Recurrent Neural Networks, Back-propagation through time; Modern Recurrent Neural Networks: Gated Recurrent Units, Lon Short Term Memory (LSTM), Deep Recurrent Neural Networks, automatic imag captioning, video to text with LSTM models.	06 Hrs
4	Deep Unsupervised Learning: Latent variable models, Autoencoders, Deep Generative Modeling: Variational Autoencoders, Generative Adversarial Networks (GANs), Recent Advance, Image generation with Generative adversarial networks, Advance Topic in Deep Learning: Transfer Learning: Need and motivation, Transfer Learning Process, Data Augmentation, Applications	06 Hrs
5	Responsible AI, MLOps and Industrial Applications: Explainable AI (XAI), Fairness and Bias in AI Systems, Responsible and Ethical AI, Model Evaluation Metrics, Model Deployment Strategies, MLOps Fundamentals, Cloud-Based AI Deployment, Monitoring and Maintenance of AI Systems, AI Agents and Tool Usage, Case Studies in Healthcare, Finance, Manufacturing, Smart Cities, and Autonomous Systems.	06 Hrs

Text / Reference Books:

1. Deep Learning, Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.

2. Machine Learning: An Algorithmic Perspective, Second Edition, Stephen Marsland, Chapman and Hall/CRC.
3. Dive into Deep Learning, Zhang, A., Lipton, Z. C., Li, M., & Smola, A. J. (2023). *Dive into deep learning*. Cambridge University Press.
4. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow Géron, A. (2022). *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow* (3rd ed.). O'Reilly Media.
5. Pattern Recognition and Machine Learning, Bishop, C. M. (2006). *Pattern recognition and machine learning*. Springer.
6. Machine Learning, Mitchell, T. M. (1997). *Machine learning*. McGraw-Hill.
7. Neural Networks and Deep Learning, Aggarwal, C. C. (2018). *Neural networks and deep learning: A textbook*. Springer.
8. Deep Learning with Python, Chollet, F. (2021). *Deep learning with Python* (2nd ed.). Manning Publications.

Teaching Scheme		Semester VI Information Security and Privacy	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	Information Security Introduction -- Defining and Understanding security through security models, Confidentiality, Integrity and Availability, formal description of security, Attacks and Defences, Threats, Vulnerabilities and Risk, Assurance, Prevention, Detection, Security Controls, Identification and Authentication. Authorization and Access Control, Access Control Models & Mechanisms and Multilevel Security, Auditing and Accountability.	06 Hrs
2	Computational Number Theory & Cryptography - Fermat's theorem, Euler's theorem, Euclid's algorithm, manually and computationally encrypt/decrypt, sign/verify signatures for small messages using RSA, Deffie-Hellman and DSA algorithms. Applied cryptography viz. Symmetric key Cryptography, asymmetric Cryptography and Digital Signatures, message authentication codes, hash functions and modes of cryptographic operations, Physical Security.	06 Hrs
3	Network Security – Network threats: eavesdropping, spoofing, modification, denial of service attacks o Introduction to network security techniques: firewalls, virtual private networks, intrusion detection. Different Network Security Protocols.	06 Hrs
4	Operating System Security & Trusted OS-- Memory, time, file, object protection requirements and techniques, Protection in contemporary operating systems, ACLs, DAC, MAC, RBAC, Identification and authentication, Identification goals, Authentication requirements, Human authentication, Machine authentication, OS Forensics. Assurance & Trust, Design principles, Evaluation criteria, Evaluation process.	06 Hrs
5	Application & Program Security– Flaws, Malicious code: viruses, Trojan horses, worms, Program flaws: buffer overflows, time-of-check to time-of-use flaws, incomplete mediation o Defenses, Software development controls, Testing techniques, Secure Coding, Distributed Systems Security.	06 Hrs

Text/Reference Books:

1. The Basics of Information Security by Jason Andress, Syngress Publication.
2. Security in Computing (3rd Edition) 3rd Edition by Charles P. Pfleeger (Author), Shari Lawrence Pfleeger (Author), PHI.
3. B. Tjaden Fundamentals of Secure Computer Systems Franklin Beedle & Associates 2003.

4. D. Russell & G.T. Gangemi, Sr, Computer Security Basics.
5. W. Stallings, Network Security Essentials. Prentice Hall, 2003.

Teaching Scheme		Semester VI Computer Network Laboratory	Examination Scheme	
TH	-		CA	60
PR	2		MSE	-
CR	1		ESE	40

List of Experiments:

1. Study of Analog and Digital Signals: Generate and analyze analog and digital signals.
2. Verification of Nyquist Bit Rate and Shannon Capacity.
3. Implementation of Hamming Code
4. Implementation of Cyclic Redundancy Check (CRC)
5. Implementation of Internet Checksum: Compute and verify Internet checksum using one's complement arithmetic. Analyze its role in error detection during data transmission.
6. Study of Framing and Flow Control Techniques: Implement byte stuffing and bit stuffing methods along with Stop-and-Wait ARQ. Analyze the efficiency of framing and flow control mechanisms.
7. Study of Ethernet and CSMA/CD: Capture and analyze Ethernet frames using a packet analyzer. Observe medium access control and collision handling in Ethernet networks.
8. Performance Analysis of Network Topologie
9. Wireless LAN Performance Analysis: Study how throughput and signal quality vary with distance between wireless nodes and the access point in an IEEE 802.11 network.
10. IPv4 and IPv6 Address Configuration
11. Simulation of IP Forwarding Across Routers: Configure routers and analyze packet forwarding between different networks. Observe routing table entries and packet paths.
12. Study of RIP and OSPF Routing Protocols: Configure RIP and OSPF and compare routing table formation, route convergence, and path selection mechanisms.
13. Implementation of Link State Routing Algorithm
14. Study of TCP Connection Establishment: Capture packets to observe TCP three-way handshake and connection termination. Analyze sequence numbers and acknowledgments.
15. TCP/UDP Socket Programming
16. File Transfer Using TCP/IP Sockets
17. Analysis of DNS and HTTP Protocols: Capture and analyze DNS queries and HTTP request-response messages using a network protocol analyzer.
18. Study of FTP, SMTP and POP Protocols
19. Implementation of Public Key Cryptography and Digital Signature
20. Firewall Configuration and Packet Filtering: Configure firewall rules to allow or block network traffic and analyze their impact on network security and accessibility.

Teaching Scheme		Semester VI Full Stack Development	Examination Scheme	
TH	1		CA	60
PR	2		MSE	-
CR	2		ESE	40

COURSE CONTENT

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

Text / Reference Books:

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

List of Practicals:

1. Design a Responsive Web Page using Bootstrap: Create a responsive webpage using Bootstrap containers, typography, tables, buttons, forms, and navigation components.
2. Develop a Multi-Column Layout using Bootstrap Grid System: Design a responsive web page using Bootstrap grid classes and demonstrate layout adaptation across different screen sizes.

3. Customize Web Pages using Bootstrap Themes and Components: Implement cards, alerts, modals, accordions, carousels, and Bootstrap themes to enhance user interface design.
4. JavaScript Basics and Type Conversion: Develop scripts demonstrating variables, operators, control statements, functions, and explicit/implicit type conversions.
5. JavaScript String Manipulation and Regular Expressions
6. Event-Driven Programming using JavaScript
7. JavaScript Error Handling and Hoisting:
8. DOM Manipulation using JavaScript
9. Implement jQuery Events and Effects
10. HTML and CSS Manipulation using jQuery
11. jQuery Traversing Techniques: Demonstrate parent, child, sibling, ancestor, and descendant traversal methods on a structured HTML document.
12. Asynchronous Data Retrieval using jQuery AJAX: Fetch and display data from a server asynchronously using AJAX methods such as load(), get(), and post().
13. Embedding PHP in HTML: Create dynamic web pages using PHP scripts embedded within HTML and display runtime-generated content.
14. Form Handling using PHP: Develop a form processing application that accepts user input, validates data, and displays the submitted information.
15. PHP Arrays and String Operations: Implement programs demonstrating indexed arrays, associative arrays, multidimensional arrays, string functions, and regular expressions.
16. PHP-MySQL Database Connectivity: Establish a connection between PHP and MySQL, perform CRUD operations, and display database records on a webpage.
17. Student Management System using PHP and MySQL: Develop a web application to add, update, delete, and search student records stored in a MySQL database.
18. Laravel Installation and Project Setup: Install Laravel, create a new project, understand project structure, and configure environment settings.
19. Form Handling and Validation in Laravel
20. Working with Controllers and Routes in Laravel: Create controllers, define routes, and handle requests and responses using MVC architecture.
21. Laravel Blade Templates with Bootstrap: Design reusable layouts using Blade templates and integrate Bootstrap components for responsive interfaces.
22. Database Migration and Eloquent ORM: Create database tables using migrations and perform CRUD operations using Laravel Eloquent models.
23. Laravel CRUD Application
24. Authentication and Session Management in Laravel: Implement user registration, login, logout, and session management features using Laravel authentication mechanisms.
25. Mini Project – Full Stack Laravel Application: Develop a complete web application integrating Bootstrap, JavaScript, jQuery, PHP, MySQL, and Laravel following the MVC design pattern.

Teaching Scheme		Semester VI Prompt Engineering	Examination Scheme	
TH	1		CA	60
PR	2		MSE	-
CR	2		ESE	40

COURSE CONTENT

Unit No.	Topic	Hours
1	Evolution of Natural Language Processing (NLP) to Large Language Models (LLMs). Anatomy of LLMs including tokens, embeddings, and context windows. Importance of prompt engineering and its role in improving model outputs. Applications of prompt engineering in AI and Machine Learning systems. Introduction to popular LLMs such as GPT, Claude, PaLM, Mistral, and related models. Comparison between prompt engineering and fine-tuning approaches.	02 Hrs
2	Concepts of Zero-Shot, One-Shot, and Few-Shot prompting. Instructional prompting techniques for task-specific outputs. Delimiting strategies for structuring prompts. Role-based prompting and persona assignment. Socratic prompting for guided reasoning and learning. Evaluation of prompts based on accuracy, relevance, hallucination, and safety. Prompt debugging and optimization techniques.	02 Hrs
3	Chain-of-Thought prompting for complex reasoning tasks. Self-Ask prompting for problem decomposition and multi-step reasoning. ReAct (Reason + Act) prompting for combining reasoning with action execution. Multimodal prompting using text and image inputs. Design of reusable prompt templates. Introduction to prompt engineering using Python APIs. Development of prompt-driven applications using LangChain and OpenAI SDK.	02 Hrs
4	Prompt design for coding assistance, code generation, and debugging. Development of conversational agents and dialogue systems. Educational prompting for tutoring, assessment, and content generation. Medical and healthcare prompting for information retrieval and analysis. Legal prompting for document understanding and compliance support. Data wrangling, analysis, and report generation using prompts. Prompting techniques for low-resource and regional languages.	02 Hrs
5	Understanding bias, toxicity, and misinformation in Large Language Model outputs. Identification and mitigation of hallucinations. Adversarial prompting and jailbreak attacks on language models. Safety best practices in prompt design and deployment. Evaluation of generated outputs using BLEU, ROUGE, BERTScore, and human evaluation methods. Introduction to function calling and tool use with LLMs. Retrieval-Augmented Generation (RAG) concepts and applications. Emerging trends and future directions in prompt engineering and generative AI systems.	02 Hrs

Text / Reference Books:

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

List of Practicals:

1. Exploration and comparison of responses generated by different LLMs.
2. Analysis of tokenization, embeddings, and context window limitations.
3. Design of Zero-Shot, One-Shot, and Few-Shot prompts.
4. Implementation of role-based and instructional prompting techniques.
5. Prompt evaluation and debugging exercises.
6. Application of Chain-of-Thought and Self-Ask prompting.
7. Development of ReAct-based reasoning workflows.
8. Multimodal prompting using text and image inputs.
9. Prompt template development using Python APIs.
10. Code generation and debugging using LLM prompts.
11. Conversational chatbot design using prompt engineering.
12. Data analysis and reporting using LLMs.
13. Evaluation of bias, toxicity, and hallucination in model outputs.
14. Adversarial prompting and jailbreak testing.
15. Development of a simple Retrieval-Augmented Generation (RAG) application.
16. Mini Project: Development of a domain-specific AI assistant using prompt engineering techniques.