Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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Revised Curriculum (As per NEP)
UNDER GRADUATE PROGRAMME
(B. Tech. Information Technology)

SECOND YEAR ENGINEERING

WITH EFFECT FROM THE ACADEMIC YEAR 2025-2026

Vision of University

"The University is committed to become a leading 'Center of Excellence' in the field of Engineering, Technology and Science as a seat of learning with a national character and international outlook."

Mission of University

"The University is committed to provide quality technical education, research and development services to meet the needs of industry, business, service sector and society, at large."

Vision of the Department

“To achieve excellence in teaching, learning and research to develop quality engineers to meet the current trends in the emerging world of Information Technology.”

Mission of the Department

M1: The department constantly aims at providing quality technical education.
M2: The department works in pace with modern scientific and technological development.
M3: The department strives to meet the needs of industry, business, the service sector and the society at large.”

Semester III

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
1	Engineering Mathematics III	24UD1000BS301	PCC	3	0	0	3	20	20	60	-	-	100
2	Computer Organization and Architecture	24UD1246PC302		3	0	0	3	20	20	60	-	-	100
3	Operating Systems	25UD1246PC303		3	0	0	3	20	20	60	-	-	100
4	Data Structures and Algorithms	25UD1246PC304		3	0	0	3	20	20	60	-	-	100
5	Open Electives		OE*	2	0	0	2	20	20	60	-	-	100
6	Multi-Disciplinary Minor		MD-M#	2	0	0	2	20	20	60	-	-	100
7	Universal Human Values -II	24UD1UHVVE307	VEC	3	0	0	3	20	20	60	-	-	100
8	Life of Chhatrapati Shivaji Maharaj	24UD1000VE308A	VEC	1	0	0	1	50	-	-	-	-	50
9	HSSM-I (Any One)		HSSM	2	0	0	2	20	20	60	-	-	100
	A. Organizational Behavior	24UD1246HM309A											
	B. Management Information System	24UD1246HM309B											
	C. Financial statement analysis and reporting - I	24UD1246HM309C											
10	Operating Systems Lab	25UD1246PCL310	PCC	0	0	2	1	-	-	-	60	40	100
11	Data Structures and Algorithms Lab	25UD1246PCL311	PCC	0	0	2	1	-	-	-	60	40	100
12	Community Engagement Project /Field Project	24UD1246CP312	CEP/FP	0	0	4	2	-	-	-	60	40	100
	Total			**22**	**0**	**8**	**26**	**210**	**160**	**480**	**180**	**120**	**1150**

*** Students will have to choose one of the courses from a bucket of "Open Electives" given in annexure-I. The updated list is provided at University website.**

 # 2 Credits based on the choice of MD-M from another department.

Semester IV

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	**Total**
1	Object Oriented Programming with Java	25UD1246PC401	PCC	3	0	0	3	20	20	60	-	-	100
2	Data Communication and Computer Networks	24UD1246PC402		3	0	0	3	20	20	60	-	-	100
3	Probability and Statistics	24UD1246PC403		3	0	0	3	20	20	60	-	-	100
4	Discrete Mathematics	25UD1246PC404		3	0	0	3	20	20	60	-	-	100
5	Open Electives		OE**	3	0	0	3	20	20	60	-	-	100
6	Multi-Disciplinary Minor		MD-M##	2	0	0	2	20	20	60	-	-	100
7	Constitution of India	24UD1COIVE407	VEC	2	0	0	AU	50	-	-	-	-	50
8	Life of Bharatratna Dr. Babasaheb Ambedkar	24UD1000VE408B	VEC	1	0	0	1	50	-	-	-	-	50
9	HSSM-II(Any One)		HSSM	2	0	0	2	20	20	60	-	-	100
	A. Entrepreneurship Essentials	24UD1246HM409A											
	B. Innovation, Business Models and Entrepreneurship	24UD1246HM409B											
	C. Financial statement analysis and reporting - II	24UD1246HM409C											
10	Modern Indian Language(Any One)		AEC	2	0	0	2	20	20	60	-	-	100
	Marathi	24UD1000AE410A											
	Hindi	24UD1000AE410B											
	Sanskrit	24UD1000AE410C											
11	Time series analysis using Python	24UD1246VSL411	VSEC	1	0	2	2	-	-	-	60	40	100
12	Object Oriented Programming with Java	25UD1246PCL412	PCC	0	0	2	1	-	-	-	60	40	100
	Total			**25**	**0**	**4**	**25**	**210**	**160**	**480**	**180**	**120**	**1100**

**** Students will have to choose one of the courses from a bucket of "Open Electives" given in annexure-I. The updated list is provided at University website.**

2 Credits based on the choice of MD-M from another department.

Abbreviations: Generic/ Open Electives: **OE**; Vocational Skill and Skill Enhancement Courses: **VSEC**; Vocational Skill Courses: **VSC**; Skill Enhancement Courses: **SEC**; Ability Enhancement Courses: **AEC**; Indian Knowledge System: **IKS**; Value Education Courses: **VEC**; OJT: On Job Training: Internship/ Apprenticeship; Field projects: **FP**; Community engagement project: **CEP**; Co-curricular Courses: **CC**; Research Methodology: **RM**; Research Project: **RP**, Liberal Learning Course: **Lib. Learn**, Courses on Humanities, Social Science, and Management: **HSSM**

Multidisciplinary Minor I [Semester III]

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
	Any One		MD-M	02	00	00	02	20	20	60	-	-	100
1	Computer Organization and Architecture	24UD1246MD306A											
2	Operating Systems	25UD1246MD306B											
3	Data Structures and Algorithms	25UD1246MD306C											

Multidisciplinary Minor II [Semester IV]

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
	Any One		MD-M	02	00	00	02	20	20	60	-	-	100
1	Object Oriented Programming with Java	25UD1246MD406A											
2	Data Communication and Computer Networks	24UD1246MD406B											
3	Probability and Statistics	24UD1246MD406C											
4	Discrete Mathematics	25UD1246MD406D											

B. Tech. IT (Honors) [Semester III]

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
	Any One		Honors	03	00	00	03	20	20	60	-	-	100
1	Microcontrollers and Applications	24UD1246HR301											
2	Principles of Programming Languages	24UD1246HR302											
3	Open Source Computing	24UD1246HR303											

B. Tech. IT (Honors) [Semester IV]

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
	Any One		Honors	03	00	00	03	20	20	60	-	-	100
1	Advanced Computer Architecture	24UD1246HR401											
2	Modern Algebra	24UD1246HR402											
3	Advanced Data Structures	24UD1246HR403											

B. Tech. IT (By Research) [Semester III]

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
	Any One												
1	Introduction to Research	24UD1246RS301	Research	03	00	00	03	20	20	60	-	-	100
2	Intellectual Property Rights	24UD1246RS302											

B. Tech. IT (By Research)[Semester IV]

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
	Any One												
1	Development Research Methods	24UD1246RS401	Research	03	00	00	03	20	20	60	-	-	100
2	Research ethics and Integrity	24UD1246RS402											

Course Title : Engineering Mathematics III	**Semester : III**
Prerequisite : Engineering Mathematics II	**L – T – P : 3-0-0**
Course Code : 24UD1000BS301	**Credits : 3**
Course Type :PCC	

Course Objective:

1. To provide in depth knowledge of complex numbers.
2. To find the solution of differential equations.
3. To find an in-depth knowledge of Fourier series analysis of periodic function

Course Outcomes:

After successful completion of this course the student will be able:

1. To develop an ability to use characteristics of complex numbers in problems pertaining to electric circuits.
2. To develop an acquaintance with the method of finding solutions of differential equations.
3. To develop an in-depth knowledge of vector differentiation and vector integration.
4. To develop Fourier series expansion of different periodic functions.

Course Contents:

UNIT I

Laplace Transform **[08 Hours]**

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 tn , 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.

UNIT II

Inverse Laplace Transform **[08 Hours]**

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.

UNIT III

Fourier Transform **[08 Hours]**

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.

UNIT IV

Partial Differential Equations and their Applications **[08 Hours]**

Formation of Partial differential equations by eliminating arbitrary constants and functions, Equations solvable by direct integration, Linear equations of first order (Lagrange's linear equations), Method of separation of variables – applications to find DR. flow equation , and one-dimensional wave equation.

UNIT V

Functions of Complex Variables **[07 Hours]**

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).

Textbooks:

1. B. S. Grewal, ***"Higher Engineering Mathematics"***, Khanna Publishers, New Delhi.
2. H. K. Das, Er. Rajnish Verma, ***"Higher Engineering Mathematics"***, S. Chand & CO. Pvt. Ltd., New Delhi.
3. Dr. B. B. Singh, ***"A course in Engineering Mathematics (Volume-III)"***, Synergy Knowledge ware, Mumbai.
4. B. V. Ramana, ***"Higher Engineering Mathematics"***, Tata McGraw-Hill Publications, New Delhi.

Reference books:

1. Erwin Kreyszig, ***"Advanced Engineering Mathematics"***, John Wiley & Sons, New York.
2. Peter O' Neil, ***"A TextBook of Engineering Mathematics"***, Thomson Asia Pvt. Ltd., Singapore.
3. C. R. Wylie, L. C. Barrett, ***"Advanced Engineering Mathematics"***, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. C. R. Wylie , L. C. Barrett, ***"Integral Transforms and their Engineering Applications"***, Synergy Knowledge ware, Mumbai.
5. I. N. Sneddon, ***"Integral Transforms"***, Tata McGraw-Hill, New York.

Course Title : Computer Organization and Architecture	**Semester : III**
Prerequisite : Nil	**L – T – P : 3-0-0**
Course Code : 24UD1246PC302	**Credits : 3**
Course Type :PCC	

Course Objective:

1. To understand the structure, functions and characteristics of computer systems.
2. To understand how arithmetic operations are carried out.
3. To study hierarchical memory systems including cache memory and virtual memory.
4. To understand the structure and functions of the control unit.
5. To identify input / output devices and their data transfer mechanisms.

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand the design of the functional units of a digital computer system.
2. To manipulate representations of numbers stored in digital computers.
3. To understand the basics of memory systems, cache and virtual memories.
4. To apply the knowledge of micro-operations to design modules of control units.
5. To understand different ways of communication with I/O devices.

Course Contents:

UNIT I

Introduction **[08 Hours]**

Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function.

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.

UNIT II

Computer Arithmetic **[08 Hours]**

The arithmetic and logic unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.

UNIT III

Memory Organization **[08 Hours]**

Memory Hierarchy, Cache memory (Principles, Mapping techniques and Performance), Main Memory, (RAM, ROM, Memory Expansion), Virtual Memory

External Memory: Organization and characteristics of magnetic disk, Magnetic tape, Optical memory, RAID.

UNIT IV

Control Unit **[08 Hours]**

Control unit operation: Micro-operations, Control of the processor, Control Unit Fundamentals, Control Unit designs, Applications of micro-programming.

UNIT V

Input/ Output Organization **[07 Hours]**

I/O Devices and Modules, Methods of I/O: Programmed I/O, Interrupt driven I/O, Direct memory access. Parallel processing: Multiple processor organization, Symmetric multiprocessor, Cache

coherence and the MESI protocol.

Textbooks:

1. William Stalling, "***Computer Organization and Architecture: Designing for Performance***", Prentice Hall Publication, 8th edition, 2009.
2. Hayes, "***Computer Architecture and Organization***", McGraw-Hill Publication, 3rd edition, 2012.
3. Zaky, "***Computer Organization***", McGraw-Hill Publication, 5th edition, 2011.

Reference books:

1. Morgan, Hennessy, Patterson, "***Computer Architecture: A Quantitative Approach***", Kaufman Publication, 4th edition, 2007.
2. Morris Mano, "***Computer System Architecture***", Pearson Education India, 3rd edition, 2007.
3. Mostafa Abd-El-Barr, Hesham El-Rewini, "***Fundamentals of Computer Organization and Architecture***", Wiley Publication, 1st edition, 2004.
4. Miles J. Murdocca, Vincent P. Heuring, "***Computer Architecture and Organization: An Integrated Approach***", Wiley Publication, 1st edition, 2007.

Course Title : Operating Systems	**Semester : III**
Course Code : 25UD1246PC303	**L – T – P : 3-0-0**
Prerequisite : Nil	**Credits : 3**
Course Type: PCC	

Course Objective:

1. To study the basic concepts and functions of operating systems.
2. To learn about Processes, Threads and Scheduling algorithms.
3. To understand the principles of Concurrency.
4. To understand the principles of Deadlocks.
5. To study File systems.

Course Outcomes:

After successful completion of this course the student will be able:

1. Describe the structure, components, types, and services of operating systems, including system calls and system programs.
2. Understand and apply various process scheduling algorithms, concurrency and synchronization techniques.
3. Understand and apply methods to handle deadlocks, including prevention, avoidance, detection, and recovery techniques.
4. Explain memory management techniques including paging, segmentation, and virtual memory and evaluate page replacement algorithms.
5. Discuss file system architecture.

Course Contents:

UNIT I

Operating System Structures **[08 Hours]**

Operating System Structures: Definition, Types of operating system, Batch, Time sharing, Distributed, Real time, Network OS, Mobile OS, System components, OS structures, Monolithic, Microkernel, layered, Modular, Virtual Machine, System services, Systems calls, System programs, System structures.

UNIT II

Processes and CPU scheduling **[08 Hours]**

Process concept, Process scheduling, Operation on a process, Cooperating processes, Threads, Intercrosses communication, Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Scheduling algorithms and performance evaluation.

Process Synchronization: The critical-section problem, Critical regions, Synchronization hardware, Semaphores, Classical problems of synchronization, Monitors.

UNIT III

Deadlocks: **[08 Hours]**

Systems model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock, combined approach to deadlock handling.

UNIT IV

Memory Management and Virtual Memory: **[08 Hours]**

Logical versus physical address space, Swapping, Contiguous allocation, Paging, Segmentation with paging, Demand paging, Page replacement algorithms, Thrashing.

UNIT V

File Management and Security **[06 Hours]**

Introduction to file system, file access control models, Encryption for file security, Security policies in OS, security auditing and logging, OS hardening techniques.

Textbooks:

1. A. Silberschatz, P. Galvin, "***Operating System Concepts***", Wiley Publication, 10th Edition, 2018.
2. A. S. Tanenbaum, H. Bos, "***Modern Operating Systems***", Pearson Education, 5th Edition, 2022.

Reference books:

1. D.M. Dhamdhere,"***Systems Programming and Operating Systems***", Tata McGraw Hill Publication, 2nd Edition, 2001.
2. G. Nutt, "***Operating Systems Concepts***", Addison Wesley Publication, 3rd Edition.
3. H. M. Deitel, "***An Introduction to Operating Systems***", Pearson education Publication, 3rd Edition, 2007.

Course Title : Data Structures and Algorithms	**Semester : III**
Course Code : 25UD1246PC304	**L – T – P : 3-0-0**
Prerequisite : Programming in C	**Credits : 3**
Course Type :PCC	

Course Objective:

1. Understand foundational concepts of data structures and algorithms design for solving computational problems efficiently.
2. Analyze the complexity of algorithms using asymptotic notations and recurrence relations.
3. Explore linear and nonlinear data structures, including linked lists, stacks, queues, trees, and graphs.
4. Implement and apply classic algorithmic paradigms such as Divide & Conquer, Greedy, and Dynamic Programming to real-world problems.
5. Develop problem-solving skills by designing algorithms and selecting appropriate data structures based on application requirements.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Explain the need for data structures and evaluate the efficiency of algorithms using time and space complexity analysis.
2. Implement and perform operations on fundamental data structures such as linked lists, stacks, and queues.
3. Apply tree and graph data structures for efficient information representation and traversal in computational problems.
4. Design and analyze algorithms using Divide and Conquer, Greedy, and Dynamic Programming techniques.
5. Solve real-life optimization and path-finding problems using algorithmic strategies like Dijkstra's, Kruskal's, and Floyd-Warshall algorithms.

Course Contents:

UNIT I

[08 Hours]

Introduction to Data Structures and Algorithms: Need of data structures, Types of data structures, Algorithm basics, Characteristics and classification of algorithms, Mathematical Foundations: Growth of functions, Asymptotic notations (Big O, Ω, Θ), Recurrence relations, Performance Analysis: Time and space complexity, best/average/worst-case analysis.

UNIT II

[08 Hours]

Linked list: Implementation of linked list, Operation on linked list, Doubly linked list, Circular linked list, Stack and Queue: Stack representation, Stack operations, Queue representation, Queue operations, Linked Stacks and Queues.

UNIT III

[08 Hours]

Binary Tree: Basic concepts of trees, Representation of binary tree, Binary tree traversals, Binary search tree, Graphs: Basics concepts of graphs, Representation of graphs, Graph traversals; BFS and DFS, Minimum spanning trees (Kruskal and Prim's algorithms).

UNIT IV

[08 Hours]

Divide and Conquer Technique: Binary Search, Merge Sort, Quick Sort, Strassen's matrix multiplication,

Finding maximum and minimum.
Greedy Algorithms: Concepts and strategy, Fractional knapsack, Job sequencing with deadlines, Optimal merge pattern, Dijkstra's algorithm.

UNIT V

[08 Hours]

Dynamic Programming: Principle, Multistage graphs, All pairs shortest paths, Travelling salesman problem.

Textbooks:

1. E. Horowitz, D. Mehta, S. Sahni, "Fundamentals of Data Structure in C++", Silicon Press, 2nd edition, 2008.
2. E. Horowitz, S. Sahni and S. Rajsekaran, "Fundamentals of Computer Algorithms", Universities Press (India), 2nd edition, 2018.
3. Thomas Cormen, Charles Leiserson, Ronald Rivest and Cliford Stein, "Introduction to Algorithms", MIT Press, 4th edition, 2022.

Reference books:

1. Semour Lipschutz, "Data Structures with C', Tata McGraw-Hill, 1st edition, 2010.
2. S. Sridhar, "Design and Analysis of Algorithms", Oxford University Press, 2nd edition, 2023.
3. Robert Sedgewick, Kevin Wayne, "Algorithms", Addison-Wesley, 4th edition, 2021.
4. Anany Levitin "Introduction to Design and Analysis of Algorithms", Pearson, 3rd edition, 2021.

Course Title : Universal Human Values- II **Semester : III**
Course Code : 24UD1UHVVE307 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type : VEC

Course Objective:

1. To understand the harmony between the self and the body and learn programs to ensure self-regulation and health. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value based living in a natural way
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

Course Outcomes:

After successful completion of this course the student will be able:

1. To articulate the concepts of continuous happiness and prosperity.
2. To understand how to achieve harmony between the self and the body and learn methods for self-regulation and health maintenance.
3. To understand the role of the family in human interaction and societal harmony.
4. To comprehend the harmony in nature and the interconnectedness of its elements.
5. To gain competence in professional ethics and holistic management practices.

Course Contents:

UNIT I

Introduction to Value Education **[05 Hours]**

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.

UNIT II

Harmony in the Human Being **[05 Hours]**

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.

UNIT III

Harmony in the Family and Society **[05 Hours]**

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.

UNIT IV

Harmony in the Nature (Existence) **[05 Hours]**

Understanding Harmony in Nature - Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature - Realizing Existence as Coexistence at All Levels - The Holistic Perception of Harmony in Existence.

UNIT V

Implications of the Holistic Understanding – a Look at Professional Ethics **[06 Hours]**

Natural Acceptance of Human Values - Definitiveness of (Ethical) Human Conduct - A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models-Typical Case Studies - Strategies for Transition towards Value-based Life and Profession.

Textbooks:

1. R R Gaur, R Asthana, G P Bagaria, ***"A Foundation Course in Human Values and Professional Ethics"***, 2nd Revised edition, Excel Books, New Delhi, 2019, ISBN 978-93-87034-47-1.
2. A Nagaraj, ***Jeevan Vidya: Ek Parichaya",*** Jeevan Vidya Prakashan, Amarkantak, 1999.

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)

Course Title : Life of Chhatrapati Shivaji Maharaj **Semester : III**
Course Code : 24UD1000VE308A **L – T – P : 0-0-1**
Prerequisite :NIL **Credits : 1**
Course Type : VEC

Course Objective:

1. Analyze Chhatrapati Shivaji Maharaj's leadership qualities, strategic thinking, and management skills.
2. Develop critical thinking and problem-solving skills through case studies and discussions.
3. Recognize the relevance of the Chhatrapati's principles and values in modern times.

Course Outcomes:

After successful completion of this course the student will be able:

1. Explain Chhatrapati Shivaji Maharaj's military strategies, conquests, and establishment of the Maratha Empire.
2. Evaluate the Chhatrapati's leadership qualities, such as courage, vision, human values and adaptability.
3. Apply the Chhatrapati's principles, such as decentralization and social welfare, to modern engineering challenges.

Course Contents:

UNIT I

Shivaji Maharaj as a Great Conqueror **[05 Hours]**

Master Strategist and innovator in Military Tactics, Guerrilla Warfare (Ganimi Kava), Fortress Strategy, Avoidance of Direct Confrontation, Diplomacy and Alliances, Naval Power.

UNIT II

Shivaji Maharaj's Management and leadership strategies: **[05 Hours]**

Architecture and metallurgy of Raigad Fort, Use of Light Cavalry, Intelligence Network, Asymmetric Warfare, Logistics and Supply Chains, Fortifications and Military Architecture.

UNIT III

Shivaji Maharaj's views on Democracy and Nationalism: **[05 Hours]**

Shivaji Maharaj's views about Women's rights, their dignity and religious views, His views on Democracy & Nationalism

Textbooks:

1. Desai, Ranjit, "***Shriman Yogi"***, Mehta Publishing House, 2018.
2. Kurundkar, Narhar, "***Chatrapati Shivaji Maharaj Jeevan Rahasya"***, Deshamukh and Company, 2024.
3. ***"Sarkar,Jadunath, Shivaji and His Times by Jadunath Sarkar, Classic Book on the Life and History of the Maratha Emperor"***, Nandy Books, 2024.

Reference books:

1. Keluskar, Krushnaji Arjun, ***"Chhatrapati Shivaji Maharaj"***, SudhirPrakashan, 2020.
2. Bedekar, Ninad, ***"Kalatil Vyavsthapan Tatve"*** , 2015.

Course Title : Organizational Behavior	**Semester : III**
Course Code : 24UD1246HM309A	**L – T – P : 2-0-0**
Prerequisite : Nil	**Credits : 2**
Course Type : HSSM	

Course Objective:

1. To provide a comprehensive understanding of organizational behavior and its role in enhancing management practices.
2. To understand emotional labor, affective events theory, emotional intelligence, and emotion regulation, and their significance in the workplace.
3. To explore biographical and other differentiating characteristics that influence diversity.
4. To assess group properties and decision-making processes to create effective teams.
5. To evaluate various leadership theories, including trait and behavioral theories.

Course Outcomes:

After successful completion of this course the student will be able:

1. To analyze the fundamental concepts of organizational behavior and its importance in management.
2. To evaluate the concepts of emotional labor, affective events theory, emotional intelligence, and emotion regulation.
3. To define diversity and discrimination and discuss their implications in the workplace.
4. To analyze the different directions, modes, and choices of communication within organizations.
5. To differentiate between groups and teams and describe the stages of group development and evaluate various leadership theories, including trait and behavioral theories.

Course Contents:

UNIT I

Introduction to Organizational Behavior **[05 Hours]**

Management and organizational behavior, Complementing intuition with systematic study, Disciplines and opportunities for OB, Developing an OB Model. Attitudes: Job Attitudes, Measuring job satisfaction, What causes job satisfaction, Outcomes of job satisfaction, Emotions and mood

UNIT II

Personality and values **[05 Hours]**

Personality, Personality frameworks, Other personality attributes relevant to OB, Personality and situation, Values, Linking an individual's personality and values to the workplace, Cultural values. Perception: Making judgments about others, the link between perception and individual decision making, Decision making in organizations, Influences on decision making, Creativity model.

UNIT III

Diversity **[05 Hours]**

Diversity in organizations: Diversity, Discrimination, Biographical characteristics, other differentiating characteristics, Ability, Implementing diverging management strategies. Motivation: Early and contemporary theories of Motivation. Motivating by job design: the Job Characteristic Model (JCM)

UNIT IV

Communication **[05 Hours]**

Direction of communication, Modes of communication, Choice of communication, Persuasive communication, Barriers to effective communication. Foundation of group behavior: Group and group

identity, Stages of group development, Group properties, Group decision making.

UNIT V

From Groups to teams **[06 Hours]**

Group, differences between group and teams, Types of teams, Creating effective teams, Turning individuals into team players.

Textbooks:

1. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, "***Organizational Behavior***", Pearson Publication, 18th edition, 2018.
2. Uma Sekaran, "***Organizational Behavior***", McGraw Hill Company, New Delhi, 2011.

Reference books:

1. Fred Luthans, "***Organizational Behavior***", McGraw Hill International edition, 11th edition.
2. S. S. Khanka, "***Organizational Behavior***", S. Chand and Co. Ltd, New Delhi, 2008.

Course Title : Management Information System **Semester : III**
Course Code : 24UD1246HM309B **L – T – P : 2-0-0**
Prerequisite : Nil **Credits : 2**
Course Type : HSSM

Course Objective:

1. To familiarize students with the various types of information systems (e.g., TPS, MIS, DSS, ESS) and their applications in organizational settings.
2. To analyze how information is presented and processed, and how decision-making is influenced by biases and errors.
3. To understand the role of office automation, executive support systems, and critical success factors in enhancing management efficiency.
4. To study the application of AI, expert systems, neural networks, fuzzy logic, and intelligent agents in knowledge management.
5. To equip students with the skills needed to analyze and design systems using tools such as Data Flow Diagrams (DFDs), decision trees.

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand and explain the fundamental concepts of information systems and their importance in modern organizations.
2. To critically analyze how information is presented and processed within organizations, recognizing potential biases and errors in decision-making.
3. To evaluate the impact of information systems on management processes and demonstrate an understanding of office automation and executive support systems.
4. To understand knowledge management, including the role of AI and other technologies in enhancing organizational learning and decision-making.
5. To acquire practical skills in decision analysis and system design, including the use of DFDs, decision trees.

Course Contents:

UNIT I

Introduction **[05 Hours]**

Overview of Information Systems, Changing Business Requirements, Design and Use of Information Systems, Structure of Information Systems & Introduction to the MIS Triangle, Data and Information Processing, Feedback, and Information Flows, Organization charts, Types of IS, Application s/w, Overview of Various Information Systems.

UNIT II

Concept of Information **[05 Hours]**

Relationship between Organizations and Information Technology, Challenges faced by Information Systems, Information Presentation techniques, Case study on Information Content, Discussion on discretion in information content, Exploring Decision Maker Bias and Error Causes, Overview of the Decision-Making Process.

UNIT III

Impact of IS on Management **[05 Hours]**

Understanding the Infosphere, Role of Office Automation in Management, Introduction to Executive Support Systems, Critical Success Factors in IS, Humans as Information Processors, Exploring Concreteness in Information Systems.

UNIT IV

Knowledge Management **[05 Hours]**

Hardware and software overview, software concepts, GUI, Understanding the Hierarchy of Knowledge, Types and Value of Knowledge, Organizational, Learning and Knowledge Work Systems, Introduction to Artificial Intelligence (AI) and Expert Systems (ES) Neural Network. Team Learning, System thinking, Seven models

UNIT V

Decision Analysis **[06 Hours]**

Introduction to Data Flow Diagrams (DFDs), Decision tables, Decision Trees, K map, minimal forms.

Textbooks:

1. Kenneth C. Laudon & Jane P. Laudon, ***"Management Information Systems"***, Pearson Publishing.
2. Gabriele Piccoli**, "*Information Systems for Managers: Text and Cases".***

Reference books:

1. JIrma Becerra-Fernandez and Rajiv Sabherwal, ***"Knowledge Management: An Evolutionary View"***.
2. Alan Dennis, Barbara Haley Wixom, and Roberta M. Roth, ***"Systems Analysis and Design"***.

Course Title : Financial statement analysis and reporting - I **Semester: III**
Course Code : 24UD1246HM309C **L – T – P : 2-0-0**
Prerequisite : Nil **Credits : 2**
Course Type : HSSM

Course Objective:

1. Gain insights into the structure and dynamics of the Indian economy, various industries, and forms of business organizations.
2. Learn the nature, objectives, and limitations of financial statements, and understand the needs of various stakeholders.
3. Acquire skills in using various tools and techniques for financial statement analysis, including ratio analysis, comparative and common size statements, and Du-Pont analysis.
4. Develop the ability to prepare and interpret financial statement analysis reports, understand business combinations, and consolidated financial statements.
5. Learn about reporting regulations in India for various business organizations including sole proprietorships, partnerships, private companies, and public/government companies.

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand the definition of Accounting, comprehend the Scope and function of Accounting.
2. To define and explain sources of income such as net profit, revenue.
3. To understand cash, receivable and inventory accounting.
4. To have a clear understanding of the fixed asset and depreciation.
5. To learn about business investments & liabilities.

Course Contents:

UNIT I

Accounting Model **[06 Hours]**

Understanding Business Organizations, What is Accounting, Users of Accounting Information, Financial and Management Accounting, Accounting Measurement Assumptions, Generally Accepted Accounting Principles and the Accounting Environment, Forms of Business Organization, Accounting, Capital Market, and Corporate Governance, The Accounting Equation, Financial Statements, Fraud and Ethical Issues in Accounting, Accounts, Commonly Used Accounts, The Double-entry System: The Basis of Modern Accounting, Recording Transactions, Trial Balance.

UNIT II

Measuring Income **[06 Hours]**

Income Measurement, Accrual Accounting, The Adjustment Process: Converting Cash into Accrual, Adjusting Entries, Worksheet: The Accountant's Invaluable Tool, Using the Worksheet, Overview of the Accounting Cycle, Closing Entries, Post-closing Trial Balance, Reversing Entries, Pro Forma Financial Measures, Revenue from Sales, Cost of Goods Sold, Operating Expenses.

UNIT III

Cash, Receivables & Inventories **[06 Hours]**

Internal Control Systems, Internal Control for Cash, Cash and Cash Equivalents, Bank Reconciliation, Trade Receivables, Bills Receivable, Revenue from Construction Contracts, Franchises, and Leases, Pledging, Assignment, and Factoring, Financial Analysis of Receivables Current Assets, Inventory Valuation and Income Measurement, Determining the Physical Inventory, Inventory Costs, Cost Formulas, Inventory Valuation, Conservatism, Neutrality, and Prudence, Comparability, Estimating

Inventory Value, Perpetual Inventory System, Manufacturing Costs, Financial Analysis of Inventories, Managing the Operating Cycle.

UNIT IV

Fixed Assets **[06 Hours]**

Fixed Assets in Perspective, Property, Plant and Equipment, Cost of Acquisition, Depreciation Depreciation Methods, Capital and Revenue Expenditures, Depreciation for Income Tax Purposes, Disposal of Depreciable Assets, Myths About Depreciation, Revaluation of Property, Plant and Equipment, Intangible Assets, Natural Resources, Impairment of Assets, Financial Analysis of Fixed Assets.

UNIT V

Investments & Liabilities **[06 Hours]**

Investments in Perspective, Financial Instruments and Financial Assets, Equity and Debt Instruments, Impairment of Financial Assets, Equity Investments for Business Purposes, Subsidiaries, Consolidated Financial Statements, Business Combination, Joint Ventures, Associates, Investments in Separate Financial Statements, Investment Property. Liabilities in Perspective, Classification of Liabilities, Current Liabilities, Contingent Liabilities, Long-term Liabilities, Income Taxes, Off-balance Sheet Financing.

Textbooks:

1. Gupta Ambrish,Narayanaswamy R, "***Financial Accounting for Management - An Analytical Perspective***", 4th edition, Pearson Education, 2012.
2. Subramanyam, K. R. and John, J.W, "***Financial Accounting – A Managerial Perspective***", 5th edition , Prentice Hall of India, 2015.
3. Penman, S.H, "***Financial Statement Analysis"***,12th edition, Tata McGraw Hill, 2014

Reference books:

1. Erich A. H, "***Financial Statement Analysis and Security Valuation***", 4th edition, Tata McGraw Hill. 2014.
2. Erich A. Helfert, "***Techniques of Financial Analysis: A Guide to Value Creation***", 16th edition , Tata McGraw Hill, 2014.

Course Title : Operating Systems Lab | **Semester : III**
Course Code : 25UD1246PCL310 | **L – T – P : 0-0-2**
Prerequisite : Nil | **Credits : 1**
Course Type : PCC

List of Experiments:

1. Basics of UNIX commands.
2. Shell Programming.
3. Implement the following CPU scheduling algorithms: Round Robin, SJF, FCFS, Priority scheduling.
4. Implement all file allocation strategies: Sequential, Indexed Linked.
5. Implement Semaphores.
6. Implement all File Organization Techniques.
7. Implement Bankers Algorithm for Dead Lock Avoidance.
8. Implement an Algorithm for Dead Lock Detection.
9. Implement all page replacement algorithms: FIFO, LRU, LFU.
10. Implement Shared memory and IPC.
11. Implement Paging Technique of memory management.
12. Implement Threading and Synchronization Applications.

Course Title : Data Structures and Algorithms Lab	**Semester : III**
Course Code : 25UD1246PCL311	**L – T – P : 0-0-2**
Prerequisite : Programming in C Lab	**Credits : 1**
Course Type : PCC	

List of Experiments:

Lab Experiments List:

1. Write a program to implement a singly linked list.
2. Write a program to implement a queue and a stack using an array and a singly linked list.
3. Write a program to implement Quick Sort algorithm.
4. Write a recursive program to find the maximum and minimum in an array using Divide and Conquer approach.
5. Write a program to implement Binary Search algorithm.
6. Write a program to implement fractional Knapsack algorithm using a greedy approach.
7. Write a program to implement job sequencing with deadlines to maximize profit.
8. Write a program to implement Prim's algorithm to find the minimum spanning tree of a graph.
9. Write a program to implement Kruskal's algorithm to find the minimum spanning tree of a graph.
10. Write a program to implement Floyd-Warshall algorithm to compute shortest paths between all pairs of vertices in a graph.

Course Title : Community Engagement Project/Field Project	**Semester : III**
Course Code : 24UD1000CP312	**L – T – P : 0-0-4**
Prerequisite : Nil	**Credits : 2**
Course Type :CEP/FP	

In this course, students are required to participate in field-based learning/projects generally under the supervision of faculty. The community project should be based on program core courses. The curricular component of 'community engagement and service' will involve activities that would expose students to the socio-economic issues in society so that the theoretical learning's can be supplemented by actual life experiences to generate solutions to real-life problems.

Multidisciplinary Minor I [Semester III]

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
	Any One		MD-M	02	00	00	02	20	20	60	-	-	100
1	Computer Organization and Architecture	24UD1246MD306A											
2	Operating Systems	25UD1246MD306B											
3	Data Structures and Algorithms	25UD1246MD306C											

Course Title : Computer Organization and Architecture **Semester : III**
Course Code : 24UD1246MD306A **L – T – P : 2-0-0**
Prerequisite : Nil **Credits : 2**
Course Type :MD-M

Course Objective:

1. To understand the structure, functions and characteristics of computer systems.
2. To understand how arithmetic operations are carried out.
3. To study hierarchical memory systems including cache memories and virtual memory.
4. To understand the structure and functions of the control unit.
5. To identify input / output devices and their data transfer mechanisms.

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand the design of the functional units of a digital computer system.
2. To understand representations of numbers stored in digital computers.
3. To understand the basics of memory systems, cache and virtual memories.
4. To apply the knowledge of micro-operations to design modules of control units.
5. To understand different ways of communication with I/O devices.

Course Contents:

UNIT I

Introduction **[05 Hours]**

Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function.

Instruction Sets: Characteristics, Types of operands, Types of operations, Addressing modes, Instruction format, Types of instruction, Instruction execution, Structure of program.

UNIT II

Computer Arithmetic **[05 Hours]**

The arithmetic and logic Unit, Integer representation, Floating point representation.

UNIT III

Memory Organization **[05 Hours]**

Internal Memory: Semiconductor main memory, Virtual memory systems and cache memory systems, External Memory: Organization and characteristics of magnetic disk, Magnetic tape, Optical memory, RAID.

UNIT IV

Control Unit **[05 Hours]**

Control unit operation: Micro-operations, Control of the processor, Hardwired implementation, Micro-programmed Control Unit.

UNIT V

Input/ Output Organization **[05 Hours]**

I/O module, Programmed I/O, Interrupt driven I/O, Direct memory access.

Textbooks:

1. William Stalling, "***Computer Organization and Architecture: Designing for Performance***", Prentice Hall Publication, 8th edition, 2009.
2. Hayes, "***Computer Architecture and Organization***", McGraw-Hill Publication, 3rd edition, 2012.
3. Zaky, "***Computer Organization***", McGraw-Hill Publication, 5th edition, 2011.

Reference books:

1. Morgan, Hennessy, Patterson, "***Computer Architecture: A Quantitative Approach***", Kaufman Publication, 4th edition, 2007.
2. Morris Mano, "***Computer System Architecture***", Pearson Education India, 3rd edition, 2007.
3. Mostafa Abd-El-Barr, Hesham El-Rewini, "***Fundamentals of Computer Organization and Architecture***", Wiley Publication, 1st edition, 2004.
4. Miles J. Murdocca, Vincent P. Heuring, "***Computer Architecture and Organization: An Integrated Approach***", Wiley Publication, 1st edition, 2007.

Course Title : Operating Systems	**Semester : III**
Course Code : 25UD1246MD306B	**L – T – P : 2-0-0**
Prerequisite : -	**Credits : 2**
Course Type: MD-M	

Course Objective:

1. To study the basic concepts and functions of operating systems.
2. To learn about Processes, Threads and Scheduling algorithms.
3. To understand the principles of Concurrency.
4. To understand the principles of Deadlocks.
5. To study File systems.

Course Outcomes:

After successful completion of this course the student will be able:

1. To describe the structure, components, types, and services of operating systems, including system calls and system programs.
2. To understand and apply various process scheduling algorithms, concurrency and synchronization techniques.
3. To understand and apply methods to handle deadlocks, including prevention, avoidance, detection, and recovery techniques.
4. To explain memory management techniques including paging, segmentation, and virtual memory and evaluate page replacement algorithms.
5. To discuss file system architecture.

Course Contents:

UNIT I

Operating System Structures **[05 Hours]**

Definition, Types of operating system, System components, System services, Systems calls. Operating system structures.

UNIT II

Processes and CPU scheduling **[07 Hours]**

Process concept, Process scheduling, Operation on a process, Cooperating processes, Intercrosses communication, Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling. Process Synchronization: The critical-section problem, Critical regions, Semaphores, Monitors.

UNIT III

Deadlocks **[05 Hours]**

Systems model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

UNIT IV

Memory Management and Virtual Memory **[05 Hours]**

Logical versus physical address space, Swapping, Contiguous allocation, Paging, Segmentation with paging, Demand paging, Page replacement algorithms.

UNIT V

File Management and Security **[06 Hours]**

Introduction to file system, file access control models, Encryption for file security, Security policies in OS, security auditing and logging, OS hardening techniques.

Textbooks:

1. A. Silberschatz, P. Galvin, "***Operating System Concepts***", Wiley Publication, 10th Edition, 2018.
2. A. S. Tanenbaum, H. Bos, "***Modern Operating Systems***", Pearson Education, 5th Edition, 2022.

Reference books:

1. D.M. Dhamdhere,"***Systems Programming and Operating Systems***", Tata McGraw Hill Publication, 2nd Edition, 2001.
2. G. Nutt, "***Operating Systems Concepts***", Addison Wesley Publication, 3rd Edition.
3. H. M. Deitel, "***An Introduction to Operating Systems***", Pearson education Publication, 3rd Edition, 2007.

Course Title : Data Structures and Algorithms **Semester : III**
Course Code : 25UD1246MD306C **L – T – P : 2-0-0**
Prerequisite : Programming in C **Credits : 2**
Course Type :MD-M

Course Objective:

1. Understand foundational concepts of data structures and algorithms design for solving computational problems efficiently.
2. Analyze the complexity of algorithms using asymptotic notations and recurrence relations.
3. Explore linear and nonlinear data structures, including linked lists, stacks, queues, trees, and graphs.
4. Implement and apply classic algorithmic paradigms such as Divide & Conquer, Greedy, and Dynamic Programming to real-world problems.
5. Develop problem-solving skills by designing algorithms and selecting appropriate data structures based on application requirements.

Course Outcomes:

After successful completion of this course the student will be able:

1. To explain the need for data structures and evaluate the efficiency of algorithms using time and space complexity analysis.
2. To implement and perform operations on fundamental data structures such as linked lists, stacks, and queues.
3. To apply tree and graph data structures for efficient information representation and traversal in computational problems.
4. To design and analyze algorithms using Divide and Conquer, Greedy, and Dynamic Programming techniques.
5. To solve real-life optimization and path-finding problems using algorithmic strategies like Dijkstra's, Kruskal's, and Floyd-Warshall algorithms.

Course Contents:

UNIT I

[05 Hours]

Introduction to Data Structures and Algorithms: Need of data structures, Types of data structures, Algorithm basics, Characteristics and classification of algorithms, Asymptotic notations (Big O, Ω, Θ), Time and space complexity.

UNIT II

[06 Hours]

Linked list: Implementation of linked list, Operation on linked list, Stack and Queue: Stack representation, Stack operations, Queue representation, Queue operations.

UNIT III

[05 Hours]

Binary Tree: Basic concepts of trees, Representation of binary tree, Binary tree traversals, Graphs: Basics concepts of graphs, Representation of graphs, Graph traversals; BFS and DFS, Minimum spanning trees (Kruskal and Prim's algorithms).

UNIT IV

[05 Hours]

Divide and Conquer Technique: Binary Search, Quick Sort, Finding maximum and minimum.
Greedy Algorithms: Concepts and strategy, Fractional knapsack, Optimal merge pattern, Dijkstra's algorithm.

UNIT V

[05 Hours]

Dynamic Programming: Principle, Multistage graphs, All pairs shortest paths, Travelling salesman problem.

Textbooks:

1. E. Horowitz, D. Mehta, S. Sahni, "***Fundamentals of Data Structure in C++***", Silicon Press, 2nd edition, 2008.
2. E. Horowitz, S. Sahni and S. Rajsekaran, ***"Fundamentals of Computer Algorithms"***, Universities Press (India), 2nd edition, 2018.
3. Thomas Cormen, Charles Leiserson, Ronald Rivest and Cliford Stein, ***"Introduction to Algorithms"***, MIT Press, 4th edition, 2022.

Reference books:

1. Semour Lipschutz, ***"Data Structures with C'***, Tata McGraw-Hill, 1st edition, 2010.
2. S. Sridhar, ***"Design and Analysis of Algorithms"***, Oxford University Press, 2nd edition, 2023.
3. Robert Sedgewick, Kevin Wayne, ***"Algorithms"***, Addison-Wesley, 4th edition, 2021.
4. Anany Levitin ***"Introduction to Design and Analysis of Algorithms"***, Pearson, 3rd edition, 2021.

B. Tech. IT (Honors) [Semester III]

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
	Any One		Honors	03	00	00	03	20	20	60	-	-	100
1	Microcontrollers and Applications	24UD1246HR301											
2	Principles of Programming Languages	24UD1246HR302											
3	Open Source Computing	24UD1246HR303											

Course Title :Microcontrollers and Applications **Semester : III**
Course Code : 24UD1246HR301 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type :Honors

Course Objective:

1. To provide a foundational understanding of microcontrollers and microprocessors.
2. To introduce the 8051 microcontroller and its addressing modes.
3. To introduce PIC microcontrollers and their basic architecture.
4. To understand multi-user/multitasking operating systems and memory management in advanced microprocessors.
5. To gain practical knowledge with simulators and programmers for the 8051 microcontroller.

Course Outcomes:

After successful completion of this course the student will be able:

1. To gain a solid understanding of microcontrollers and microprocessors.
2. To comprehend the architecture and addressing modes of the 8051 microcontroller.
3. To configure I/O ports and use various modules (timer, CCP, ADC, SSP) in PIC microcontrollers.
4. To gain knowledge of the 8086 microprocessor architecture.
5. To gain hands-on experience with simulators and programmers for the 8051 microcontroller.

Course Contents:

UNIT I

Introduction to Microcontrollers **[08 Hours]**

Introduction to Microcontrollers & Microprocessors, Basic Architectures of Microcontrollers, Processor Types & Memory Structures, Organization of Data Memory, Introduction to Microcontrollers & Microprocessors.

UNIT II

Intel 8051 Microcontroller **[08 Hours]**

Introduction, Addressing modes, port structure, External memory access, Timers, Interrupts in 8051, Program branching instruction, Serial Communication I and II, 8051 instruction set, 8051 Sample assembly language program, Atmd AT89C51 MicroController Programming.

UNIT III

PIC Controllers **[08 Hours]**

Introduction, Basic Architecture, Instruction set, I/O port configuration, Timer module, CCP module, Analog to digital converter module, Synchronous Serial Port (SSP) Modul I/O Port Expansion using Serial Peripheral Interface (SPI), I 2C Communication in PIC Microcontroller, Software for I ^{2}C Communication, Parallel slave port.

UNIT IV

Architecture of Advanced Microprocessor **[08 Hours]**

Architecture of 8086, Multi-User/ Multitasking Operating System, Memory Management in Advanced Microprocessors, Architecture of Intel 80286, Intel 80386 - A 32-bit Microprocessor with Memory Paging Facility, Use of Translation Look-aside Buffer (TLB) in 80386, Pentium Architecture, PowerPC Architecture.

UNIT V

Experiments on Microcontrollers **[07 Hours]**

Simulator and Programmer for 8051, Interfacing of A/D and D/A with AT89C51, Blinking of LED using AT89C51 , Frequency Divider Using AT89C51, External Interrupt with AT89C51, Interfacing a Keypad with AT89C51, Interfacing PIC16F877 Microcontroller with an LCD.

Textbooks:

1. Ramesh S. Gaonkar, ***"Microprocessor Architecture, Programming, and Applications with the 8085",*** 5th edition, Penram International, 2009.
2. Douglas Hall ,***"Microprocessor & Interfacing"***, 2nd edition, TMH, 2006.
3. Muhammad A. Mazidi, ***"The 8051 Microcontroller And Embedded Systems Using Assembly and C"***, 2nd edition., PHI, 2012.

Reference books:

1. Kenneth J. Ayala, ***"The 8051 Microcontroller"*****,** 3rd edition., Cengage Learning Publication, 2007.
2. Ajit Pal, "***Microcontrollers: Principles and Applications***", 2nd edition, PHI, 2011.

Course Title : Principles of Programming Languages **Semester : III**
Course Code : 24UD1246HR302 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type : Honors

Course Objective:

1. To introduce the fundamental concepts of syntax and semantics in programming languages.
2. To explore different programming paradigms, including functional and imperative languages.
3. To understand data abstractions, control structures, and scope management in programming languages.
4. To explore type systems, including lambda calculus, polymorphism, and object-oriented programming concepts like classes and inheritance.
5. To get introduced to functional programming, LISP, garbage collection algorithms.

Course Outcomes:

After successful completion of this course the student will be able:

1. To explain the syntax and semantics of programming languages and their impact on language design.
2. To differentiate between functional and imperative programming paradigms based on operational semantics.
3. To apply principles of abstraction, qualification, and correspondence in program design..
4. To demonstrate an understanding of type systems, polymorphism, and object-oriented programming concepts.
5. To implement basic programs in functional programming languages like LISP and understand garbage collection mechanisms.

Course Contents:

UNIT I

[08 Hours]

Notions of syntax and semantics of programming languages; introduction to operational/natural semantics of functional and imperative languages.

UNIT II

[08 Hours]

Data abstractions and control constructs; block-structure and scope, principles of abstraction, qualification and correspondence; parameter passing mechanisms; runtime structure and operating environment.

UNIT III

[08 Hours]

Practical and implementation issues in run-time systems and environment, abstracts machines, features of functional and imperative languages.

UNIT IV

[08 Hours]

The untyped and simply-typed Lambda calculus' type systems for programming languages including simple types and polymorphism; objects, classes and inheritance in object-oriented languages.

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UNIT V

[07 Hours]

Introduction, Applications of Logic Programming, Introduction to LISP, Garbage collection,

algorithms.

Textbooks:

1. Sebesta R., "***Concepts Of Programming Languages***", 4th edition, Pearson Education.
2. Wand and Haynes ,***"Essentials of Programming Languages",*** Friedman, , Prentice-Hall International (PHI), 1998.
3. Michael Scott, ***"Programming Language Pragmatics".*** Morgan Kaufmann, 2000.

Reference books:

1. Ghezzi C, Milano P., Jazayeri M., "***Programming Languages Concepts***", 3rd edition, John Wiley and Sons Pvt. Ltd (WSE), ISBN - 0195113063
2. Michael L. Scott "***Programming Language Pragmatics***", ELSEVIER Publication, ISBN: 81- 8147-370-1
3. Roosta S., Thomson, ***"Foundations of Programming Languages"***, Brooke/Cole, ISBN 981- 243-141-1
4. Sethi R., ***"Programming Languages concepts & constructs"***, 2nd edition, Pearson Education, ISBN 81 - 7808 - 104 – 0

Course Title : Open Source Computing **Semester : III**
Course Code : 24UD1246HR303 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type :Honors

Course Objective:

1. To introduce students to open source technology, including its significance and applications.
2. To understand the demographics, sociology, and psychology of open source development.
3. To introduce the Java programming language and its object-oriented principles.
4. To develop advanced Java programming skills, including input/output and graphics programming.
5. To develop web applications using the MEAN (MongoDB, Express, Angular, Node) framework.

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand the significance and applications of open source technology.
2. To understand the demographics, sociology, and psychology behind open source development.
3. To be proficient in Java programming and understand object-oriented principles.
4. To develop advanced Java programming skills, including input/output and graphics programming.
5. To develop web applications using the MEAN (MongoDB, Express, Angular, Node) framework.

Course Contents:

UNIT I

Open Source Technologies **[08 Hours]**

Introduction to open source technology, Internet, open source operating systems, open source platform.

UNIT II

Open Source Development **[08 Hours]**

Demographics, sociology and Psychology of open source development, legal issues in open source, Economics of open source, the GNU Project.

UNIT III

Application Development using Java **[07 Hours]**

Introduction to Java, object oriented programming, classes and objects, encapsulation, inheritance, polymorphism, method overloading, dynamic method lookup/dispatch, application programming interface

UNIT IV

Advanced Programming in Java **[08 Hours]**

Input output, graphics programming, collection frameworks, swing components, multithreading, client-server programming using Sockets.

UNIT V

Web Development Programming **[08 Hours]**

Design Documents, understanding Hypertext Markup language, Cascading Style sheets. Understanding Express.js, Anjular.js, Node.js,Web page developments, using MEAN (MongoDB, Express, Angular, Node) framework.

Textbooks:

1. Fadee P. deek, James McHugh, ***"Open Source: Technology and Policy"***, 2008.
2. Achyut S. Godbole, Atul Kahate, **"Web Technologies"**, 2nd edition, Tata McGraw Hill publication.
3. Michael Moncur, ***"Sams Teach Yourself JavaScript in 24 Hours",*** Sams.

Reference books:

1. ***"Java 8 Programming: Black Book",*** Dreamtech Press, 2015.
2. Tanveer Alam, ***"Web Technologies"***, 2008.

B. Tech. IT (By Research) [Semester III]

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
	Any One												
1	Introduction to Research	24UD1246RS301	Research	03	00	00	03	20	20	60	-	-	100
2	Intellectual Property Rights	24UD 1246RS302											

Course Title : Introduction to Research **Semester : III**
Course Code : 24UD1246RS301 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type :Research

Course Objective:

1. To introduce the concept of research, its significance, and its methodologies.
2. To learn techniques for conducting thorough literature surveys using various academic databases.
3. To gain proficiency in experimental techniques, data analysis, and modeling relevant to research.
4. To develop skills for effectively writing and presenting technical research.
5. To encourage creative thinking in research and discuss the importance of ethics.

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand the fundamental principles and methodologies of research.
2. To conduct comprehensive literature surveys using databases like Web of Science and Scopus.
3. To acquire skills in experimental design, data analysis, and modeling.
4. To be proficient in technical writing and capable of delivering effective technical presentations.
5. To develop creative approaches to research and understand the ethical considerations involved.

Course Contents:

UNIT I

Introduction to Research **[08 Hours]**

Group discussion on what constitutes research, Overview of research processes and methodologies.

UNIT II

Literature Survey and Experimental Skills **[08 Hours]**

Overview of literature surveys, Conducting literature surveys using Web of Science and Scopus Developing experimental skills

UNIT III

Data Analysis and Modeling Skills **[07 Hours]**

Techniques for writing up research findings, Data analysis methods, Modeling skills for research.

UNIT IV

Technical Writing and Presentations **[08 Hours]**

Principles of technical writing, Preparing and delivering technical presentations, Encouraging creativity in Research, Group discussion on ethics in research, Design of experiments.

UNIT V

Intellectual Property and Specialized Research **[08 Hours]**

Understanding intellectual property, Conducting research in computer science and engineering.

Textbooks:

1. C. R Kothari, ***"Research Methodology: Methods and Techniques"***, New Age International, 2004.
2. David McNaab, ***"Research Methods for Political Science"***, New York: Routledge, 2010.

Reference books:

1. Jayson D. Mycoff, ***"Working with Political Science Research Methods"***, London: Sage, 2019.
2. S P Gupta, ***"Statistical Methods"***, Sultan Chand & Sons, 2012.

Course Title :Intellectual Property Rights **Semester : III**
Course Code : 24UD1246RS302 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits :3**
Course Type :Research

Course Objective:

1. To provide a comprehensive understanding of the concept of property and the evolution of intellectual property rights.
2. To explore the specifics of copyrights, including their origins, definitions, types, registration procedures, assignment, license, terms, piracy, infringement, remedies, and the particularities of software copyrights.
3. To discuss infringement, remedies, offenses related to trademarks, passing off, penalties, and domain names in cyberspace.
4. To discuss international conventions on design and the functions of design protection.
5. To discuss the legal provisions related to E-Commerce and E-Governance.

Course Outcomes:

After successful completion of this course the student will be able:

1. To comprehend the concept of property and the evolution of intellectual property rights.
2. To address issues of patent and copyright infringement and apply appropriate remedies and penalties.
3. To handle issues related to trademark infringement, passing off, and cyberspace domain names with appropriate legal knowledge.
4. To navigate the registration and cancellation processes for designs and be aware of international conventions.
5. To apply legal knowledge to issues in E-Commerce, E-Governance, digital signatures, electronic signatures, and cybercrimes.

Course Contents:

UNIT I

Introduction to IPR **[08 hours]**

Basics of Intellectual Property, The Intangible Economy

UNIT II

Patent Rights and Trademarks **[08 hours]**

Patents—From ball pens to biologics, Trade Marks—What does red soles and barbie girl mean?

UNIT III

Copyrights **[08 hours]**

Copyright—Is it right to copy? Unconventional IP—The expanding scope

UNIT IV

Enforcement of IP **[08 hours]**

Protecting your rights, IP for Business—A profit making asset class, IP, Research, and Universities, IP for the Creative and Entertainment Industries

UNIT V

Governments Role in Fostering IP **[07 hours]**

ACT-2000 , IT Act - Introduction, E-Commerce and legal provisions E- Governance and legal provisions Digital signature and Electronic Signature, Cybercrimes.

Textbooks:

1. Dr. G.B. Reddy, ***"Intellectual Property Rights and the Law"***, Gogia Law Agency.
2. Dr. B. L. Wadehra, ***"Law relating to Intellectual Property"***, Universal Law Publishing Co.

Reference books:

1. P. Narayanan, ***"IPR"***.
2. Dr. S.R. Myneni, ***"Law of Intellectual Property"***, Asian Law House.

Course Title : Object Oriented Programming with Java **Semester : IV**
Course Code : 25UD1246PC401 **L – T – P : 3-0-0**
Prerequisite : Programming in C **Credits : 3**
Course Type: PCC

Course Objective:

1. To understand the foundational concepts of OOP, including classes, objects, inheritance, polymorphism, and encapsulation.
2. To gain proficiency in writing, compiling, and debugging Java programs.
3. To apply core Java features for effective problem-solving.
4. To develop a strong understanding of essential concepts like exception handling, multithreading, and file I/O.
5. To prepare students to design and implement robust, reusable, and efficient Java applications.

Course Outcomes:

After successful completion of this course the student will be able:

1. To explain and apply fundamental OOP concepts to model real-world problems.
2. To use inheritance and polymorphism to create flexible and scalable code.
3. Implement methods for handling runtime errors using exception handling.
4. To develop programs that interacts with files and handle data streams.
5. To create multi-threaded applications to enhance performance and concurrency.

Course Contents:

UNIT I

Introduction to Java and OOP Fundamentals **[08 Hours]**

Java's history, features, and the Java Virtual Machine (JVM), Classes and Objects: Defining classes, creatir objects, and understanding constructors, Data Types and Control Structures: Primitive types, variable operators, and control flow statements, Methods and Overloading: Creating methods, passing arguments, ar method overloading.

UNIT II

Inheritance, Interfaces, and Packages **[07 Hours]**

Inheritance: The concept of inheriting classes, using the super keyword, and method overriding, Polymorphism: The difference between compile-time and run-time polymorphism. Abstract Classes and Interfaces: Creating and implementing interfaces and abstract classes, Packages: Organizing classes into packages and managing access control.

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UNIT III

Exception Handling and Collections **[08 Hours]**

Exception Handling: The try-catch-finally block, throw and throws keywords, and custom exceptions, The Throwable class and different exception types. Collections Framework: An introduction to the basic collections, such as ArrayList and HashMap.

UNIT IV

Multithreading and File I/O **[08 Hours]**

Multithreading: The concept of threads, creating threads using the Thread class and Runnable interface. Synchronization: Ensuring thread safety and inter-thread communication. File I/O: Reading from and writing to files using various stream classes.

UNIT V

Applets, AWT, and Swing (GUI) **[08 Hours]**

Introduction to Applets and their lifecycle, Event Handling: The Delegation Event Model, event sources, and listeners, GUI Programming with AWT and Swing: Creating windows, panels, and basic components like buttons and text fields. Layout Managers.

Textbooks:

1. E. Balagurusamy, "***Programming with Java Primer***", McGraw Hill publication, 7th edition, 2023.
2. Herbert Schildt, "***Java, The Complete Reference***", McGraw Hill publication, 13th edition, 2024.

Reference books:

1. Joshua Bloch, "***Effective Java",*** 3rd Edition, Pearson publication, 2017.
2. Robert C. Martin, ***"Clean Code: A Handbook of Agile Software Craftsmanship"***, Prentice Hall, 2008.

Course Title : Data Communication and Computer Networks **Semester : IV**
Course Code : 24UD1246PC402 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type : PCC

Course Objective:

1. To introduce students to the basic components and concepts of data communication and networking.
2. To provide a comprehensive understanding of transmission media, multiplexing and switching.
3. To explain error detection and correction techniques, and medium access control.
4. To explain the functions and protocols associated with Internet layer, Transport and Application layers.
5. To understand the various network topologies and network devices.

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand the fundamentals of data communication and computer networks.
2. To understand transmission media, multiplexing and switching.
3. To gain the ability to implement and analyze error detection and correction techniques and understand medium access control methods.
4. To be capable of describing Internet and Transport layer protocols.
5. To identify and explain the various components and topologies of data communication systems.

Course Contents:

UNIT I

Fundamentals of Data Communication and Computer Network **[08 Hours]**

Process of data communication and its components: Transmitter, Receiver, Medium, Message, Protocols, Standards, Standard organizations, Bandwidth, Data transmission rate, Baud rate and Bits per second, Modes of communication (Simplex, Half duplex, Full Duplex), Analog signal and digital signal, Analog and Digital Transmission: analog to digital, digital to analog conversion, Fundamentals of computer networks: definition and need of computer network, Applications, Network benefits , Classification of network: LAN, WAN, MAN.

UNIT II

Transmission Media and Switching **[08 Hours]**

Guided transmission media: Twisted-pair cable, Coaxial cable, Fiber-optic cable, Unguided transmission media: Radio waves, Microwaves, Infrared, Satellite, Line-of-sight Transmission, Point-to-Point, Broadcast, Multiplexing: Frequency-division multiplexing, Time - division multiplexing, Switching: Circuit-switched network, Packet switched network.

UNIT III

Error Detection and Correction **[08 Hours]**

Types of errors, Forward error correction versus retransmission, Framing: fixed sized and variable sized framing, Error detection: Repetition codes, Parity bits, Checksums, CRC, Error Correction: Automatic Repeat Request (ARQ), Hamming code, Standard architecture, Features, Bluetooth architecture: Piconet, Scatternet, Introduction to mobile generations: 3G, 4G and 5G.

UNIT IV

Network Communication Models **[08 Hours]**

The OSI model: layered architecture, Encapsulation, Layers in OSI Model and its functions, Wired and Wireless LAN, TCP/IP layers and their functions, Introduction to protocols: Internet layer - IP, ARP, ICMP, Transport Layer-TCP and UDP, Application Layer-FTP, HTTP, SMTP, TELNET, DHCP, Addressing: Physical address, Logical address, Port address, IP address-Concept, Notation, Address space, IPv4 addressing: Classful and Classless Addressing.

UNIT V

Network Topologies and Network Devices **[08 Hours]**

Network Computing Model: Peer to Peer, Client server, Network topologies: Introduction, Definition, Selection criteria, Types of topology- Star, Mesh, Tree, Hybrid, Network connecting devices: Switch, Router, Repeater and Bridge.

Textbooks:

1. Behrouz A. Forouzan ,***"Data Communications and Networking"***, 4th edition TMH, 2006.
2. Andrew S Tanenbaum, ***"Computer Networks"***, 4th edition. Pearson Education, PHI.

Reference books:

1. P.C .Gupta, ***"Data communications and Computer Networks"***, PHI.
2. S. Keshav, ***"An Engineering Approach to Computer Networks"***, 2nd edition, Pearson Education.
3. W.A. Shay, ***"Understanding communications and Networks"***, 3rd edition, Cengage Learning.
4. James F. Kurose and Keith W. Ross, ***"Computer Networking: A Top-Down Approach Featuring the Internet."*** 3rd edition, Pearson Education.
5. William Stallings, ***"Data and Computer Communication"***, 6th edition, Pearson Education, 2000.

Course Title : Probability and Statistics **Semester : IV**
Course Code : 24UD1246PC403 **L – T – P : 3-0-0**
Prerequisite : Discrete Mathematics **Credits : 3**
Course Type : PCC

Course Objective:

1. To understand probability concepts.
2. To acquire knowledge of probability distributions.
3. To get exposure to hypothesis testing using distributions.
4. To understand principles of correlation and regression..
5. To be exposed to discrete time Markov chains.

Course Outcomes:

After successful completion of this course the student will be able:

1. To acquire analytical ability in solving mathematical problems as applied to the respective branches of engineering.
2. To understand the use of probability distribution in real life situations
3. To identify the correlation and regression between two parameters.
4. To test research outcomes using hypothesis testing.
5. To predict the future outcome in uncertainties using the markov chain.

Course Contents:

UNIT I

Probability Theory: **[08 Hours]**

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, 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.

UNIT II

Theoretical Probability Distributions: **[07 Hours]**

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.

UNIT III

Correlation: **[08 Hours]**

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, 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.

UNIT IV

Testing of Hypothesis: **[08 Hours]**

Introduction to Sampling Distributions, Population and Sample, Null Hypothesis and Alternative Hypothesis, Single and Two Tailed Test, Testing of Hypothesis, Level of Significance, Critical Region, Procedure for Testing of Hypothesis Large Sample Test- Test for Single Proportion, Two Sample Proportions, Large Sample Test- Test for Single Mean, Two Sample Means, Small Sample Tests – "t" Test For a Single Mean, "t" Test for the difference of Means, Paired "t" Test, F Test – Test of Significance of the Difference between Two Population Variances, Chi Square Test for Goodness of Fit.

UNIT V

Applied Statistics: **[08 Hours]**

Curve fitting by the method of least squares- fitting of straight lines, Second degree parabolas, Markov Chains: Introduction to Stochastic process, Markov process, Markov chain one step & n-step Transition Probability, Classification of states of a Markov chain – Applications.

Textbooks:

1. Veerarajan T., **"*Probability, Statistics and Random Processes*"**, Tata McGraw Hill, 1st reprint, 2004.
2. S. C. Gupta and V.K. Kapoor, **"*Fundamentals of Mathematical Statistics*"**, Sultan Chand & Sons, 9 th extensively revised edition, 1999.
3. G. V. Kumbhojkar, **"*Probability and Random Processes*"**, C. Jamnadas and Co., 14th edition, 2010.
4. Erwin Kreyszig, **"*Advanced Engineering Mathematics*"**, John Wiley & Sons, 9th edition, 2006.
5. Veerarajan T., **"*Engineering Mathematics (for semester III)*"**, Tata McGraw-Hill, New Delhi, 2010.
6. G. Haribaskaran, **"*Probability, Queuing Theory and Reliability Engineering*"**, Laxmi Publications, 2nd edition, 2009.
7. Murray Spiegel, John Schiller, R. ALU Srinivasan, **"*Probability and Statistics*"**, Schaum's Outlines, 4th edition, 2013.

Reference books:

1. Trivedi K. S., **"*Probability and Statistics with reliability, Queueing and Computer Science Applications*"**, Prentice Hall of India, New Delhi, 1984.
2. Gross.D, Harris.C.M., **"*Fundamentals of Queuing Theory*"**, John Wiley and Sons, 1985.
3. Allen. A. O., **"*Probability Statistics and Queuing Theory*"**, Academic Press, 1981.

Course Title : Discrete Mathematics | **Semester : IV**
Course Code : 25UD1246PC404 | **L – T – P : 3-0-0**
Prerequisite : Engineering Mathematics I and II | **Credits : 3**
Course Type :PCC

Course Objective:

1. To provide a solid foundation in the core concepts and techniques of discrete mathematics.
2. To develop skills in logical reasoning and formal proof techniques.
3. To enhance students' ability to think algorithmically and understand the theoretical underpinnings of computer science.
4. To apply discrete mathematical concepts to solve problems in computer science and related fields.
5. To introduce students to mathematical modeling using discrete structures.

Course Outcomes:

After successful completion of this course the student will be able:

1. To demonstrate a clear understanding of fundamental discrete structures such as sets, relations, functions, and sequences.
2. To construct and evaluate mathematical proofs using logical reasoning, including direct proofs, indirect proofs, and proof by induction.
3. To apply combinatorial techniques to solve counting problems, including permutations, combinations, and the principle of inclusion-exclusion.
4. To understand and apply basic concepts of graph theory, including graph representations, traversal algorithms, and graph coloring.
5. To develop mathematical models for real-world problems using discrete structures and analyze these models.

Course Contents:

UNIT I

Sets and Sequences **[08Hours]**

The Foundations: Sets theory and its applications, Set operations, Laws of set theory, Power sets, Partitions, Multi-sets, Cardinality, Principle of inclusion and exclusion, Applications of sets: Problems on set operations and principle of inclusion-exclusion, Propositional logic, Propositional equivalences, Propositional algebra, Basic logical operations, De Morgan's laws, Predicates and quantifiers, Nested quantifiers, Rules of inference, Proof methods and strategy, Applications of logic: Translating English statements into propositions, Boolean searches in web pages, Bit operations.

UNIT II

Recursion **[08 Hours]**

Induction and recursion: Mathematical induction, Strong induction, Recursive definitions, Re-cursive algorithms, Applications: Proofs using mathematical induction, Functions: Definition and types of functions: Injective, Subjective and bijective, Composition, Identity and inverse of function, Recursively defined functions, Applications of functions, Job scheduling problem.

UNIT III

Counting Principles **[08 Hours]**

Basic Counting Principles: Permutations, Combinations, Binomial coefficients, Generalized permutations and combinations, Combinations and permutations with repetition, Generating permutations and combinations, Recurrence relation, Solving linear recurrence relations with constant coefficients,

Applications of counting principles, Pigeonhole principle and its applications.

UNIT IV

Relations **[08 Hours]**

Properties of binary relations, Closure of relations, Warshall's algorithm, Equivalence relations and partitions, Partial ordering relations and lattice application of relations: N-ary relations and their applications, Databases and relations. Algebraic Structures: Algebraic systems, Groups, Semi groups, Monoid, Subgroups, Permutation groups, Codes and group codes, Isomorphism and automorphisms, Homomorphism, Fermat's little theorem, Polynomial rings, Applications of groups, Ring, Field.

UNIT V

Graph Theory **[08 Hours]**

Graph Theory: Basic terminology, Multi graphs and weighted graphs, Paths and circuits, Shortest path in weighted graph, Hamiltonian and Euler paths and circuits, Factors of a graph, Shortest path algorithm, Traveling salesman problem, Planar graph and Kuratowsk is graph and theorem, Independent sets, Graph coloring, Trees, Rooted trees, Path length in rooted trees, Binary search trees, Spanning trees and cut set, Theorems on spanning trees, Cut sets, Circuits, Minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning tree.

Textbooks:

1. K. H. Rosen, ***"Discrete Mathematics and Its Applications"*,** Tata McGraw Hill Publication, 8th edition, 2018.
2. J. P. Tremblay, R. Manohar, ***"Discrete Mathematical Structures with Applications toComputer Science"***, McGraw Hill Publication, 1st edition, 2001.
3. L. Liu, *"Elements of Discrete Mathematics"*, McGraw-Hill Publication, 3rd edition, 2008.

Reference books:

1. B. Kolman, R. Busby, S. Ross,***"Discrete Mathematical Structures"*,** Pearson Education, 6th edition, 2009.
2. R. K. Bisht, H. S. Dhami, ***"Discrete Mathematics",*** Oxford University Press, 2015.

Course Title : Constitution of India **Semester : IV**
Course Code : 24UD1COIVE407 **L – T – P : 2-0-0**
Prerequisite : Nil **Credits : AU**
Course Type : VEC

Course Objective:

1. To provide an overview of the historical background, philosophy, and features of the Indian Constitution.
2. To examine the forms, importance, and evaluation of Fundamental Rights, and understand the Directive Principles of State Policy.
3. To study the function, law-making procedures, and the role of the executive council and state assemblies.
4. To understand the forms, powers, and functions of the judiciary, along with the structure and role of the Election Commission.
5. To explore provisions for social justice, challenges in Indian democracy, and the roles of constitutional institutions.

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand the historical context and philosophical underpinnings of the Indian Constitution.
2. To be familiar with the fundamental rights, duties, and directive principles enshrined in the Constitution.
3. To understand the structure, functions, and changing trends of the Indian Parliament.
4. To grasp the functions and powers of the judiciary and the election commission, along with recent reform
5. To learn about constitutional provisions for social justice and the challenges facing Indian democracy.

Course Contents:

UNIT I

Introduction to Indian Constitution **[06 Hours]**

Historical background, Philosophy of Indian Constitution, Preamble of Constitution- its forms and importance, Features of Indian Constitution, The nature of Indian Federation.

UNIT II

Fundamental Rights and Directive Principles **[05 Hours]**

Fundamental Rights- its forms and importance, Fundamental rights in Constitution, Evaluation of Fundamental rights, Fundamental duties, Directive Principles of State Policies (Meaning, Objectives and Source), Classification of Directive Principles, Implementation of Directive Principles.

UNIT III

Composition and Structure of Parliament **[05 Hours]**

Function of Parliament, Law making Procedure, Executive Council structure and Role, State assembly, Changing Trends of Parliament.

UNIT IV

Judiciary and Election Commission **[06 Hours]**

Forms of Judiciary, Power, Function and Role of Supreme Court, Judicial Review, Judicial Activism,

Structure, Function and Role of Election Commission, Electoral System and Reforms in it.

UNIT V

Socialism of Constitution **[06 Hours]**

Provision for Women Empowerment, Protection of Rights of Backward Class, Special Provision for Scheduled Tribes, Protection of Rights of workers, Socialistic democracy, Democracy in India: Challenges, Constitutional Institutions and their role, Lokpal and Lokayukt, State Central Relation, Important Amendments, Nationalism, Criminalisation of Politics.

Textbooks:

1. D. Basu, ***"Introduction to the Constitution of India "***, Lexis Nexis Publishers, 23rd edition, 2018.
2. B. Shiva Rao (Editor), ***"Framing of India's Constitution, Select Documents"***, Vol. 1, 2015.

Reference books:

1. T. K. Tope, ***"Constitutional Law of India"***, Sujata V. Manohar (Editor), Eastern Book Company, 3rd edition, 2010.
2. Sir Ivor Jennings, ***"Some Characteristics of Indian Constitution"***, Geoffrey Cumberlege Publishers, 1953.

Course Title : Life of Bharatratna Dr. Babasaheb Ambedkar **Semester : IV**
Course Code : 24UD1000VE408B **L – T – P : 1-0-0**
Prerequisite : Nil **Credits : 1**
Course Type : VEC

Course Objective:

1. To analyze Dr. Ambedkar's role in shaping India's constitution and social justice movements.
2. To recognize the relevance of his principles in contemporary engineering and societal contexts.
3. To develop critical thinking and problem-solving skills through case studies and discussions.

Course Outcomes:

After successful completion of this course the student will be able:

1. To explain Dr. Ambedkar's key contributions to the Constitution of India, establishment of human values and social reform.
2. To identify and analyze his leadership qualities and strategic thinking.
3. To evaluate the impact of his legacy on Maharashtra's culture, politics, and economy.

Course Contents:

UNIT I

Introduction **[05 hours]**

Introduction to the Socio-political Context of Dr. Babasaheb Ambedkar's Era, British Colonialism, Indian National Movement, Caste Hierarchy, Untouchability, Social Reform Movements, Role in the Indian freedom struggle.

UNIT II

The Contribution of Dr. Babasaheb Ambedkar **[05 hours]**

Contributions to the Constitution of India, Vision for Social Justice and Empowerment.

UNIT III

Legacy and Relevance Today **[05 hours]**

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.

Textbooks:

1. Keer, Dhananjay, "***Dr.Babasaheb Ambedkar Lifeand Mission***", PopularPrakashan, 1954.
2. Ambedkar B. R., "***Annihilation of Caste***", Fingerprint Publishing, 2023.

Reference books:

1. Ambedkar B. R.," ***Buddha or Karl Marx***", Infinite Words, 2024.
2. Ambedkar B. R., "***The Problem of Rupee: It's Origin and it's Solution***", Sudhir Prakashan, 2021.

Course Title : Entrepreneurship Essentials **Semester : IV**
Course Code : 24UD1246HM409A **L – T – P : 2-0-0**
Prerequisite : Nil **Credits : 2**
Course Type : HSSM

Course Objective:

1. To understand the myths and realities surrounding entrepreneurship.
2. To understand the importance of mission and vision in entrepreneurship.
3. To learn the fundamentals of marketing management and market research.
4. To understand the concepts of innovation, including design thinking, design-driven innovation, and systems thinking.
5. To learn about various funding options for new ventures, including bootstrapping, crowd sourcing, angel investors, venture capital, and debt financing.

Course Outcomes:

After successful completion of this course the student will be able:

1. To differentiate between myths and realities of entrepreneurship.
2. To articulate the mission and vision for a new venture.
3. To apply marketing management principles and conduct market research.
4. To develop comprehensive business plans and pitch them effectively.
5. To innovate and adapt to changing market conditions and technological advancements.

Course Contents:

UNIT I

Introduction **[05 Hours]**

Dhirubhai Ambani & Sofia Myths & Realities about entrepreneurship entrepreneurial qualities, Why start-ups fail?

UNIT II

Mission-vision **[06 Hours]**

Entrepreneurial qualities – I, Mission, vision, entrepreneurial qualities – II, Value proposition, Business Model canvas Business model generation, Competitive advantage Lean start-up – 1 Lean, start-up – 2 Team and early recruit Legal forms of business

UNIT III

Marketing and Financial Skills **[05 Hours]**

Marketing management 1 Marketing management 2 Market research –I, Market research –II Market research –Example, Introduction to financial statements Profit & Loss statement Balance sheet Cash flow Example – 1 Example – 2 Cost-volume-profit & Bread-Even analysis Capital budgeting.

UNIT IV

Business Planning and Innovation **[05 Hours]**

Business plan-I Business plan-II Pitching Go-to-market strategies Does & Don'ts.

UNIT V

Navigating the Start-up Ecosystem **[06 Hours]**

How to innovate Design Thinking Design-Driven Innovation, Systems thinking Open innovation, TRIZ How to start a start-up? Government incentives for entrepreneurship (1 lecture) Incubation, acceleration Funding new ventures – bootstrapping, crowd sourcing, angel investors, VCs, debt financing (3), due

diligence Legal aspects of business (IPR, GST, Labour law).

Textbooks:

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha, *"Entrepreneurship"*, 11th edition, McGrawHill, 2022.
2. Rajeev Roy, ***"Entrepreneurship"***, 3rd edition, Oxford University Press, 2020.

Reference books:

1. Dr. Anna Maria Bliven,*" **Entrepreneurship Essentials You Always Wanted To Know**"*, Kindle edition.
2. Eric Ries, *"**The Lean Startup**"*.

Course Title : Innovation, Business Models and Entrepreneurship **Semester : IV**
Course Code : 24UD1246HM409B **L – T – P : 2-0-0**
Prerequisite : Nil **Credits : 2**
Course Type : HSSM

Course Objective:

1. To learn the steps involved in innovation management and idea management systems.
2. To explore concepts such as idea championship, participation, and co-creation for innovation.
3. To develop strategies for technological innovation management and technology forecasting.

Course Outcomes:

After successful completion of this course the student will be able:

1. To analyze the current business environment and its impact on innovation.
2. To utilize divergent and convergent thinking and design thinking principles in entrepreneurship.
3. To develop comprehensive business models and understand the traits of successful entrepreneurs.
4. To understand the strategic role of SMEs in sustainable development and material efficiency.
5. To understand the different types of IPR, including patents and copyrights, and their significance in India.

Course Contents:

UNIT I

Introduction to Innovation and Creativity **[05 Hours]**

Analyzing the Current Business Scenario, Innovation and Creativity- An Introduction, Innovation in Current Environment, Types of Innovation, School of Innovation.

UNIT II

Innovation Management **[06 Hours]**

Challenges of Innovation, Steps of Innovation Management, Idea Management System, Divergent V/s Convergent Thinking, Design Thinking and Entrepreneurship.

UNIT III

Experimentation and Business Models **[06 Hours]**

Experimentation in Innovation Management, Idea Championship, Participation for Innovation, Co-creation for Innovation, Proto typing to Incubation, What is a Business Model, Who is an Entrepreneur, Social Entrepreneurship, Blue Ocean Strategy-I, Blue Ocean Strategy-II.

UNIT IV

Marketing and Technological Innovation **[06 Hours]**

Marketing of Innovation, Technology Innovation Process, Technological Innovation Management Planning, Technological Innovation Management Strategies, Technology Forecasting. Sustainability Innovation and Entrepreneurship, Innovation Sustainable Conditions, Innovation: Context and Pattern, SME'S strategic involvement in sustainable development, Exploration of business models for material efficiency services.

UNIT V

Intellectual Property Rights and Business Models [06 Hours]

Management of Innovation, creation of IPR, Management of Innovation, creation of IPR, Types of IPR, Patents and Copyrights, Patents in India, Business Models and value proposition, Business Model Failure: Reasons and Remedies, Incubators : Business Vs Technology, Managing Investor for Innovation, Future markets and Innovation needs for India**.**

Textbooks:

1. Alexander Osterwalder and Yves Pigneur, ***"Business Model Generation"***.
2. Peter Drucker, ***"Innovation and Entrepreneurship"***.
3. Eric Ries, ***"The Lean Startup"***.

Reference books:

1. Clayton M. Christensen, ***"The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail".***
2. Thomas Lockwood, ***"Design Thinking: Integrating Innovation, Customer Experience, and Brand Value".***
3. W. Chan Kim and Renée Mauborgne, ***"Blue Ocean Strategy: How to Create Uncontested Market Space and Make the Competition Irrelevant"***.
4. Eric Ries, ***"The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses"***.

Course Title : Financial Statement Analysis and Reporting - II **Semester: IV**
Course Code : 24UD1246HM409C **L–T–P : 2-0-0**
Prerequisite : Financial Statement Analysis and Reporting - I **Credits : 2**
Course Type : HSSM

Course Objective:

1. To gain insights into the structure of various industries, and forms of business organizations.
2. To learn the nature, objectives, and limitations of financial statements.
3. To develop the ability to prepare and interpret financial statements.
4. To acquire skills in using various tools and techniques for financial statement analysis.
5. To learn about ratio analysis for comparing the business organization performance

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand the various forms of business organizations.
2. To prepare and analyze the profit & loss statement of a business organization.
3. To prepare and analyze balance sheets of a business organization.
4. To prepare and analyze cash flow statements of a business organization.
5. To be proficient in using ratio analysis, comparative statements and financial parameters.

Course Contents:

UNIT I

Corporate Accounts and Investments **[06 Hours]**

Introduction to Companies, Types of Companies, Shares and Share Capital, Issue of Shares, Share Issue, Payments in Installment, Buyback of Shares, Debentures and Bonds, Income Statement/Profit and Loss Account, Balance Sheet, Company Annual Report, Financial Instrument, Assets and Liabilities, Joint Ventures, Subsidiaries and Associates, Consolidated Financial Statement, Business Combinations, Accounting for Investments.

UNIT II

Preparation of Final Accounts **[06 Hours]**

The Income Statements Introduction, Format of Profit and Loss Account, Profit and Loss Account of a Manufacturing Concern, Appropriation of Profit, Advantages of Profit and Loss Account.

UNIT III

Presentation of Financial Statements **[06 Hours]**

Balance Sheet, Conceptual Basis of a Balance Sheet, Capital and Revenue Expenditure and Receipts, Classification of Items on a Balance Sheet, Format of Balance Sheet, Balance Sheet Equation, Preparing Balance Sheet.

UNIT IV

Cash Flow Statement **[06 Hours]**

Introduction to Cash Flow Statement, Cash and Cash Equivalents, Cash Flow Activities, Operating Activities, Some Special Items, Free Cash Flow, Fund Flow Statement, Analysis of Cash Flow Statement, Preparation of Cash Flow Statement.

UNIT V

Financial Statement Analysis **[06 Hours]**

Introduction, Techniques for Financial Statement Analysis, Horizontal Analysis: Comparative and Trend

Statements, Vertical Analysis: Common Size, Liquidity Ratios: Current and Quick Ratio, Solvency Ratios: D/E, Interest Coverage, Profitability Ratios: GP, NP, EBIT, EBDITA, EPS, Return Ratios: ROI, ROE, Turnover Ratios, Analysis of Stock and Debtors, Working Capital Management, Stock Prices and Financial Data: P/E.

Textbooks:

1. Gupta Ambrish, Narayanaswamy R, "***Financial Accounting for Management - An Analytical Perspective***", 4th edition, Pearson Education, 2012.
2. Bapat and Raith Atha, **"Financial Accounting – A Managerial Perspective"**, Mc Graw Hill, 2017.
3. Subramanyam, K. R. and John, J.W, "***Financial Accounting – A Managerial Perspective***", 5th edition , Prentice Hall of India, 2015.
4. Penman, S.H, "***Financial Statement Analysis"***, 12th edition, Tata McGraw Hill, 2014.

Reference books:

1. Erich A. H, "***Financial Statement Analysis and Security Valuation***", 4th edition, Tata McGraw Hill. 2014.
2. Erich A. Helfert, "***Techniques of Financial Analysis: A Guide to Value Creation***", 16th edition, Tata McGraw Hill, 2014.

Course Title : Modern Indian Language(उपयोजित मराठी/ व्यावहारिक मराठी) **Semester : IV**
Course Code : 24UD1000AE410A **L – T – P : 2-0-0**
Prerequisite : Nil **Credits : 2**
Course Type : AEC

Course Objective:

1. मराठी भाषेचा ऐतिहासिक प्रवास, तिच्या निर्मितीतील संस्कृत, प्राकृत आणि अपभ्रंशभाषांचा प्रभाव समजून घेणे.
2. मराठी लेखनाचे नियम, व्याकरण व शुद्धलेखन यांची अचूकता आत्मसात करणे.
3. सर्जनशील आणि औपचारिक लेखनकौशल्ये विकसित करणे.
4. भाषांतरतत्त्वे, प्रक्रिया आणि सांस्कृतिक संदर्भयांचा विचार करून मराठीतून इंग्रजी आणि इंग्रजीतून मराठी भाषांतर करण्याचे कौशल्य प्राप्त करणे.

Course Outcomes:

1. विद्यार्थी मराठीभाषेच्या ऐतिहासिक प्रवासाची समज वाढवतील आणि तिच्या विकासातील टप्पे स्पष्टपणे सांगू शकतील.
2. शुद्ध व प्रमाणबद्ध लेखन करण्याची क्षमता प्राप्त होईल.
3. विविध प्रकारच्या लेखनशैली आत्मसात करून सृजनशील, विश्लेषणात्मक आणि औपचारिक लेखन करू शकतील.
4. अचूक, स्पष्ट आणि भाषिक- सांस्कृतिक दृष्टिकोनातून योग्य भाषांतर करू शकतील.
5. व्यावसायिक आणि साहित्यिक भाषांतरात प्रावीण्य मिळवू शकतील.

Course Contents:

घटक- १

मराठीचा उगम आणि विकास

मराठीचा उगम आणि विकास, मराठी भाषेवर संतपरंपरेचा प्रभाव- ज्ञानेश्वर, तुकाराम, नामदेव आणि एकनाथ यांच्या रचनांचा अभ्यास, मराठीतबखरीलेखन व इतिहास दर्शन. आधुनिक मराठी आणि सुधारणा चळवळी- टिळक, फुले, आणिआगरकर यांचे योगदान.

घटक- २

स्वातंत्र्यानंतरची मराठी भाषा

महाराष्ट्र राज्यनिर्मिती 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.

घटक- ३

मराठी लेखनाचे नियम आणि व्याकरण

वर्णमाला, शब्दांच्या जाती (नाम, सर्वनाम, विशेषणइ.), काल आणि त्याचे प्रकार, संधि, वाक्यप्रकार (विधानार्थी वाक्य, प्रश्नार्थी वाक्य, आज्ञार्थी वाक्य इ.), विरामचिन्हे आणि त्यांचे उपयोग, शुद्धलेखन, समानार्थीशब्द (पर्यायवाची शब्द), विरुद्धार्थी शब्द.

घटक- ४

लेखनकौशल्य

लेखनकौशल्याचा परिचय- लेखनकौशल्याचे महत्त्व आणि आवश्यकता, पत्रलेखन, निबंधलेखन, वृत्तलेखन

(वृत्तपत्रीयलेखन), इतिवृत्तलेखन, सारांशलेखन.

घटक- ५

भाषांतर (मराठीतून इंग्रजी अणि इंग्रजीतून मराठी)

भाषांतराचा मूलभूत परिचय- भाषांतराची व्याख्याआणि स्वरूप, महत्त्वआणि उपयोग, भाषांतराचे प्रकार इ., पारिभाषिक शब्दावली, मराठीतून इंग्रजी आणि इंग्रजीतून मराठी भाषांतर.

संदर्भ साहित्य:

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

Course Title : Modern Indian Language(सामान्य हिंदी / व्यावहारिक हिंदी) **Semester : IV**
Course Code : 24UD1000AE410B **L – T – P : 2-0-0**
Prerequisite : Nil **Credits : 2**
Course Type : AEC

पाठ्यक्रम उद्देश्य (Course Objective):

1. हिंदी भाषा के उद्भव, विकास और ऐतिहासिक प्रवृत्तियों को समझाना।
2. हिंदी व्याकरण और लेखन कौशल में दक्षता प्रदान करना।
3. प्रशासन, शिक्षा और संचार में हिंदी के व्यावहारिक उपयोग को स्पष्ट करना।
4. अनुवाद कौशल विकसित करना, जिससे तकनीकी एवं व्यावसायिक संचार सुगम हो।

अपेक्षित परिणाम (Course Outcomes):

1. विद्यार्थी हिंदी भाषा के ऐतिहासिक और आधुनिक विकास को समझेंगे।
2. हिंदी व्याकरण और लेखन के नियमों में दक्षता प्राप्त करेंगे।
3. व्यावसायिक, प्रशासनिक और तकनीकी लेखन में हिंदी का प्रयोग कर सकेंगे।
4. अनुवाद के सिद्धांतों को सीखकर अंग्रेजी और हिंदी के बीच प्रभावी अनुवाद कर सकेंगे।

Course Contents:

इकाई – १

हिंदी भाषा का उद्भव और स्रोत

हिंदी भाषा की उत्पत्ति और स्वरूप, संस्कृत, प्राकृत और अपभ्रंश से हिंदी का विकास, हिंदी की प्रमुख बोलियाँ (ब्रज, अवधी, खड़ी बोली, भोजपुरी, राजस्थानी आदि), हिंदी पर फारसी, अरबी और अंग्रेज़ी भाषाओं का प्रभाव.

इकाई- २

स्वातंत्र्योत्तर काल में हिंदी भाषा

प्रशासन, शिक्षा और संचार माध्यमों में हिंदी की भूमिका, राजभाषा के रूप में हिंदी – संवैधानिक स्थिति और व्यावहारिक उपयोग, हिंदी का वैश्विक विस्तार और डिजिटल माध्यमों में हिंदी की उपस्थिति, प्रशासन और संचार माध्यमों में हिंदी.

इकाई- ३

हिंदी भाषा लेखन के नियम और व्याकरण

वर्णमाला, शब्द-भेद, संधि, वाक्य रचना, वर्तनी, उपसर्ग, प्रत्यय और शब्द निर्माण की प्रक्रिया, विराम चिन्हों का प्रयोग पर्यायवाची शब्द, विलोम शब्द.

इकाई- ४

लेखन कौशल

पत्र लेखन, प्रतिवेदन (रिपोर्ट) लेखन, विज्ञप्ति, नोटिस और परिपत्र लेखन, निबंध लेखन, सार लेखन.

इकाई- ५

अनुवाद (अंग्रेजी से हिंदी और हिंदी से अंग्रेजी)

अनुवाद : सिद्धांत और परंपरा, अनुवाद : क्षेत्र, प्रकार, पारिभाषिक शब्दावली, अंग्रेजी से हिंदी और हिंदी से अंग्रेजी अनुवाद.

Reference books:

1. डॉ. हरीशचंद्र वर्मा, "***हिंदी भाषा का उद्भव और विकास***", लोकभारती प्रकाशन.

2. डॉ. रामविलास शर्मा, "***हिंदी भाषा का इतिहास***", राजकमल प्रकाशन.
3. डॉ. विश्वनाथ प्रसाद, " ***भारत में राजभाषा हिंदी***", भारतीय राजभाषा परिषद.
4. डॉ. हरीशचंद्र वर्मा ,"***हिंदी व्याकरण और रचना***", लोकभारती प्रकाशन.
5. डॉ. रमेश गुप्ता ,"***हिंदी लेखन कौशल***", साहित्य भवन.
6. डॉ. ओमप्रकाश ,"***अनुवाद विज्ञान और सिद्धांत***", राजकमल प्रकाशन.

Course Title : Modern Indian Language(संस्कृतअभ्यासक्रम) **Semester : IV**
Course Code : 24UD1000AE410C **L – T – P : 2-0-0**
Prerequisite : Nil **Credits : 2**
Course Type : AEC

Course Objective:

1. संस्कृत भाषेचा ऐतिहासिक प्रवास
2. संस्कृत लेखनाचे नियम, व्याकरण आत्मसात करणे.
3. दैनंदिन संवादासाठी लागणारे काही शब्द यांचा अभ्यास करणे.

Course Outcomes:

1. विद्यार्थी संस्कृत भाषेच्या ऐतिहासिक प्रवासाची समज वाढवतील आणि तिच्या विकासातील टप्पे स्पष्टपणे सांगू शकतील.
2. शुद्ध व प्रमाणबद्ध लेखन करण्याची क्षमता प्राप्त होईल.
3. विविध प्रकारच्या लेखन शैली आत्मसात करून लेखन करू शकतील.
4. अचूक, स्पष्ट आणि भाषिक-सांस्कृतिक दृष्टिकोनातून योग्य भाषांतर करू शकतील.

Course Contents:

UNIT I

Introduction to Sanskrit

Importance and history of Sanskrit, Sanskrit alphabets (Varnamala), Swaras (Vowels), Vyanjanas (Consonants), Pronunciation and script (Devanagari)

UNIT II

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).

UNIT III

Simple Vocabulary and Sentence Formation

Basic words and their meanings (nature, family, animals, objects, etc.), Greetings and basic conversational phrases, Formation of simple sentences.

UNIT IV

Selected Sanskrit Shlokas and Subhashitas

Recitation and meaning of simple verses from Bhagavad Gita, Hitopadesha, or Panchatantra, Common proverbs (Subhashitas).

UNIT V

Reading and Writing Practice

Reading simple Sanskrit texts, Writing small paragraphs in Sanskrit.

सन्दर्भ पुस्तकानि :

१. संस्कृत साधना डॉ मधुसूदन पेन्ना

२. अभ्याससारिणी (संस्कृत व्याकरणम्) संस्कृतसंवर्धन प्रतिष्ठान देहली

३. विभक्तिवल्लरी (संस्कृतभारती बेंगलुरु)

४. संस्कृत व्यवहारसाहस्री (संस्कृतभारती बेंगलुरु)

५. सम्भाषणसोपानम् - जनार्दन हेगडे (संस्कृतभारती बेंगलुरु)

६. सुभाषित संस्कृतम् (संस्कृतभारती बेंगलुरु)

७. हितोपदेश - मित्रलाभ

८. भारतीय ज्ञान परम्परा - आचार्य श्री श्रेयस कुर्डेकर

Course Title : Time Series Analysis using python **Semester : IV**
Course Code : 24UD1246VSL411 **L – T – P : 1-0-2**
Prerequisite : Nil **Credits : 02**
Course Type :VSEC

Course Objective:

1. To provide an understanding of the fundamental concepts of time series analysis and its historical context.
2. To teach the basics of Python programming and its application in time series analysis.
3. To equip students with techniques for exploratory time series data analysis, including autocorrelation and decomposition methods.
4. To explain stationary time series models, their properties, and relevant statistical tests.
5. To cover ARMA and ARIMA models, including model building, estimation methods, and forecasting techniques.

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand the key concepts and objectives of time series analysis.
2. To use Python and its libraries for time series analysis.
3. To perform exploratory data analysis on time series data using various techniques.
4. To understand and apply stationary time series models, including moving average and autoregressive models.
5. To build, estimate, and diagnose ARMA and ARIMA models and use them for forecasting.

Course Contents:

UNIT I

Time Series Concepts and Python **[08 Hours]**

The Concept of Time Series, What Is Time Series , Brief History of Time Series Analysis, Objectives of Time Series Analysis, The Programming Language Python, Introduction and Installing, Demonstrations, Python Extension Packages and Some Usages, Time Series Moment Functions and Stationarity, Moment Functions, Stationarity and Ergodicity, Sample Autocorrelation Function, White Noise and Random Walk, Time Series Data Visualization.

UNIT II

Exploratory Time Series Data Analysis **[05 Hours]**

Partial Autocorrelation Functions , Definition of PACF , Sample PACF and PACF Plot, White Noise Test, Simple Time Series Compositions , Time Series Decomposition and Smoothing , Deterministic Components and Decomposition Models , Decomposition and Smoothing Methods.

UNIT III

Stationary Time Series Models **[05Hours]**

Backshift Operator, Differencing, and Stationarity Test, Backshift Operator, Differencing and Stationarity, KPSS Stationarity Test, Moving Average Models, Definition of Moving Average Models, Properties of MA Models, Invertibility , Autoregressive Models , Definition of Autoregressive Models , Durbin-Levinson Recursion Algorithm , Properties of Autoregressive Models , Stationarity and Causality of AR Models , Autoregressive Moving Average Models , Definitions, Properties of ARMA Models.

UNIT IV

ARMA and ARIMA Modeling and Forecasting **[05 Hours]**

Model Building Problems, Estimation Methods , The Innovations Algorithm, Method of Moments,

Method of Conditional Least Squares, Method of Maximum Likelihood, Order Determination, Diagnosis of Models , Forecasting.

UNIT V

Non-stationary Time Series Models **[05 Hours]**

The Box-Jenkins Method, Seasonal Differencing, SARIMA Models , SARIMA Model Building , General Idea , Case Studies, REGARMA Models.

Textbooks:

1. Changquan Huang, AllaPetukhina***, "Applied Time Series Analysis and Forecasting with Python"***, Springer.
2. Brockwell, P.J. and R.A. Davis, ***"Time Series: Theory and Methods"***, 2nd edition, Springer-Verlag, 2009.
3. Cowpertwait, Paul S.P and Andrew V. Metcalfe, ***"Introductory Time Series with R"***, Springer, 2008.
4. Kirchgassner, G. and J. Wolters, ***"Introduction to Modern Time Series Analysis"***, Springer, 2007.

Reference books:

1. G.E.P., Jenkins, G.M. and Reinsel, G.C. , ***"Time Series Analysis, Forecasting and Control, Box"***, Prentice-Hall, 1994.
2. Chris Chatfield, and Haipeng Xing ***,"The Analysis of Time Series: An Introduction with R"***, CRC Press, London., 2019.
3. Galit Shmueli and Kenneth C. Lichtendahl Jr, ***"Practical Time Series Forecasting with R: A hands-on Guide"***, Axelrod Schnall Publishers, 2016.

Course Title : Object Oriented Programming with Java Lab | **Semester : IV**
Course Code : 25UD1246PCL412 | **L – T – P : 0-0-2**
Prerequisite : Programming in C Lab | **Credits : 1**
Course Type : PCC

List of Experiments:

1. Write a Java program to demonstrate the use of classes, objects, and constructors.
2. Implement a program to calculate the area and perimeter of a shape using method overloading.
3. Create a program to illustrate the use of static keywords for methods and variables.
4. Design a program to demonstrate the principle of encapsulation using private data members and public methods.
5. Develop a simple program that showcases single and multilevel inheritance.
6. Write a program that demonstrates method overriding and the use of the super keyword.
7. Create a program that uses an abstract class to define a common structure for multiple derived classes.
8. Implement a program that uses an interface to define a contract for classes.
9. Demonstrate the use of an array of objects.
10. Write a program to handle exceptions using try, catch, and finally blocks.
11. Develop a program that uses a user-defined exception.
12. Create a program to read and write text data to a file.
13. Implement a multi-threaded application to perform a task concurrently.
14. Write a program to demonstrate thread synchronization to prevent race conditions.
15. Develop a simple GUI application using Swing that includes a button and a text field.

Multidisciplinary Minor II [Semester IV]

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
	Any One		MD-M	02	00	00	02	20	20	60	-	-	100
1	Object Oriented Programming with Java	25UD1246MD406A											
2	Data Communication and Computer Networks	24UD1246MD406B											
3	Probability and Statistics	24UD1246MD406C											
4	Discrete Mathematics	25UD1246MD406D											

Course Title : Object Oriented Programming with Java **Semester : IV**
Course Code : 24UD1246MD406A **L – T – P : 2-0-0**
Prerequisite : Programming in C **Credits : 2**
Course Type: MDM

Course Objective:

1. To understand the foundational concepts of OOP, including classes, objects, inheritance, Polymorphism and encapsulation.
2. To gain proficiency in writing, compiling, and debugging Java programs.
3. To apply core Java features for effective problem-solving.
4. To develop a strong understanding of essential concepts like exception handling, multithreading.
5. To prepare students to design and implement robust, reusable, and efficient Java applications.

Course Outcomes:

After successful completion of this course the student will be able:

1. To explain and apply fundamental OOP concepts to model real-world problems.
2. To use inheritance and polymorphism to create flexible and scalable code.
3. Implement methods for handling runtime errors using exception handling.
4. To develop programs that interacts with files and handle data streams.
5. To create multi-threaded applications to enhance performance and concurrency.

Course Contents:

UNIT I

Introduction to Java and OOP Fundamentals **[08 Hours]**

Java's history, features, and the Java Virtual Machine (JVM), Classes and Objects: Defining classes, creating objects, and understanding constructors, Data Types and Control Structures: Primitive types, variables, operators, and control flow statements, Methods and Overloading: Creating methods, passing arguments, and method overloading.

UNIT II

Inheritance, Interfaces, and Packages **[07 Hours]**

Inheritance: The concept of inheriting classes, using the super keyword, and method overriding, Polymorphism: The difference between compile-time and run-time polymorphism. Abstract Classes and Interfaces: Creating and implementing interfaces and abstract classes, Packages: Organizing classes into packages and managing access control.

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UNIT III

Exception Handling and Collections **[06 Hours]**

Exception Handling: The try-catch-finally block, throw and throws keywords, and custom exceptions, The Throwable class and different exception types.

UNIT IV

Multithreading and File I/O **[05 Hours]**

Multithreading: The concept of threads, creating threads using the Thread class and Runnable interface. Synchronization: Ensuring thread safety and inter-thread communication.

UNIT V

Graphical User Interface **[05Hours]**

Event Handling: The Delegation Event Model, event sources, and listeners, GUI Programming with AWT and Swing: Creating windows, panels, and basic components like buttons and text fields. Layout Managers.

Textbooks:

1. E. Balagurusamy, "***Programming with Java Primer***", McGraw Hill publication, 7th edition, 2023.
2. Herbert Schildt, "***Java, The Complete Reference***", McGraw Hill publication, 13th edition, 2024.

Reference books:

1. Joshua Bloch, "***Effective Java",*** 3rd Edition, Pearson publication, 2017.
2. Robert C. Martin, ***"Clean Code: A Handbook of Agile Software Craftsmanship"***, Prentice Hall, 2008.

Course Title : Data Communication and Computer Networks **Semester : IV**
Course Code : 24UD1246MD406B **L – T – P : 2-0-0**
Prerequisite : Nil **Credits : 2**
Course Type : MDM

Course Objective:

1. To introduce students to the basic components and concepts of data communication and networking.
2. To provide a comprehensive understanding of transmission media, multiplexing and switching.
3. To explain error detection and correction techniques, and medium access control.
4. To explain the functions and protocols associated with Internet layer, Transport and Application layers.
5. To understand the various network topologies and network devices.

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand the fundamentals of data communication and computer networks.
2. To understand transmission media, multiplexing and switching.
3. To gain the ability to implement and analyze error detection and correction techniques and understand medium access control methods.
4. To be capable of describing Internet and Transport layer protocols.
5. To identify and explain the various components and topologies of data communication systems.

Course Contents:

UNIT I

Fundamentals of Data Communication and Computer Network **[06 Hours]**

Process of data communication and its components: Transmitter, Receiver, Medium, Message, Protocols, Bandwidth, Data transmission rate, Baud rate and Bits per second, Modes of communication (Simplex, Half duplex, Full Duplex), Analog signal and digital signal, Analog and Digital Transmission: analog to digital, digital to analog conversion, Fundamentals of computer networks, Classification of network: LAN, WAN, MAN.

UNIT II

Transmission Media and Switching **[05 Hours]**

Guided transmission media: Twisted-pair cable, Coaxial cable, Fiber-optic cable, Unguided transmission media: Radio waves, Microwaves, Infrared, Satellite, Line-of-sight Transmission.

UNIT III

Error Detection and Correction **[05 Hours]**

Types of errors, Forward error correction versus retransmission, Framing: fixed sized and variable sized framing, Error detection: Repetition codes, Parity bits, Checksums, CRC, Error Correction: Hamming Code.

UNIT IV

Network Communication Models **[05 Hours]**

The OSI model: layered architecture, Encapsulation, Layers in OSI Model and its functions, TCP/IP layers and their functions, Introduction to protocols and their functions.

UNIT V

Network Topologies and Network Devices **[05 Hours]**

Network topologies: Introduction, Definition, Selection criteria, Types of topology- Star, Mesh, Tree, Hybrid, Network connecting devices: Switch, Router, Repeater, Bridge.

Textbooks:

1. Behrouz A. Forouzan ,***"Data Communications and Networking"***, 4th edition TMH, 2006.
2. Andrew S Tanenbaum, ***"Computer Networks"***, 4th edition. Pearson Education, PHI.

Reference books:

1. P.C .Gupta, ***"Data communications and Computer Networks"***, PHI.
2. S. Keshav, ***"An Engineering Approach to Computer Networks"***, 2nd edition, Pearson Education.
3. W.A. Shay, ***"Understanding communications and Networks"***, 3rd edition, Cengage Learning.
4. James F.Kurose and Keith W. Ross, ***"Computer Networking: A Top-Down Approach Featuring the Internet."*** 3rd edition, Pearson Education.
5. William Stallings, ***"Data and Computer Communication"***, 6th edition, Pearson Education, 2000.

Course Title : Probability and Statistics **Semester : IV**
Course Code : 24UD1246MD406C **L – T – P : 2-0-0**
Prerequisite : Nil **Credits : 2**
Course Type : MDM

Course Objective:

1. To understand probability concepts.
2. To acquire knowledge of probability distributions.
3. To get exposure to hypothesis testing using distributions.
4. To understand principles of correlation and regression.
5. To be exposed to discrete time Markov chains.

Course Outcomes:

After successful completion of this course the student will be able:

1. To acquire analytical ability in solving mathematical problems as applied to the respective branches of engineering.
2. To understand the use of probability distribution in real life situations
3. To identify the correlation and regression between two parameters.
4. To test research outcomes using hypothesis testing.
5. To predict the future outcome in uncertainties using the markov chain.

Course Contents:

UNIT I

Probability Theory **[06 Hours]**

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, Random Variable and Mathematical Expectation: Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation.

UNIT II

Theoretical Probability Distributions **[06 Hours]**

Binomial distribution, Poisson distribution, Normal distribution, Properties of binomial, Poisson and normal distributions.

UNIT III

Correlation **[07 Hours]**

Introduction, Types of correlation, Correlation and causation, Karl Pearson's correlation coefficient, Spearman's rank correlation, Linear Regression Analysis: Introduction, Linear and non-linear regression, Lines of regression, Derivation of regression lines of y on x and x on y.

UNIT IV

Testing of Hypothesis **[06 Hours]**

Introduction to Sampling Distributions, Population and Sample, Null Hypothesis and Alternative Hypothesis, Single and Two Tailed Test, Testing of Hypothesis, Level of Significance, Critical Region, Procedure for Testing of Hypothesis Large Sample Test- Test for Single Proportion, Large Sample Test- Test for Single Mean, Small Sample Tests – "t" Test For a Single Mean, "t" Test for the difference of Means, Chi Square Test for Goodness of Fit.

UNIT V

Applied Statistics **[06 Hours]**

Curve fitting by the method of least squares- fitting of straight lines, Markov Chains: Introduction to Stochastic process, Markov process, Markov chain one step & n-step Transition Probability.

Textbooks:

1. Veerarajan T., **"*Probability, Statistics and Random Processes*"**, Tata McGraw Hill, 1st reprint, 2004.
2. S. C. Gupta and V.K. Kapoor, **"*Fundamentals of Mathematical Statistics*"**, Sultan Chand & Sons, 9 th extensively revised edition, 1999.
3. G. V. Kumbhojkar, **"*Probability and Random Processes*"**, C. Jamnadas and Co., 14th edition, 2010.
4. Erwin Kreyszig, **"*Advanced Engineering Mathematics*"**, John Wiley & Sons, 9th edition, 2006.
5. Veerarajan T., **"*Engineering Mathematics (for semester III)*"**, Tata McGraw-Hill, New Delhi, 2010.
6. G. Haribaskaran, **"*Probability, Queuing Theory and Reliability Engineering*"**, Laxmi Publications, 2nd edition, 2009.
7. Murray Spiegel, John Schiller, R. ALU Srinivasan, **"*Probability and Statistics*"**, Schaum's Outlines, 4th edition, 2013.

Reference books:

1. Trivedi K. S., **"*Probability and Statistics with reliability, Queueing and Computer Science Applications*"**, Prentice Hall of India, New Delhi, 1984.
2. Gross.D, Harris.C.M., **"*Fundamentals of Queuing Theory*"**, John Wiley and Sons, 1985.
3. Allen. A. O., **"*Probability Statistics and Queuing Theory*"**, Academic Press, 1981.

Course Title : Discrete Mathematics **Semester : IV**
Course Code : 25UD1246MD406D **L – T – P : 2-0-0**
Prerequisite : Engineering Mathematics I and II **Credits : 2**
Course Type : MDM

Course Objective:

1. To provide a solid foundation in the core concepts and techniques of discrete mathematics.
2. To develop skills in logical reasoning and formal proof techniques.
3. To enhance students' ability to think algorithmically and understand the theoretical underpinnings of computer science.
4. To apply discrete mathematical concepts to solve problems in computer science and related fields.
5. To introduce students to mathematical modeling using discrete structures.

Course Outcomes:

After successful completion of this course the student will be able:

1. To demonstrate a clear understanding of fundamental discrete structures such as sets, relations, functions, and sequences.
2. To construct and evaluate mathematical proofs using logical reasoning, including direct proofs, indirect proofs, and proof by induction.
3. To apply combinatorial techniques to solve counting problems, including permutations, combinations, and the principle of inclusion-exclusion.
4. To understand and apply basic concepts of graph theory, including graph representations, traversal algorithms, and graph coloring.
5. To develop mathematical models for real-world problems using discrete structures and analyze these models.

Course Contents:

UNIT I

Sets and Sequences **[05 Hours]**

Data Models. Finite Sets, Power Set, Cardinality of finite sets, Cartesian Product, Properties of Sets, Vector Implementations of Sets.

UNIT II

Describing Sets : Logic & Proof **[06 Hours]**

Introduction to Logic. Propositional Logic, Truth tables, Deduction, Resolution, Predicates and Quantifiers, Mathematical Proofs. Infinite sets, well-ordering. Countable and Uncountable sets, Cantor's diagonalization. Mathematical Induction - weak and strong induction

UNIT III

Relational Structures on Sets : Relations &Grap **[05 Hours]**

Relations, Equivalence Relations. Functions, Bijections. Binary relations and Graphs. Trees (Basics). Posets and Lattices, Hasse Diagrams. Boolean Algebra.

UNIT IV

Sizes of Sets : Counting and Combinatorics **[05 Hours]**

Counting, Sum and product rule, Principle of Inclusion Exclusion. Pigeon Hole Principle, Counting by Bijections. Double Counting. Linear Recurrence relations - methods of solutions. Generating Functions. Permutations and counting.

UNIT V

Structured Sets **[05 Hours]**

Algebraic Structures Structured sets with respect to binary operations. Groups, Semi groups, Monoids. Rings, and Fields. Vector Spaces, Basis.

Text Books:

1. Ralph P. Grimaldi, ***"Discrete and Combinatorial Mathematics: An Applied Introduction"***.
2. Susanna S. Epp, ***"Discrete Mathematics: An Introduction to Mathematical Reasoning".***
3. Ronald L. Graham, Donald E. Knuth, and Oren Patashnik, ***"Concrete Mathematics: A Foundation for Computer Science"***.
4. Douglas B. West, ***"Introduction to Graph Theory".***

Reference Books:

1. Alan Tucker, ***"Applied Combinatorics"***.
2. Winfried Karl Grassmann, Jean-Paul Tremblay, ***"Logic and Discrete Mathematics: A Computer Science Perspective"***.

B. Tech. IT (Honors) [Semester IV]

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
	Any One												
1	Advanced Computer Architecture	24UD1246HR401											
2	Modern Algebra	24UD1246HR402	Honors	03	00	00	03	20	20	60	-	-	100
3	Advanced Data Structures	24UD1246HR403											

Course Title : Advanced Computer Architecture **Semester : IV**
Course Code : 24UD1246HR401 **L – T – P : 3-0-0**
Prerequisite : Computer Architecture and Organization **Credits : 3**
Course Type : Honors

Course Objective:

1. To introduce students to performance metrics in computer systems and techniques for enhancing performance.
2. To provide a foundational understanding of parallel processing concepts and pipelining in computer architectures.
3. To explore power dissipation issues in processors and techniques for designing low-power systems.
4. To delve into pipeline data-path design, challenges in ILP realization, and advanced concepts like out-of-order execution and branch prediction.
5. To discuss I/O types, models, protocols, and mechanisms like Sockets and Interrupt Service Routines (ISR).

Course Outcomes:

After successful completion of this course the student will be able:

1. To measure and analyze performance metrics in computer systems.
2. To understand the concepts and benefits of parallel processing and pipelining.
3. To design and evaluate instruction sets based on performance considerations.
4. To understand pipeline data-path design, hazards, and advanced execution techniques.
5. To be familiar with I/O models, protocols, and key mechanisms for efficient data transfer.

Course Contents:

UNIT I

Design Space Exploration and Optimizations **[06 Hours]**

Performance metrics and performance enhancement techniques, Basic concepts of parallel processing and pipelining, Power dissipation in processors, power metrics, and low-power design techniques.

UNIT II

Instruction set architecture design **[06 Hours]**

Instruction set design, implementation and performance perspectives, relative advantages of RISC and CISC instruction set, Data Path Design**.**

UNIT III

Instruction-level parallelism (ILP) **[06 Hours]**

Pipeline data-path, data-dependence. Challenges in ILP realization. Pipeline hazards and their solutions, out-of-order execution, branch prediction, and dynamic scheduling. VLIW and superscalar processors.

UNIT IV

Memory systems **[08 Hours]**

Overview of memory hierarchy, Cache design considerations, instruction vs. data caches, write-policy and replacement policy, analysis of cache performance, and cache design for performance enhancement. Brief overview of memory technologies (SRAM, DRAM, and flash).

UNIT V

Data Level Parallelism **[07 Hours]**

Flynn Processor classification, SIMD, MIMD, GPU architectures, IO: types, models, protocols, Sockets, ISR.

Textbooks:

1. J. L. Hennessy, D. A. Patterson, ***"Computer Architecture: a quantitative approach"***, Morgan Kaufmann, 5th edition, 2011, ISBN: 978-1558605961.
2. William Stallings, "***Computer Organization and Architecture"***, Prentice Hall, 10th edition, 2015, ISBN-10: 013293633X, ISBN-13: 978-0132936330

Reference books:

1. Andrew S. Tanenbaum, **"*Structured Computer Organization"***, Prentice Hall, 6th edition, 2012, ISBN: 978-0132916523.
2. Patterson, J.L. Hennessy, ***"Computer Organization and Design: The Hardware/Software Interface"***, Morgan Kaufmann, 5th edition, 2013, ISBN-13:9780124078864
3. C. Hamacher, Z. Vranesic and S. Zaky, ***"Computer Organization"***, McGraw-Hill, 5th edition, 2002, ISBN: 0072320869.

Course Title : Modern Algebra | **Semester : IV**
Course Code : 24UD1246HR402 | **L – T – P : 3-0-0**
Prerequisite : Nil | **Credits : 3**
Course Type : Honors

Course Objective:

1. To understand the fundamental concepts of groups, including subgroups and elementary properties of Abelian and non-Abelian groups.
2. To learn about cosets, the index of subgroups, and the properties of group homomorphisms and isomorphisms.
3. To explore specific examples such as the ring of real quaternions, rings of continuous functions, ring of matrices, and polynomial rings.
4. To understand the properties of ring homomorphisms and operations on ideals.
5. To understand Euclidean domains, principal ideal domains, and unique factorization domains.

Course Outcomes:

After successful completion of this course the student will be able:

1. To define and identify subgroups, Abelian groups, non-Abelian groups, and cyclic groups.
2. To analyze properties of group homomorphisms, isomorphisms, normal subgroups, and quotient groups.
3. To work with specific rings such as the ring of real quaternions, rings of continuous functions, ring of matrices, and polynomial rings.
4. To work with Euclidean domains, principal ideal domains, and unique factorization domains.
5. To develop a strong foundation in abstract algebra, enabling further study in advanced mathematics and related fields.

Course Contents:

UNIT I

Groups and Subgroups **[08 Hours]**

Introduction to Groups: Definition and Examples of Groups, Properties of Groups, Subgroups: Definition and Examples, Cyclic Subgroups, The Subgroup Test, Permutations and Symmetric Groups: Permutation Groups, Symmetric Groups, Group Homomorphisms and Isomorphisms: Homomorphisms, Isomorphisms, Properties of Isomorphisms, Cayley's Theorem: Statement and Proof, Cosets and Lagrange's Theorem: Cosets, Lagrange's Theorem, Applications of Lagrange's Theorem.

UNIT II

Rings and Fields **[08 Hours]**

Introduction to Rings: Definition and Examples of Rings, Ring Properties, Ring Homomorphisms and Isomorphisms: Homomorphisms, Isomorphisms, Ideals and Factor Rings: Ideals, Quotient Rings, Prime and Maximal Ideals, Integral Domains and Fields: Definitions and Properties, Characteristics of a Ring, Polynomial Rings: Definition and Examples, Division Algorithm, Roots of Polynomials.

UNIT III

Advanced Group Theory **[08 Hours]**

Normal Subgroups and Quotient Groups: Normal Subgroups, Quotient Groups, Group Actions: Definitions and Examples, Orbit and Stabilizer, Applications of Group Actions, Sylow Theorems: Sylow p-subgroups, Sylow Theorems and Applications, Direct Products and Finitely Generated Abelian Groups: Direct Products, Structure Theorem for Finitely Generated Abelian Groups.

UNIT IV

Advanced Ring Theory **[08 Hours]**

Modules over a Ring: Definition and Examples, Submodules and Quotient Modules, Module Homomorphisms: Definitions and Properties, Principal Ideal Domains (PIDs): Definition and Examples, Structure Theorems, Factorization in Integral Domains: Unique Factorization Domains (UFDs), Euclidean Domains.

UNIT V

Field Theory and Galois Theory **[07 Hours]**

Field Extensions: Algebraic and Transcendental Extensions, Degree of Field Extensions, Splitting Fields and Algebraic Closures: Definition and Properties, Examples, Finite Fields: Structure and Examples, Galois Theory: Automorphism Groups of Fields, Fundamental Theorem of Galois Theory, Applications of Galois Theory

Textbooks:

1. Joseph A. Gallian, ***"Contemporary Abstract Algebra"***, 4th edition, Narosa Publishing House, Nev Delhi, 1999.
2. I.N. Herstein, ***"Topics in Algebra",*** Wiley Eastern Limited, India, 1975.
3. John B. Fraleigh, ***"A First Course in Abstract Algebra"***, 7th edition, Pearson Prentice Hall, 2002.
4. David S. Dummit and Richard M. Foote, ***"Abstract Algebra"***, 3rd edition, John Wiley and Son (Asia) Pvt. Ltd, Singapore, 2004.

Reference books:

1. Michael Artin, ***"Abstract Algebra"***, 2nd edition, Pearson Prentice Hall, 2011.
2. Joseph J. Rotman, ***"An Introduction to the Theory of Groups"***, 4th edition, Springer Verlag, 1995.
3. Robinson, Derek John Scott., ***"An Introduction to Abstract Algebra"***, Hindustan Book Agency 2010.
4. D.A.R.Wallace, Groups, ***"Rings and Fields"***, Springer, 1998.

Course Title : Advanced Data Structures **Semester : IV**
Course Code : 24UD1246HR403 **L – T – P : 3-0-0**
Prerequisite : Data Structures and Applications **Credits : 3**
Course Type : Honors

Course Objective:

1. To review and solidify understanding of abstract data types, data structures, and algorithms.
2. To learn and implement various advanced priority queue structures such as leftist heaps, skew heaps, binomial heaps, Fibonacci heaps, pairing heaps, and double-ended priority queues.
3. To understand and implement various dictionary data structures including hash tables, universal hash functions, and balanced binary search trees.
4. To study and implement multidimensional and spatial data structures such as interval trees, segment trees, range trees, priority search trees, quadtrees, octrees, and R-trees.
5. To apply data structures in real-world applications such as IP router tables, web information retrieval, computational biology, geographic information systems, and computational geometry.

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand and apply the concepts of abstract data types, data structures, and algorithms.
2. To design and implement various advanced priority queue structures.
3. To analyze and compare the efficiency of different priority queue implementations.
4. To implement and utilize various dictionary data structures for efficient data storage and retrieval.
5. To understand the principles behind balanced binary search trees and advanced dictionary structures.

Course Contents:

UNIT I

Review of Basic Concepts: **[08 Hours]**

Abstract data types, Data structures, Algorithms, Big Oh, Omega and Theta notations, Solving recurrence equations, Amortized complexity.

UNIT II

Priority Queues: **[08 Hours]**

Leftist Heap, Skew Heaps, Binomial, Fibonacci and Pairing Heaps, Double ended priority queues.

UNIT III

Dictionary Structures: **[08 Hours]**

Hash Tables, Universal hash functions, Balanced Binary Search Trees, Splay Trees, 2-3 trees, 2-3-4 trees, Red-black trees, Skip lists, Randomized Dictionary Structures, Heap Trees.

UNIT IV

Multidimensional and Spatial Structures: **[08 Hours]**

Interval, Segment, Range, and Priority Search Trees, Quadtrees and Octrees, R-trees, Persistent Data Structures, Cache-Oblivious Data Structures.

UNIT V

Applications: **[07 Hours]**

IP Router Tables, Data Structures in Web Information Retrieval, Computational Biology, Geographic Information Systems, Computational Geometry: Geometric data structures.

Textbooks:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, ***"Introduction to Algorithms"***, PHI Learning Pvt. Ltd., 3rd edition.
2. Peter Brass, ***"Advanced Data Structures"***, Cambridge University Press.

Reference books:

1. Dinesh P. Mehta, Sartaj Sahni, ***"Handbook of Data Structures and Applications"***, Chapman and Hall/CRC.

B. Tech. IT (By Research)[Semester IV]

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
	Any One												
1	Development Research Methods	24UD1246RS401	Research	03	00	00	03	20	20	60	-	-	100
2	Research ethics and Integrity	24UD1246RS402											

Course Title : Development Research Methods **Semester : IV**
Course Code : 24UD1246RS401 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type : Research

Course Objective:

1. To explore different types of development studies and understand the continuum between development research and development work.
2. To gain insight into the concept of the 'field' and the role of the 'fieldworker' in development research.
3. To learn and apply qualitative research methods such as interviews, focus groups, participatory methods, diaries, and case studies in development research.
4. To adopt interdisciplinary perspectives and analyze problems using the logical framework approach.
5. To understand the challenges of implementing rights-based approaches and conducting social capital assessments.

Course Outcomes:

After successful completion of this course the student will be able:

1. To formulate typical research questions and understand the continuum between development research and development work.
2. To understand and navigate the dynamics of the 'field' and the role of the 'fieldworker' in development research.
3. To conduct qualitative research using methods such as interviews, focus groups, participatory methods, diaries, and case studies.
4. To adopt interdisciplinary perspectives to enhance the robustness of development research.
5. To evaluate evolving approaches in poverty analysis and implement gender analysis in development research.

Course Contents:

UNIT I

Different types of Development Studies: **[08 Hours]**
Forms of studies and typical research questions, development research-development work continuum.

UNIT II

Development Research Methods: **[08 Hours]**
Ethics and Values, Understanding the 'field' and the 'fieldworker'.

UNIT III

Qualitative development research methods **[08 Hours]**
Interviews, focus groups, participatory methods and approaches, diaries and case studies.

UNIT IV

Research methods and possible combinations **[08 Hours]**
Quantitative methods, mixed methods, interdisciplinary perspectives, problem analysis in logical framework approach.

UNIT V

Selected development issues and approaches: **[08 Hours]**

Evolving approaches in poverty evaluation; gender analysis and approaches to gender mainstreaming; challenges of implementing rights based approaches; social capital assessments.

Textbooks:

1. Mikkelsen, B., ***"Methods for Development Work and Development Research"***, 2nd edition, SAGE, 2005.
2. Desai, V. and Potter Robert B., ***"Doing Development Research"***, SAGE, 2006.
3. Thomas A. and Mohan G., ***"Research Skills for Policy and Development*** **How to find out fast"**, Sage Publications, 2007.

Reference books:

1. Sumner, A. and Tribe, M., ***"International Development Studies: Theories and Methods in Research and Practice"***, Sage London, 2008.
2. M. N. Srinivas, ***"The Fieldworker and the Field: Problems and Challenges in Sociological Investigation"***, Oxford India, 1979.

Course Title : Research Ethics and Integrity **Semester : IV**
Course Code : 24UD1246RS402 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type : Research

Course Objective:

1. To familiarize students with ethical principles and guidelines governing research.
2. To develop an understanding of the importance of integrity in research practices.
3. To equip students with the knowledge to recognize and address ethical dilemmas in research.
4. To prepare students to apply ethical standards in their own research activities.
5. To cultivate a commitment to responsible conduct of research and academic integrity

Course Outcomes:

After successful completion of this course the student will be able:

1. To identify and analyze ethical issues in research.
2. To apply ethical principles and guidelines to various research scenarios.
3. To demonstrate understanding of the consequences of research misconduct.
4. To develop strategies to promote integrity and ethical conduct in research.
5. To demonstrate the ability to conduct research with integrity and respect for ethical standards.

Course Contents:

UNIT I

Introduction to Research Ethics: **[07 Hours]**
Definition and importance of research ethics, Historical perspectives on research misconduct, Ethical principles (e.g., beneficence, justice, respect for persons), Ethical guidelines and regulations (e.g., Institutional Review Boards).

UNIT II

Ethical Issues in Research: **[07 Hours]**
Informed consent and confidentiality, Data management and sharing, Plagiarism and academic integrity, Conflicts of interest.

UNIT III

Research with Human Subjects: **[07 Hours]**
Ethical considerations in social and behavioral sciences, Ethical issues in medical and clinical research Vulnerable populations and special considerations.

UNIT IV

Responsible Conduct of Research: **[07 Hours]**
Research integrity and misconduct, Authorship and publication ethics, Peer review process and ethical considerations.

UNIT V

Case Studies and Practical Applications: **[07 Hours]**
Analysis of case studies in research ethics, Ethical decision-making frameworks, Application of ethical principles in research proposals and projects.

Textbooks:

1. Adil E. Shamoo and David B. Resnik, "***Responsible Conduct of Research***" .
2. Kristin Shrader-Frechette, ***"Ethics in Science: Ethical Misconduct in Scientific Research"***.
3. Eric Kodish, ***"Ethical Issues in Research Involving Human Participants"*** .
4. Don Munoz, ***"Case Studies in Research Ethics"***.

Reference books:

1. John P. Gall, Jr. and Edward L. Pohlman , ***"Ethics and Integrity in Research and Practice".***
2. Paul F. Camenisch and A. Rebecca Reviere, ***"The Ethics of Research with Human Subjects"***.
3. Nicholas H. Steneck, ***"The Responsible Conduct of Research".***
4. Deborah C. Poff and Wilfrid J. Waluchow, "***Ethical Issues in Research: A Guide for Students and Researchers***".
5. Patricia J. Garcia and Lynn H. Singer, ***"Ethical Challenges in Study Design and Informed Consent for Health Research in Resource-Limited Settings".***
6. Elizabeth C. Wager and Tony M. Barker, ***"The Research Ethics Guidebook: A Handbook for Students and Researchers"*** .
7. Michael J. Quinn, ***"Research Ethics: A Reader".***

EXIT SCHEME COURSES FOR UG DIPLOMA IN IT

EXIT SCHEME:

The student will have to complete all courses from any one of the groups to be eligible to get a UG Diploma in Information Technology after second year.

Bucket of Courses: Group I

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
1	Multimedia and its Applications	24UD1246VSMA11	Exit scheme	03	00	00	03	20	20	60	-	-	100
2	Computer Graphics	24UD1246VSCG12											
3	Digital Signal Image Processing	24UD1246VSDP13											

Bucket of Courses: Group II

Sr. No	Course Title	Course Code	Course Type	Teaching Scheme – Hours per week				Examination Scheme - Marks					
				L	T	P	CR	CA	MSE	ESE	TW	PR/ OR	Total
1	Machine Learning	24UD1246VSML21	Exit scheme	03	00	00	03	20	20	60	-	-	100
2	Deep Learning	24UD1246VSDL22											
3	Reinforcement Learning	24UD1246VSRL23											

Bucket of Courses: Group I

Course Title : Multimedia and its Applications **Semester : IV**
Course Code : 24UD1246VSMA11 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type : Exit

Course Objective:

1. To gain a comprehensive understanding of multimedia definitions, classifications, applications, and the hardware and software components used in multimedia, including CDROM and DVD.
2. To learn about digital audio technology, including sound cards, recording, editing, and different audio file formats to Understand MP3 and MIDI fundamentals and how to integrate sound into multimedia projects.
3. To understand the role of text and graphics in multimedia, including coloring, digital imaging fundamentals, development and editing of graphics, file formats, scanning, and digital photography.
4. To gain knowledge of computer animation fundamentals, including kinematics, morphing, and various animation software tools and techniques.
5. To understand how video works, broadcast video standards, digital video fundamentals, production, and editing techniques, along with different video file formats.

Course Outcomes:

After successful completion of this course the student will be able:

1. To demonstrate a thorough understanding of multimedia definitions, classifications, applications, and the necessary hardware and software, including CDROM and DVD technologies.
2. To apply knowledge of digital audio technology to record, edit, and work with various audio file formats, including MP3 and MIDI, and incorporate sound effectively into multimedia projects.
3. To utilize text and graphics in multimedia projects, with skills in digital imaging, editing, and an understanding of various file formats, as well as scanning and digital photography techniques.
4. To create animations using fundamental computer animation principles, kinematics, morphing, and various animation software tools and techniques.
5. To produce and edit digital videos, understanding broadcast video standards, digital video fundamentals, and different file formats used in multimedia.

Course Contents:

UNIT I

Introduction **[08 Hours]**

Definition, Classification, Multimedia application, Multimedia Hardware, Multimedia software, CDROM - DVD.

UNIT II

Multimedia Audi **[08 Hours]**

Digital medium, Digital audio technology, Sound cards, Recording, Editing, MP3, MIDI fundamentals, Working with MIDI , Audio file formats , Adding sound to Multimedia project.

UNIT III

Multimedia Text **[08 Hours]**

Text in Multimedia, Multimedia graphics: coloring, digital imaging fundamentals, development and editing , file formats , scanning and digital photography

UNIT IV

Multimedia Animation **[08 Hours]**

Computer animation fundamentals, Kinematics, morphing, animation software tools and techniques. Multimedia Video: How video works, broadcast video standards, digital video fundamentals, digital video production and editing techniques, file formats.

UNIT V

Multimedia Project **[08 Hours]**

Stages of project , Multimedia skills , design concept , authoring, planning and costing , Multimedia Team. Multimedia, looking towards the Future: Digital Communication and New Media, Interactive Television, Digital Broadcasting, Digital Radio, Multimedia Conferencing

Textbooks:

1. S. Gokul, "***Multimedia Magic***", BPB Publications, 2nd edition.
2. Tay Vaughen , "***Multimedia Making it Work***", TMH, 6th edition.

Reference books:

1. KiranThakrar, Prabhat k, and leigh, "***Multimedia System Design***", Prentice Hall India.
2. Malay k Pakhira, "***Computer graphics, Multimedia and Animation***", Prentice Hall India, 2nd edition.

Course Title : Computer Graphics **Semester : IV**
Course Code : 24UD1246VSCG12 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type : Exit

Course Objective:

1. To understand the fundamentals of computer graphics and to explore object representation techniques.
2. To develop a thorough understanding of matrix representation, homogeneous coordinate systems, and composition of 3D transformations.
3. To learn about illumination and shading, including lighting models, shading models, intensity representation, color models, and texture synthesis.
4. To understand the 3D viewing pipeline, view coordinate system, viewing transformation, projection methods, and window-viewport transformations.
5. To gain proficiency in 2D and 3D clipping algorithms, hidden surface removal techniques, and rendering processes. To understand scan conversion of lines, circles, fill areas, and characters, as well as anti-aliasing techniques.

Course Outcomes:

After successful completion of this course the student will be able:

1. To understand the historical evolution, key issues, challenges, and the graphics pipeline in computer graphics and the basics of graphics hardware and software.
2. To apply various object representation techniques, including boundary representation, splines, and space partitioning, to model complex objects in computer graphics.
3. To use matrix representation, homogeneous coordinate systems, and composition to perform 3D transformations.
4. To apply illumination and shading techniques, including simple lighting models, shading models, intensity representation, color models, and texture synthesis.
5. To execute 2D and 3D clipping algorithms, apply hidden surface removal techniques, and render graphics effectively. Perform scan conversion of lines, circles, fill areas, and characters, and apply anti-aliasing techniques.

Course Contents:

UNIT I

Introduction **[08 Hours]**

Historical evolution, issues and challenges, graphics pipeline, hardware and software basics, Objec representation – boundary representation, splines, space partitioning.

UNIT II

Modeling transformations **[08 Hours]**

Matrix representation, homogeneous coordinate system, composition, 3D transformations, Illumination and shading – background, simple lighting model, shading models, intensity representation, color models, texture synthesis.

UNIT III

3D viewing **[08 Hours]**

Viewing pipeline, view coordinate system, viewing transformation, projection, Window-viewpo transformation.

UNIT IV

Clipping and hidden surface removal: **[08 Hours]**

Clipping in 2D, 3D clipping algorithms, hidden surface removal, Rendering, scan conversion of line, circle, fill-area and characters, anti-aliasing.

UNIT V

Graphics hardware and software: **[07 Hours]**

Generic architecture, I/O, GPU, Shader programming, Graphics software (openGL).

Textbooks:

1. Samit Bhattacharya, ***"Computer Graphics"***, Oxford University Press, 2015.
2. Hearn. D,& Baker. M. P. , ***"Computer Graphics with OpenGL"***, 3rd edition, Pearson.

Reference books:

1. Graham Sellers, Richard S. Wright, Jr., Nicholas Haemel**,** ***"OpenGL Superbible: Comprehensive Tutorial and Reference"***, 7th edition, Addison-Wesley Educational Publishers,2015.
2. John F. Hughes, Andries van Dam, Morgan McGuire, David F. Sklar, James D. Foley, Steven K. Feiner, Kurt Akeley, ***"Computer Graphics: Principles and Practice"***, 3rd edition, Addison-Wesley Professional, 2013.
3. Alan Watt, ***"3D Computer Graphics"***, 2nd edition, 2000.

Course Title : Digital Signal Image Processing **Semester : IV**
Course Code : 24UD1246VSDP13 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type : Exit

Course Objective:

1. To understand the basic elements and advantages of DSP over analog signal processing.
2. To explain the A/D conversion process, including sampling, quantization, encoding, and the sampling theorem.
3. To understand FFT algorithms, including direct, divide and conquer, and radix-2 approaches.
4. To learn about transform domain processing and applications of FFT in convolution and DCT in JPEG compression.
5. To understand techniques for region and boundary segmentation, object recognition, and pattern classification.

Course Outcomes:

After completion of this course students will be able:

1. To understand the basic components of DSP systems and their advantages in processing digital signals.
2. To understand the process of A/D conversion and the importance of sampling and quantization.
3. To have practical experience with FFT algorithms for efficient signal processing.
4. To comprehend the concepts of image sampling, reconstruction, and quantization.
5. To understand methods for region and boundary segmentation, as well as object recognition and pattern classification in images.

Course Contents:

UNIT I

Introduction **[08 Hours]**

Basic elements of digital signal processing (DSP) system, advantage of digital over analog signal processing, summary of DSP applications and introduction to DSP through applications, Introduction to signal and system and its properties like linearity, time invariance; Linear convolution, properties of linear convolution, A\D conversion process as sampling, Quantization, encoding, sampling theorem.

UNIT II

Analysis of Signals **[08 Hours]**

Transform domain representation of the signal, Fourier transform, Fourier transform of standard signals, FFT algorithms, direct, divide and conquer approach, radix-2 algorithm.

UNIT III

Digital Image Processing fundamentals **[08 Hours]**

Introduction, Image Representation, Monochrome Vision Model, Color Vision Model, Image Sampling and Reconstruction Concepts for monochrome and color Image Monochrome and Color Image Quantization, Two-dimensional signal processing, VectorSpace Image Representation, Two-Dimensional Fourier Transform, Transform Domain Processing, Fast Fourier Transform Convolution, Discrete Cosine Transform its application in Baseline JPEG.

UNIT IV

Image Improvement Techniques **[08 Hours]**

Image Enhancement, Contrast manipulation, Histogram processing, Image restoration, Image denoising.

UNIT V

Image Analysis and feature extraction **[07 Hours]**

Edge detection, Color edge detection, Region and boundary segmentation, Object recognition, pattern and pattern classes.

Textbooks:

1. J.G. Proakis, D.G. Manolakis,***" Digital Signal processing"***, 4th edition, Pearson Education.
2. Rafael C. Gonzalez and Richard E. Woods, ***"Digital Image Processing"***, 2nd edition, Pearson.
3. Pratt W.K., ***"Digital Image Processing: PIKS Scientific Inside"***, 4th edition.

Reference books:

1. Ashok Ambardar,***"Digital signal processing: A modern introduction"***,1 edition, Cenage learning .
2. Milan Sonka, Vaclav Hlavac and Roger Boyle,***"Image Processing, Analysis and Machine Vision"***, 3rdedition, Springer.
3. Forsyth and Ponce, ***"Computer Vision – A Modern Approach"***, 2nd edition, Prentice Hall.
4. Richard Szeliski, ***"Computer Vision: Algorithms and Applications"***, Springer.

Bucket of Courses: Group II

Course Title : Machine Learning **Semester : IV**
Course Code : 24UD1246VSML21 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type : Exit

Course Objective:

1. To understand well-defined learning problems and the process of designing a learning system.
2. To comprehend the concept learning task and the general-to-specific ordering of hypotheses.
3. To learn and implement algorithms such as Find-S, list-then-eliminate, and candidate elimination.
4. To derive and implement the back propagation algorithm and understand its convergence and generalization properties.
5. To estimate hypothesis accuracy and understand the basics of sampling theory.

Course Outcomes:

After successful completion of this course the student will be able:

1. To implement algorithms such as Find-S, list-then-eliminate, and candidate elimination.
2. To design and train multilayer networks using the back propagation algorithm.
3. To use Bayes theorem for concept learning and apply the Bayes optimal classifier and Naïve Bayes classifier.
4. To apply instance-based learning techniques such as k-nearest neighbor and locally weighted regression.
5. To apply optimization and regularization techniques for deep learning and design convolutional networks.

Course Contents:

UNIT I

Introduction **[08 Hours]**

Well defined learning problems, Designing a Learning System, Issues in Machine Learning; - The Concept Learning Task - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias - Decision Tree Learning - Decision tree learning algorithm Inductive bias- Issues in Decision tree learning.

UNIT II

Artificial Neural Networks **[08 Hours]**

Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of back propagation rule Back propagation Algorithm- Convergence, Generalization; – Evaluating Hypotheses – Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms.

UNIT III

Bayesian Learning **[08 Hours]**

Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm; - Computational Learning Theory – Sample Complexity for Finite Hypothesis spaces, Sample Complexity for Infinite Hypothesis spaces, The Mistake Bound Model of Learning.

UNIT IV

Instance-Based Learning **[08 Hours]**

k-Nearest Neighbor Learning, Locally Weighted Regression, Radial basis function networks, Case-based

learning - Genetic Algorithms – an illustrative example, Hypothesis space search, Genetic Programming, Models of Evolution and Learning.

UNIT V

Reinforcement Learning **[08 Hours]**

The Learning Task, Q Learning, Support vector Machines, Deep learning networks – Deep Feed-forward Networks – Regularization for Deep Learning – Optimization for Training Deep Models – Convolution Network.

Textbooks:

1. Tom. M. Mitchell, ***"Machine Learning"***, McGraw Hill International edition, 1997
2. C Bishop, ***"Pattern Recognition and Machine Learning"***, Springer, 2006.

Reference books:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, ***"Deep Learning"***, The MIT Press Cambridge, Massachusetts, London, England, 2016.

Course Title : Deep Learning **Semester : IV**
Course Code : 24UD1246VSDL22 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type : Exit

Course Objective:

1. To learn the basics of supervised classification tasks and optimization techniques such as gradient descent, stochastic gradient descent, momentum, and adaptive sub-gradient methods.
2. To explore techniques for regularizing deep networks, model exploration, and hyper-parameter tuning.
3. To gain an understanding of convolutional neural networks (CNNs) and their components such as stacking, striding, and pooling.
4. To learn about recurrent neural networks (RNNs), unfolding computational graphs, and different types of RNNs including bidirectional RNNs and encoder-decoder architectures.
5. To study various types of autoencoders such as under complete, regularized, sparse, and denoising autoencoders.

Course Outcomes:

After successful completion of this course the student will be able:

1. To implement basic supervised classification tasks and optimize logistic classifiers using various gradient descent methods.
2. To apply regularization techniques, conduct model exploration, and tune hyper-parameters for deep networks.
3. To implement and understand recurrent neural networks, including their computational graphs and different variants.
4. To explore the representational power, layer size, and depth of autoencoders, and work with stochastic encoders and decoders.
5. To analyze and solve complex problems using deep learning techniques.

Course Contents:

UNIT I

Introduction **[08 Hours]**

Historical context and motivation for deep learning; basic supervised classification task, optimizing logistic classifier using gradient descent, stochastic gradient descent, momentum, and adaptive sub-gradient method.

UNIT II

Neural Networks **[08 Hours]**

Feed-forward neural networks, deep networks, regularizing a deep network, model exploration, and hyper parameter tuning.

UNIT III

Convolution Neural Networks **[08 Hours]**

Introduction to convolution neural networks: stacking, striding and pooling, applications like image, and text classification.

UNIT IV

Sequence Modeling **[08 Hours]**

Recurrent Nets: Unfolding computational graphs, recurrent neural networks (RNNs), bidirectional

RNNs, encoder-decoder sequence to sequence architectures, deep recurrent networks, LSTM networks.

UNIT V

Autoencoders **[08 Hours]**

Under complete autoencoders, regularized autoencoders, sparse autoencoders, denoising autoencoders, representational power, layer, size, and depth of autoencoders, stochastic encoders and decoders.

Textbooks:

1. Bunduma N. ,***"Fundamentals of Deep Learning",*** 2017.
2. Heaton, J. ***"Deep Learning and Neural Networks"***, Heaton Research Inc, 2015.

Reference books:

1. Deng, L., and Yu, D. ***"Deep Learning: Methods and Applications (Foundations and Trends in Signal Processing)",*** 2009.
2. Hall Mindy L, ***"Deep Learning"***, VDM Verlag, 2011.

Course Title : Reinforcement Learning **Semester : IV**
Course Code : 24UD1246VSRL23 **L – T – P : 3-0-0**
Prerequisite : Nil **Credits : 3**
Course Type : Exit

Course Objective:

1. To understand the connections between RL, related fields, and other branches of machine learning.
2. To introduce RL terminology, the Markov property, and concepts such as Markov chains and Markov reward processes (MRPs).
3. To understand the principle of optimality, iterative policy evaluation, policy iteration, and value iteration.
4. To introduce incremental Monte Carlo methods for model-free prediction and overview various TD methods such as TD(0), TD(1), and TD(λ).
5. To understand k-step estimators and provide a unified view of DP, MC, and TD evaluation methods.

Course Outcomes:

After successful completion of this course the student will be able:

1. To explain the origin, history, and significance of reinforcement learning in the context of machine learning.
2. To understand and apply RL terminology and concepts such as the Markov property, Markov chains, and MRPs.
3. To implement iterative policy evaluation, policy iteration, and value iteration algorithms.
4. To understand and implement various TD methods, including TD(0), TD(1), and TD(λ).
5. To develop a unified view of DP, MC, and TD evaluation methods and apply TD control methods like SARSA and Q-Learning.

Course Contents:

UNIT I

Introduction **[08 Hours]**

Course logistics and overview. Origin and history of Reinforcement Learning research. Its connections with other related fields and with different branches of machine learning.

UNIT II

Markov Decision Process **[08 Hours]**

Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP). Introduction to and proof of Bellman equations for MRPs along with proof of existence of solution to Bellman equations in MRP. Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations.

UNIT III

Prediction and Control by Dynamic Programming **[08 Hours]**

Overview of dynamic programming for MDP, Definition and formulation of planning in MDPs, Principle of optimality, Iterative policy evaluation, Policy iteration, Value iteration, Banach fixed point theorem, Proof of contraction mapping property of Bellman expectation and optimality operators, Proof of convergence of policy evaluation and value iteration algorithms, DP extensions.

UNIT IV

TD Methods **[08 Hours]**

Incremental Monte Carlo Methods for Model Free Prediction, Overview TD(0), TD(1) and TD(λ), k-step estimators, unified view of DP, MC and TD evaluation methods, TD Control methods - SARSA, Q Learning and their variants.

UNIT V

Policy Gradients **[08 Hours]**

Getting started with policy gradient methods, Log-derivative trick, Naive REINFORCE algorithm, bias and variance in Reinforcement Learning, Reducing variance in policy gradient estimates, baselines, advantage function, actor-critic methods.

Textbooks:

1. Richard S. Sutton and Andrew G. Barto, ***"Reinforcement Learning: An Introduction"***, 2nd edition, MIT Press, 2018.
2. Marco Wiering and Martijn van Otterlo, ***"Reinforcement Learning: State-of-the-Art"***, Springer-Verlag Berlin and Heidelberg GmbH and Co. K, 2012.
3. Stuart J. Russell and Peter Norvig, ***"Artificial Intelligence: A Modern Approach"***, 3rd edition, Pearson Education India, 2015.

Reference books:

1. Kevin P. Murphy, ***"Machine Learning: A Probabilistic Perspective"***, MIT Press, 2012.
2. Richard S. Sutton and Andrew G. Barto, ***"Reinforcement Learning: An Introduction"***, 2nd edition, KD publication, 2023.
3. Aaron Courville, Ian Goodfellow, Yoshua Bengio, ***"Deep Learning (Adaptive Computation and Machine Learning series)"***, MIT Press, 2016.