Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure and Syllabus

Second Year B. Tech

Artificial Intelligence and Machine Learning

With effect from Year 2024-25

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

Second Year B. Tech Artificial Intelligence and Machine Learning Semester-III (w.e.f. 2024-25)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	
							Continuous Assessment (CA)							
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1	PC	RCP23ACPC301	Linear Algebra and Optimization Techniques	3			25	15	15	15	60	100	3	3
2	PC	RCP23ACPC302	Data Structures	3			25	15	15	15	60	100	3	4
	PC	RCP23ALPC302	Data Structures Laboratory			2	25				25	50	1	
3	PC	RCP23ALPC303	Python Laboratory			4	25				25	50	2	2
4	MD	RCP23ACMD301	Operating Systems	2			25	15	15	15	60	100	2	2
5#	OE	RCP23OCOE301	Product Life Cycle Management	3			25	15	15	15	60	100	3	3
		RCP23OCOE302	Management Information System	3			25	15	15	15	60	100	3	
		RCP23OCOE303	Operations Research	3			25	15	15	15	60	100	3	
		RCP23OCOE304	Personal Finance Management	3			25	15	15	15	60	100	3	
		RCP23OCOE305	Public Systems and Policies	3			25	15	15	15	60	100	3	
		RCP23OCOE306	Fundamentals of Biomedical Instruments	3			25	15	15	15	60	100	3	
		RCP23OCOE307	IPR and Patenting	3			25	15	15	15	60	100	3	
		RCP23OCOE308	Entrepreneurship and Startup Ecosystem	3			25	15	15	15	60	100	3	
6	SC	RCP23IPSC301	Semester Project-I			2	25				25	50	1	1
7	HS	RCP23ITHSX01	Professional and Business Communication Tutorial		2		25					25	2	2
8	HS	RCP23ICHSX03	Economics and Financial Management	2			25	15	15	15	60	100	2	2
9	EL	RCP23ILELX05	Community Engagement Service			2	25					25	1	1
			Total	13	2	10	250			75	375	700	20	

#Any 1 Elective Course

Prepared by: Ms. S. P. Salunkhe

Checked by: Dr. P. S. Sanjekar

Prof. Dr. U. M. Patil
BOS Chairman

Prof. S. P. Shukla
C.O.E.

Prof. Dr. P. J. Deore
Dean Academics/Dy. Director

Prof. Dr. J. B. Patil
Director

Second Year B. Tech Artificial Intelligence and Machine Learning Semester-IV (w.e.f. 2024-25)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	
							Continuous Assessment (CA)							
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1	PC	RCP23ACPC401	Probability and Statistical Inference	3			25	15	15	15	60	100	3	3
2	PC	RCP23ACPC402	Design and Analysis of Algorithms	2			25	15	15	15	60	100	2	3
	PC	RCP23ALPC402	Design and Analysis of Algorithms Laboratory			2	25				25	50	1	
3	PC	RCP23ACPC403	Artificial Intelligence	2			25	15	15	15	60	100	2	3
	PC	RCP23ALPC403	Artificial Intelligence Laboratory			2	25				25	50	1	
4	PC	RCP23ALPC404	Programming Laboratory-II (Web Development)			2	25				25	50	1	1
5	MD	RCP23ACMD401	Database Management Systems	2			25	15	15	15	60	100	2	3
	MD	RCP23ALMD401	Database Management Systems Laboratory			2	25				25	50	1	
6#	OE	RCP23OCOE401	Project Management	3			25	15	15	15	60	100	3	3
		RCP23OCOE402	Cyber Security, Policies and Laws	3			25	15	15	15	60	100	3	
		RCP23OCOE403	Advanced Operations Research	3			25	15	15	15	60	100	3	
		RCP23OCOE404	Corporate Finance Management	3			25	15	15	15	60	100	3	
		RCP23OCOE405	Corporate Social Responsibility	3			25	15	15	15	60	100	3	
		RCP23OCOE406	Bioinformatics	3			25	15	15	15	60	100	3	
		RCP23OCOE407	Human Resource Management	3			25	15	15	15	60	100	3	
		RCP23OCOE408	Digital Marketing Management	3			25	15	15	15	60	100	3	
		RCP23OCOE409	Logistics and Supply Chain Management	3			25	15	15	15	60	100	3	
7	HS	RCP23ILHSX02	Design Thinking Laboratory			2	25					25	1	1
8	HS	RCP23ICHSX04	Universal Human Values	3			25	15	15	15	60	100	3	3
9	SC	RCP23IPSC401	Semester Project-II			2	25				25	50	1	1
			Total	15		12	300			90	485	875	21	

#Any 1 Elective Course

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Director

Semester - III

Linear Algebra and Optimization Techniques (RCP23ACPC301)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of

1. Solving a simultaneous linear equation using concept of matrices.
2. Calculus.

Course Objectives:

1. Understanding basic concepts of linear algebra.
2. Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
3. To understand the concept of Optimization and enhance the problem solving skills and Optimization techniques.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the concept of vector spaces, subspaces and the inner product spaces to the engineering problems.	L3	Apply
CO2	Apply the concept of vector spaces using linear transformations which is used in computer graphics and inner product spaces.	L3	Apply
CO3	Apply the concepts of eigenvalue and eigenvectors and diagonalization in linearsystems.	L3	Apply
CO4	Apply the concept of unconstrained optimization techniques to the engineering problems.	L3	Apply

Course Contents

Unit-I — 07 Hrs.

Vector Space and Inner Product Spaces:

Preview: Linear combinations of vectors, Linearly dependent and independent vectors. Definition of vector space over R, Subspaces. Basis and Dimension. Dot product in R, Definition of general inner product on a vector space over R. Norm of a vector in an inner product space. Cauchy-Schwarz inequality. Orthogonal sets and orthonormal sets in an inner product space. Orthogonal and orthonormal bases. Gram-Schmidt orthogonalization process simple examples in R^2 and R^3

Unit-II — 06 Hrs.

Linear Transformations: Definition and properties. Kernel and image of a linear transformation, Rank-Nullity Theorem. Invertible Linear Transformation, Relation between matrices and Linear Transformations, Change of bases.

Unit-III — 07 Hrs.

Matrices: Eigen values, Eigen vectors and their properties. Cayley-Hamilton theorem (without proof) and its application. Similar matrices, diagonalization of matrix. Functions of square matrix. Singular value decomposition.

Unit-IV — 06 Hrs.

Calculus: Gradient, directional derivatives, Jacobian, Hessian, convex sets, convex functions, and its properties. Unconstrained optimization techniques: Newton's method, Quasi Newton method.

Text Books:

1. Jin Ho Kwak and Sungpyo Hong, "Linear Algebra", 2nd Springer, 2004.
2. Bernard Kolman and David, "Introductory Linear Algebra- An applied first course", 9th Edition, Pearson Education, 2011.
3. Hira & Gupta, "Operation Research", S Chand.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley India,2015.

Reference Books:

1. Stephen Andrilli and David Hecker, "Elementary Linear Algebra", 5th Edition, Academic Press,2016.
2. Rudolf Lidl, Guter Pilz, "Applied Abstract Algebra", 2nd Edition, Springer 2004.

3. Howard Anton, Robert C Busby, "Contemporary linear algebra", Wiley 2003.

4. Gilbert Strang, "Introduction to Linear Algebra", 5th Edition, Cengage Learning, 2015.

5. S.D. Sharma Kedar Nath, "Operations Research", 2015.

6. Singiresu S.Rao, "Engineering optimization (Theory and Practice)", New Age International publication, 2015.

7. B. S. Grewal, "Higher Engineering Mathematics", 43th Edition,Khanna Publishers, India, 2015.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Data Structures (RCP23ACPC302)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: C – Programming

Course Objectives:

The objective of the course is to introduce and familiarize students with linear and non-linear data structures, their use in fundamental algorithms and design & implementation of these data structures. To introduce students to the basics of algorithms and time complexity. To familiarize students with various sorting and searching techniques, and their performance comparison.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the concept of time and space complexity for algorithms.	L2	Understand
CO2	Assimilate the concept of various linear and non-linear data structures.	L2	Understand
CO3	Solve the problem using appropriate data structure.	L3	Apply
CO4	Implement appropriate searching and sorting algorithms for a given problem.	L3	Apply

Course Contents

Unit-I — 04 Hrs.

Basics of Algorithms: Algorithms, Characteristics of an Algorithm, Time and Space Complexities, Order of Growth functions, Preliminary Asymptotic Notations.

Data Structures: Introduction, need of Data Structures, Types of Data Structures, Abstract Data Types (ADT)

Unit-II — 06 Hrs.

Linear Data Structures – LIST: List as an ADT, Array-based implementation, Linked List implementation, singly linked lists, circularly linked lists, doubly-linked lists, All operations (Insertion, Deletion, Merge, Traversal, etc.) and their analysis, Applications of linked lists - (Polynomial Addition).

Unit-III — 07 Hrs.

Linear Data Structure – STACK: Stack as an ADT, Operations, Array and Linked List representation of Stack, Applications – Reversing data, Conversion of Infix to prefix and postfix expression, Evaluation of postfix and prefix expressions, balanced parenthesis, etc.

Linear Data Structure – QUEUE: Queue as an ADT, Operations, Implementation of Linear Queue, Circular and Priority Queue using arrays and Linked List, DEQueue.

Applications – Queue Simulation.

Unit-IV — 08Hrs.

Non-Linear Data Structure – TREES: Tree Terminologies, Tree as an ADT, Binary Tree - Operations, Tree Traversals, Binary Search Tree (BST) - Operations, Expression Trees

Height Balanced Tree: Creation of AVL Tree

Heap: Operations on heap

Applications: Huffman coding

Unit-V — 06 Hrs.

Non-Linear Data Structure – GRAPHS: Graph Terminologies, Types of Graphs, Representation of Graph using arrays and Linked List, Breadth-First Search (BFS), Depth–First Search (DFS)

Applications of Graphs: Topological sorting

Unit-VI — 08 Hrs.

Searching: Linear Search, Binary Search and Fibonacci search.

Sorting: Bubble Sort, Selection Sort, Heap Sort, Insertion Sort, Radix Sort, Merge Sort, Quick Sort.

Analysis of Searching and Sorting Techniques.

Hashing: Hash Functions, Overflow handling, Collision & Collision Resolution Techniques, Linear hashing, Hashing with chaining, Separate Chaining, Open Addressing, Rehashing and Extendible hashing.

Text Books:

1. R. F. Gilberg and B. A. Forouzan, "Data Structures – A Pseudocode Approach with C", 2nd Edition, Cengage Learning, 2005.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, W. H. Freeman, and Company 2008.

Reference Books:

1. Mark A. Weiss, "Data Structures and Algorithm Analysis in C", 4th Edition, Pearson, 2014.
2. M. T. Goodritch, R. Tamassia, D. Mount, "Data Structures and Algorithms in C++", Wiley, 2nd Edition, 2011.
3. Kruse, Leung, Tondo, "Data Structures and Program Design in C", 2nd Edition, Pearson Education, 2013.
4. Tenenbaum, Langsam, Augenstein, "Data Structures using C", 2nd Edition Pearson, 2015.
5. Reema Thareja, "Data Structures using C", Oxford, 2017.
6. Seymour Lipschutz, "Data Structures, Schaum's Outline Series", 1st Edition, Tata McGraw-Hill, 2014.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Data Structures Laboratory (RCP23ALPC302)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

The course intends to introduce and familiarize students with data structures, their use in solving real time complex problems and implementation of these data structures. The course also aims to provide mathematical approach for analyzing algorithms using asymptotic notation and for measuring efficiency of algorithms. Finally, the course intends to make students learn various sorting and searching techniques and choose efficient one based on their efficiency.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand of stack and Demonstrate its operations.	L2	Understand
CO2	Demonstrate different types of queue and its operations.	L2	Understand
CO3	Demonstrate various Linked list types and its operations.	L2	Understand
CO4	Demonstrate heap-sort and compare Hashing techniques	L2, L4	Understand, Analyze
CO5	Understand and compare various searching and sorting techniques.	L2, L4	Understand, Analyze

List of Laboratory Experiments(At Least 10)

Suggested Experiments:

1. Implementation of Linked List using menu driven approach.
2. Implementation of different operations on linked list –copy, concatenate, split, reverse, count no. of nodes etc.
3. Implementation of polynomials operations (addition, subtraction) using Linked List.
4. Implementation of stack using menu driven approach.
5. Implementation of Infix to Postfix conversion.
6. Implementation of prefix and postfix evaluation using menu driven approach.
7. Implementation of parenthesis checker using stack.
8. Implementation of Linear queue using menu driven approach.
9. Implementation of circular queue using menu driven approach.
10. Implementation of double ended queue menu driven program.
11. Implementation of Priority queue program using array and Linked list.
12. Implementation of Binary Tree using menu driven approach.
13. Implementation of Binary Tree Traversal.
14. Implementation of BST.
15. Implementation of various operations on tree like – copying tree, mirroring a tree, counting the number of nodes in the tree, counting only leaf nodes in the tree.
16. Implementation of Graph traversal using menu driven program (DFS & BSF).
17. Implementations of Selection sort, Radix sort using menu driven.
18. Implementation of Heap & Heap Sort using menu driven program.
19. Implementation of Advanced Bubble Sort and Insertion Sort using menu driven Program.
20. Implementation of searching methods (Index Sequential, Fibonacci search, Binary Search) using menu driven program.
21. Implementation of hashing functions with different collision resolution techniques.

A minimum of 08 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on RCP23ACPC302 with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Python Laboratory (RCP23ALPC303)

Teaching Scheme
Practical : 04 Hrs./week
Credit : 02

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Prerequisite: C Programming

Course Objectives:

1. To learn the basic and OOP concepts of Python.
2. To study various advanced python concepts like inheritance, exception handling, modules etc.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand basic and object-oriented concepts, data structure implementation in python.	L2	Understand
CO2	Apply file, exception handling, text processing concepts in python.	L3	Apply
CO3	Apply database connectivity, client-server communication using python.	L3	Apply
CO4	Utilize libraries like NumPy, Matplotlib, and Pandas for data manipulation, analysis and visualization.	L3	Apply

Course Contents

Unit-I Python basics — 04 Hrs.

Data types in python, Operators in python, Input and Output, Control statement, Arrays in python, String and Character in python, Functions, List and Tuples, Dictionaries, Limitations of Python.

Unit-II Control Statements and Functions — 04 Hrs.

If statement, if-elif-else, Repetition using while loop, for loop, defining a Function, Checking & Setting Your Parameters, Default arguments, Variable length arguments, Defining and calling functions within a function, Layers of Functions, Lambda and Filter, Zip (), Map (), Reduce () function, recursion, Function Decorators.

Unit-III Introduction to OOP — 08 Hrs.

Creating a Class, Self-Variables, Constructors, Types of Methods, Constructors in Inheritance, Polymorphism, the super () Method, Method Resolution Order (MRO), Operator Overloading, Method Overloading & Overriding, Interfaces in Python.

Exceptions Handling: Exceptions, Exception Handling, Types of Exceptions, Except Block, assert Statement, User Defined Exceptions.

Unit-IV Python Modules — 04 Hrs.

Building Modules, Packages: Python Collections Module, Opening and Reading Files and Folders, Python OS Module, Python Datetime Module, Python Math and Random Modules, Text Processing, Regular expression in python.

Unit-V Python for Data Science — 06 Hrs.

Numpy: Working with Numpy, Constructing Numpy arrays, Printing arrays, Arithmetic, Operations on matrix's, numpy zeros() Matplotlib: Matplotlib Plot different charts, Pandas: Data Processing, Pandas-Data structure, Pandas-Series data, Data Frames, Introduction to data pre-processing: Data Cleaning, Pandas plotting, Exploratory Data analysis. Data Visualization: Heat map techniques

List of Laboratory Experiments

1. Write a python program to understand Expressions, Variables, Quotes, Basic Math operations.
2. Write a python program to demonstrate applications of different decision-making statements.
3. Write a python program to implement Basic String Operations & String Methods.
4. Write a python program to implement functions of List, Tuples, and Dictionaries.
5. Write a Python program to implement Arrays (1D, 2D) applications.
6. Write a python program to implement Functions and Recursion.
7. Write a python program to implement Lambda, Map, and Reduce Functions.
8. Write a python program to implement concept of Function decorators.
9. Write a python program to implement Classes & objects, Constructors.
10. Write a python program to implement Inheritance & Polymorphism.
11. Write a python program to implement Exception handling.
12. Write a python program to understand different File handling operations with exception handling.
13. Write a python program to implement database connectivity and DDL and DML commands in python using SQLite.
14. Implement different Machine learning packages like numpy, pandas and matplotlib.
15. Implement Data cleaning techniques and Data plotting's using pandas.

Minimum 08 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Text Books:

1. Dr. R. Nageswara Rao, "Core Python Programming", 3rd Edition, Dreamtech Press, 2018.
2. Mark Lutz, "Learning Python", 5th Edition", Oreilly Publication, 2013.
3. E Balagurusamy, "Introduction to computing and problem-solving using Python", McGraw Hill Education, 2018.

Reference Books:

1. Bill Lubanovic, "Introducing Python",2nd Edition, O'Reilly Media, December 2019.
2. Dan Bader, David Amos, Joanna Jablonski, Fletcher Heisler, "Python Basics: A Practical Introduction to Python", 1st Edition, Real Python, March 2021.
3. Luciano Ramalho, "Fluent Python", 2nd Edition, O'Reilly Media, May 2022.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on RCP23ALPC303 with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Operating Systems (RCP23ACMD301)

Teaching Scheme
Lectures : 02 Hrs./week
Credits : 02

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Programming Language C and Basics of Hardware, i.e., ALU, RAM, ROM, HDD etc

Course Objectives:

The objective of this course is to familiarize students with the functionality of an Operating System, its basic components & interaction among them. The course will also expose students to analyze and evaluate different policies for scheduling, deadlocks, memory management, synchronization, file management & I/O and implement these policies using a suitable programming language.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the architecture and functionality of computer systems and operating systems.	L2	Understand
CO2	Understand and apply the fundamental concepts of process and thread management and evaluate scheduling algorithm's performance to optimize operating system efficiency.	L3	Apply
CO3	Identify the need of concurrency and apply principles of concurrency to solve classical synchronization problems.	L3	Apply
CO4	Understand and apply deadlock handling strategies.	L2	Understand
CO5	Identify the need for memory management and apply the mechanisms for the same.	L3	Apply

Course Contents

Unit-I Computer system overview — 04 Hrs.

Processor, Memory, Cache, I/O modules, System Bus, Multiprocessor and Multicore organization. **Operating System** Objectives, functions and services, Resource manager, Evolution of operating system, Introduction to key terms, Process, Memory management, Operating System structures (monolithic, microkernel), Types of Operating Systems: Batch, Multiprogramming. Multitasking, Time Sharing, Parallel, Distributed, Real-time, Linux, Mobile OS.

Unit-II Process Management — 06 Hrs.

Concept of a Process, Process States(5 state model and 7 state model), creation and termination, Process Description, Process Control Block.

Threads: Concept of a Thread, Types of Threads Thread states, Concept of Multithreading,

Scheduling: Types of Schedulers, Types of Scheduling mechanisms, Preemptive and Non-preemptive, Scheduling algorithms and their performance evaluation: FCFS, SJF, SRTF, Priority based, Round Robin.

Unit-III Process Synchronization — 06 Hrs.

Concurrency: Principles of Concurrency, Process Interaction.

Mutual Exclusion: Requirements, Hardware Support, Semaphores and Mutex, Monitors

Classical synchronization problems: Producer and Consumer problem, Readers/Writers Problem, Solutions using Semaphore and Monitor.

Unit-IV Deadlock — 05 Hrs.

Principles of deadlock, Reusable resources, Consumable Resources, Conditions for deadlock, Resource Allocation Graph, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm for Single & Multiple Resources, Deadlock Detection and Recovery. Dining Philosophers Problem. Solution using Semaphore and Monitor.

Unit-V Memory Management — 05 Hrs.

Memory Management Requirements, Memory Partitioning: Fixed Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Next Fit, Relocation, Paging, Segmentation. Virtual Memory: Structure of Page Tables, Demand Paging, Structure of Page Tables, Page Replacement Strategies: FIFO, Optimal, LRU, LFU, Thrashing.

Text Books:

1. William Stallings, "Operating System: Internals and Design Principles", 8th Edition, Prentice Hall, 2014. ISBN-10: 0133805913 • ISBN-13: 9780133805918

2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley & Sons, 9th Edition, 2016,ISBN 978-81-265-5427-0.

3. Andrew Tannenbaum, "Operating System Design and Implementation", 3rd Edition, Pearson, 2015.

Reference Books:

1. Maurice J. Bach, "Design of UNIX Operating System", 2nd Edition, PHI, 2004.

2. Achyut Godbole and Atul Kahate, "Operating Systems", 3rd Edition, McGraw Hill Education, 2017.

3. Remy Card, Eric Dumas, Frank Mevel,"The Linux Kernel Book", 1st Edition, Wiley Publications, 2013.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.

2. Total duration allotted for writing the paper is 2 hrs.

Product Life Cycle Management (RCP23OCOE301)

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs./week	Term Test : 15 Marks
Credits : 03	Teacher Assessment : 25 Marks
	End Sem Exam : 60 Marks
	Total Marks : 100 Marks

Prerequisite: Knowledge of basic concepts of Management

Course Objectives:

1. To familiarize the students with the need, benefits and components of PLM.
2. To acquaint students with Product Data Management & PLM strategies.
3. To give insights into new product development program and guidelines for designing and developing a product.
4. To familiarize the students with Virtual Product Development.
5. To acquaint students with the need of Environmental aspects in PLM & its implementation.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.	L2	Understand
CO2	Illustrate various approaches and techniques for designing and developing products.	L3	Apply
CO3	Acquire knowledge in applying virtual product development tools.	L3	Apply
CO4	Acquire knowledge in implementation of Environmental aspects in PLM.	L2	Understand

Course Contents

Unit-I — 07 Hrs.

Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications

PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM

Unit-II — 07 Hrs.

Product Design and Development: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase.

Unit-III — 10 Hrs.

Methodological Evolution of Product Design: Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering, Life Cycle Approach, Characteristic Features of Life Cycle Approach.

The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process. New Product Development (NPD) and Strategies, Product Configuration and Variant Management.

Integration of Environmental Aspects in Product Design: Sustainable Development Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design, Tools and techniques for integrated design, Implementation of international standards.

Unit-IV — 07 Hrs.

Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation.

Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modelling and simulations in Product Design, Examples/Case studies.

Unit-V 08 Hrs.

Engineering Methods for product Duration design & evaluation: Durability of Products and Components, Design for Fatigue, Infinite Life Approach, Design for Finite Life.

Product Recovery Planning & Analysis: Approach to the Recovery Problem, Method for Recovery Cycles Planning, Calculation Models for Recovery Cycles Planning, Basic procedure, Determinant Factors for Recovery, Effective Component Reusability, Recovery Fractions, Extension of Useful Life.

Text Books:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realization", Springer-Verlag, 2004, ISBN: 1852338105.

2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis, 2006, ISBN: 0849327229.

Reference Books:

1. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, 2009, ISBN: 3540257314.

2. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265.

3. François Villeneuve, Luc Mathieu, Max Giordano, "Product Life-Cycle Management: Geometric Variations", United Kingdom: Wiley, 2010.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.

2. Total duration allotted for writing the paper is 2 hrs.

Management Information System (RCP23OCOE302)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: NIL

Course Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage.
4. Identify the basic steps in systems development.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the fundamental concepts of the management information systems used in business.	L2	Understand
CO2	Describe IT infrastructure and its components and its current trends.	L2	Understand
CO3	Use the tools and technologies for accessing information from databases to improve business performance and decision making.	L3	Apply
CO4	Identify and explain the security and ethical challenges in MIS along with the measures to be taken.	L2	Understand
CO5	Select a suitable social computing platform for the given requirements that integrates AI and IoT.	L3	Apply
CO6	Explain the processes involved in the information system within the organization includes information acquisition and enterprise and global management technologies.	L2	Understand

Course Contents

Unit-I — 04 Hrs.

Foundation Concepts:

- Definition and scope of Management Information Systems (MIS) in business
- Functional area information system
- The components of information systems
- Impact of IT on organizations and society
- Business Process – BPR and BPI
- Business Pressure, Organizational responses
- Competitive Advantage and Strategic IS's.

Unit-II — 05 Hrs.

Information Technology Infrastructure:

- Overview of IT infrastructure
- Hardware and Software
- **Computer Systems:** End User and Enterprise Computing
- **Computer Peripherals:** Input, Output, and Storage Technologies
- **Application Software:** End User Applications
- **System Software:** Computer System Management
- **Data Resource Management:** Technical Foundations of Database Management, Managing Data Resources, Big data, Data warehouse and Data Marts, Knowledge Management
- **Networks:** The Networked Enterprise (Wired and wireless), Pervasive computing, Cloud Computing models

Unit-III — 10 Hrs.

MIS Tools and applications for Decision making:

- ERP and ERP support of Business
- **Business intelligence (BI):** Managers and Decision Making
- **Decision Support System (DSS):** types, components, Data mining
- Executive information system

- Role of AI in decision making
- Role of predictive analytics and data visualization in business

Unit-IV 08 Hrs.

Security and Ethical Challenges

- Information security fundamentals,
- Key principles of information security,
- Common threats and vulnerabilities in MIS
- Security measures and controls,
- Access control mechanisms: authentication, authorization, and accounting (AAA),
- Encryption techniques and cryptographic protocols,
- Ethical, and societal challenges of IT,
- Legal and regulatory framework
- Privacy Policies.

Unit-V 06 Hrs.

Social Computing (SC)

- Web 2.0 and 3.0: static and dynamic platform, integration with AI and IoT.
- SC in business-shopping: leveraging social media platforms, Social listening and sentiment analysis,
- Social computing in Customer Relationship Management (CRM)
- Marketing, operational and analytic CRM,
- E-business and E-commerce – B2B B2C, E-commerce platforms and payment gateways
- Mobile commerce: growth trends, mobile wallets, contactless payments, shopping apps and platforms

Unit-VI 06 Hrs.

- **Information System within Organization:** Acquiring Information Systems and Applications: Various System development life cycle models.
- **Enterprise and Global Management of Information Technology:** Managing Data, Information Technology, Managing Global IT.
- Business processes and information systems

Textbooks:

1. A. K. Gupta, "Management Information System", S. Chand Limited, 2010.
2. K. K. Ghosh, Saini Das, and S. Mukherjee, "Management Information System", Management, IIT, Kharagpur, 2021.

Reference Books:

1. James A O'Brien, George M., Ramesh Behl, "Management Information Systems", 11^{th} Edition, Tata McGraw Hill, 2019.
2. Kelly Rainer, Brad Prince, "Management Information Systems", Wiley, 2016.

Web References:

1. Management Information System (https://nptel.ac.in/courses/110105148)
2. Management Information System (https://archive.nptel.ac.in/courses/110/105/110105148/)

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 20 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Operations Research (RCP23OCOE303)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of Mathematics, Probability.

Course Objectives:

1. Formulate a real-world problem as a linear programming problem and able to solve.
2. Understand the optimisation tools that are needed to solve linear programming problems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Formulate the real-world optimisation problem into a Linear Programming Problem (LPP) and analyse the solution obtained using LPP optimisation models	L4	Analyze
CO2	Solve Linear Programming Problems using transportation and assignment models.	L3	Apply
CO3	Apply Decision Theory to determine the optimal course of action when a number of alternatives are available, and their consequences cannot be forecast with certainty and uncertainty.	L3	Apply
CO4	Apply Game Theory for decision making under conflicting situations where there are one or more opponents (players).	L3	Apply
CO5	To breaking down a large problem into smaller sub problems and solved recursively or iteratively using Dynamic Programming models.	L4	Analyze

Course Contents

Unit-I — 12 Hrs.

Introduction to Operations Research:

Introduction, Structure of the Mathematical Model, Limitations of Operations Research.

Linear Programming:

Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method, Penalty Cost Method or Big M-method, Two Phase Method.

Unit-II — 08 Hrs.

Transportation Problem:

Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – North-west corner rule, least cost method and Vogel's approximation method. Optimality test: MODI method.

Assignment Problem:

Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem

Unit-III — 06 Hrs.

Decision Theory: Steps in Decision Theory approach, Decision-making Environment, Decision making under condition of certainty, Decision making under condition of uncertainty, Decision making under condition of risk, Maximum likelihood criterion.

Unit-IV — 06 Hrs.

Game Theory: Competitive games, rectangular game, saddle point, minimax/maximin method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.

Unit-V — 07 Hrs.

Dynamic programming: Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stagecoach/Shortest Path, cargo loading and Reliability problems

Text Books:

1. Taha, H. A., "Operations Research - An Introduction", Pearson Education, 2022.

2. Gupta P. K., Hira D. S.,"Operations Research", S. Chand Limited, 2014.

Reference Books:

1. Boucherie, R. J., Tijms, H. and Braaksma, "A Operations Research: Introduction to Models and Methods", 2021.

2. Hiller, F. S. and Liebermann, G. J, "Introduction to Operations Research", McGraw-Hill Higher Education, 2010.

3. Ravindran A., Phillips D. T. and Solberg J. J, "Operations Research: Principles and Practice", Wiley India Pvt. Limited, 2009.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Personal Finance Management (RCP23OCOE304)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: NIL

Course Objectives:

1. To create awareness and educate consumers on access to financial services.
2. To make the students understand the basic concepts, definitions and terms related to direct taxation.
3. To help the students compute the Goods and Service Tax (GST) payable by a supplier after considering the eligible input tax credit.
4. To familarise the students with microfinance for accelerating the expansion of local microbusinesses.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the Indian financial system.	L2	Understand
CO2	Use a framework for financial planning to understand the overall role finances play in his/her personal life.	L3	Apply
CO3	Compute income from salaries, house property, business/profession, capital gains and income from other sources.	L3	Apply
CO4	Compute the amount of CGST, SGST and IGST payable after considering the eligible input tax credit.	L3	Apply
CO5	Understand how Microfinance can help in financial inclusion.	L2	Understand

Course Contents

Unit-I — 07 Hrs.

Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments and Financial Markets, Financial inclusion.

Introduction to Personal Finance: Person Financial Planning in Action, Money Management Skills, Taxes in Your Financial Plan, Savings and Payment Services.

Consumer Credit: Advantages, Disadvantages, Sources and Costs.

Unit-II — 07 Hrs.

Personal Financial Management:

Loans: Home, Car, Education, Personal, Loan against property and Jewel loan.

Insurance: Types of Insurance – ULIP and Term; Health and Disability Income Insurance, Life Insurance.

Investment: Investing Basics and Evaluating Bonds, Investing in Stocks and Investing in Mutual Funds, Planning.

Unit-III — 09 Hrs.

Income Tax:

Income Tax Act Basics: Introduction to Income Tax Act, 1961

Heads of Income and Computation of Total Income and Tax Liability: Heads of Income and Computation of Total Income under various heads, Clubbing Provisions, Set off and Carry forward of Losses, Deductions, Assessment of Income and tax liability of different persons.

Tax Management, Administrative Procedures and ICDS: TDS, TCS and Advance Tax Administrative Procedures, ICDS.

Unit-IV — 08 Hrs.

Goods and Services Tax:

GST Constitutional framework of Indirect Taxes before GST (Taxation Powers of Union & State Government); Concept of VAT: Meaning, Variants and Methods; Major Defects in the structure of Indirect Taxes prior to GST; Rationale for GST; Structure of GST (SGST, CGST, UTGST & IGST); GST Council, GST Network, State Compensation Mechanism, Registration.

Levy and Collection of GST: Taxable event- "Supply" of Goods and Services; Place of Supply: Within state, Interstate, Import and Export; Time of supply: Valuation for GST- Valuation rules, taxability of reimbursement of expenses; Exemption from GST: Small supplies and Composition Scheme; Classification of Goods and Services

Unit-V 08 Hrs.

Introduction to Micro – finance:

Micro-Finance: Definitions, Scope & Assumptions, Types of Microfinance, Customers of Microfinance, Credit Delivery Methodologies, SHG concept, origin, Formation & Operation of Self Help Groups (SHGs).

Models in Microfinance: Joint Liability Groups (JLG), SHG Bank Linkage Model and GRAMEEN Model: Achievements & Challenges

Institutional Mechanism: Current Challenges for Microfinance, Microfinance Institutions (MFIs): Constraints & Governance Issues, Institutional Structure of Microfinance in India: NGO-MFIs, NBFC-MFIs, Co-operatives, Banks, Microfinance Networks and Associations; Demand & Supply of Microfinance Services in India, Impact assessment and social assessments of MFIs.

Reference Books:

1. Asha Singh, M.S. Gupta, "Banking and Financial Sector Reforms in India" , Serials Publication.
2. M.S. Gupta & J.B. Singh,"Indian Banking Sector: Essays and Issues", 1st Edition, Serials Publication.
3. K.M. Bhattacharya O.P. Agarwal,"Basics Of Banking & Finance", Himalaya Publishing House.
4. S. Subba Reddy , P. Raghu Ram, "Agricultural Finance and Management".
5. Dr.Vasant Desai, "The Indian Financial System and Development", 4th Edition, Himalaya Publishing House.
6. Sanjay Kumar Satapathy, "Income Tax Management Simple Way of Tax Management, Tax Planning and Tax Saving".
7. Dr. R. K. Jain, "Direct Tax System Income Tax", SBPD Publications.
8. S K Mishra,"Simplified Approach to GST Goods and Services Tax", Educreation Publishing.
9. Todd A Watkins, "Introduction To Microfinance", World Scientific Publishing Company.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.

2. Total duration allotted for writing the paper is 2 hrs.

Public Systems and Policies (RCP23OCOE305)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Basic Knowledge of Social science and Current affairs.

Course Objectives:

1. To explain public policy and its operations with special focus on policy relating to Government finance.
2. To analyze and evaluate the impact of the public policy on firms and economy at large.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the importance of public systems in a fast-changing environment in the global context.	L2	Understand
CO2	Analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.	L4	Analyze
CO3	Explain public policy and its operations with special focus on policy relating to Government finance.	L2	Understand
CO4	Make policies and know about the happenings in the world, in the nation and those in their locality.	L5	Evaluate
CO5	Analyze and evaluate the impact of public policy on firms and the economy at large and work under various fields as policymakers.	L5	Evaluate

Course Contents

Unit-I — 10 Hrs.

Introduction and Overview of Public Systems: Ideology of Public Systems; Mechanistic and Organic view of Society and Individuals, The Legal Framework; Federal Government; State and Local Governments, Government growth; The size of Government.

Unit-II — 06 Hrs.

Public Sector in the Economics Accounts: Public Sector in the circular flow; Public Sector in the National Income Accounts.

Unit-III — 08 Hrs.

Public Choice and Fiscal Politics: Direct Democracy; Representative Democracy; The Allocation Function; The Distribution Function; The Stabilization Function; Coordination of Budget Functions; The Leviathan Hypothesis.

Unit-IV — 10 Hrs.

Introduction and Overview of Public Policy: Markets and Government; Social goods and Market failure, Public expenditure and its evaluation; Cost Benefit Analysis, Public policy and Externalities, Taxation Policy and its impact, Income distribution, redistribution and social security issues Fiscal & Budgetary Policy, Fiscal Federalism in India.

Unit-V — 05 Hrs.

Case Studies in Expenditure Policy: Public Services

A) National Defense B) Highways C) Outdoor Recreation D) Education

Reference Books:

1. Charles Wheelan, "Introduction to Public Policy", W.W. Norton & Company, New York, 2011.
2. Thomas R. Dye, "Understanding Public Policy", Prentice Hall, 2008.
3. Anderson J.E., "Public Policy-Making: An Introduction", Boston, 2011.
4. Avasthi & Maheshwari, "Public Administration", Lakshmi Narain Agarwal, 2008.
5. Mohit Bhattacharya, "New Horizons of Public Administration", Jawahar Publishers, New Delhi, 2011.
6. Nicholas Henry, "Public Administration and Public Affairs", Prentice Hall of India, New Delhi, 2017.

7. Harvey S Rosen and Ted Gayer, "Public Finance", 10th Edition, McGraw-Hill Education, 2013.

8. Richard A. Musgrave and Peggy B. Musgrave, "Public Finance in Theory and Practice", 5th Edition, Mcgraw Hill Book, 2017.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.

2. Total duration allotted for writing the paper is 2 hrs.

Fundamentals of Biomedical Instruments (RCP23OCOE306)

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs./week	Term Test : 15 Marks
Credits : 03	Teacher Assessment : 25 Marks
	End Sem Exam : 60 Marks
	Total Marks : 100 Marks

Prerequisite: Basic knowledge of Human Anatomy, Basic knowledge of Electronics

Course Objectives:

1. To understand the basic principles and working of various medical instruments .
2. To familiarize the learners with the various medical imaging modalities, their operating principles, instrumentation and clinical applications.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Associate & describe the the different physiological processes taking place within the human body.	L2	Understand
CO2	Identify the use of biomaterials and apply principles of various transducers & sensors.	L3	Apply
CO3	Demonstrate the working principle of various medical instruments.	L3	Apply
CO4	Demonstrate principles used in imaging modalities and analysis.	L3	Apply
CO5	Identify different processes used in telemetry and telemedicine.	L2	Understand

Course Contents

Unit-I — 04 Hrs.

Basic Human Physiology

Cell: Electrical activity of excitable cells (Structure and functions of cell. Polarization and depolarization of cell)

Cardiovascular System: Heart, Conductive tissues of heart, Cardiac cycle, Heart Valves, System and Pulmonary Circulation, Transmission of Cardiac Impulse, Blood Pressure, ECG (Einthoven's Triangle, Various leads and Waveforms).

Muscle Physiology: Muscle physiology and aspects of skin resistance. Generation of EMG

Nervous System: Different parts, their functions. Reflex actions and reflex arc, Function of Sympathetic and Parasympathetic nervous system. Generation of EEG

Unit-II — 10 Hrs.

Biomaterial, Transducers and Sensors

Biomaterials used in fabrication of biodevices and implants: Polymeric, Composite biomaterials, Metallic biomaterials, and Ceramic biomaterials.

Biopotential electrodes: Electrode tissue interface, Electrode electrolyte interface Electrodes used for ECG, EEG & EMG.

Transducers & sensors: temperature transducer, pulse sensor, glucose sensor, respiration sensor

Introduction of biomaterials, Classification of biomaterials

Unit-III — 08 Hrs.

Overview of Medical Instruments

Classification, application and specifications of diagnostic, therapeutic and clinical laboratory equipment

Method of operation of these Bio Medical Instruments

ECG, EEG, EMG

Unit-IV — 09 Hrs.

Imaging Modalities and Analysis Radio graphic techniques, Computer Tomography

MRI, PET, SPECT

Ultrasonography

Endoscopy

Thermography, Retinal Imaging

Imaging application in Biometric systems

Analysis of digital images

Unit-V

08 Hrs.

Telemetry & Telemedicine

Introduction to Biotelemetry

Physiological parameters compliant to biotelemetry

Components of Biotelemetry system

Applications of telemetry in medical field (ECG, EEG & EMG)

Text Books:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice hall of India, New Delhi,2007.
2. M.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 2003.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2nd Edition, 2003.
4. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, NewYork, 1998.
5. B.D. Ratner, A.S. Hoffmann, F. J. Schoen, J. E. Lemons, "Biomaterials Science - An Introduction to Materials in Medicine", Academic Press, 1997.

Reference Books:

1. Dr Rajendra Prasad, "Electronic Measurement and Instrumentation".
2. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", 3rd Edition, Boca Raton, CRC Press LLC, 2006.
3. Curry, T. S., Dowdey, J. E., & Murry, R. C., "Christensen's physics of diagnostic radiology". Lippincott Williams & Wilkins, 1990.
4. Joon Park, R. S. Lakes, "Biomaterials: An Introduction", Springer Science & Business Media.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.

2. Total duration allotted for writing the paper is 2 hrs.

IPR and Patenting (RCP23OCOE307)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: NIL

Course Objectives:

1. To promote the knowledge of intellectual property laws of India and international treaties.
2. To encourage innovation.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Map a given project/ idea to a suitable intellectual property rights.	L3	Apply
CO2	Explain the fundamentals of the patents, copyrights, and design registrations.	L2	Understand
CO3	Draft applications to protect various intellectual property rights.	L6	Create
CO4	Communicate with national and/or international intellectual property organisations.	L4	Analyze

Course Contents

Unit-I — 03 Hrs.

Introduction to Intellectual Property Rights (IPR):

- Concept & meaning of IP and IPR.
- General principles of intellectual property rights.
- Need for intellectual property.
- Categories of IPR instruments - Patents, Trademarks, Copyrights,Industrial. Designs, Plant variety protection, Trade secrets,Geographical Indications etc.
- Ownership, assignment, licenses, infringement, validity period.
- International treaties on IPR.

Unit-II — 09 Hrs.

Copyright and Design

- The Indian Copyright Act, 1957.
- Meaning of copyrights and rights of copyrighted works.
- Types of copyright
- Process of filing a copyright application.
- Introduction to Designs Law – Definitions.
- Registration of designs and procedure.

Unit-III — 09 Hrs.

Basics of Patents

- The Indian Patent Act and The Indian Patent Rules.
- Conditions of patentability.
- Patentable and non-patentable inventions.
- Types of patent applications and patent specification.
- Inventors and Applicants.
- Category of applicants - natural person, small entity, startup and others.
- Patent databases and prior art search.

- International Patent Classification code.

Unit-IV 09 Hrs.

Patent Application Drafting

Patent application drafting:

- Application.
- Specification.
- Claims drafting:
  - Independent and dependent claims drafting.
  - Process patent and product patent claims.
- Abstract.
- Drawings.
- Declaration as to inventorship.
- Statement and undertaking.

Drafting response to communications from patent office.

- Reading and understanding examination reports.
- Drafting response.

Unit-V 09 Hrs.

Procedure for Filing a Patent Application, Timelines and Fees

- Application for grant of patent.
- Forms and Fees.
- Request for (early) publication and / or (early) examination.
- Patent examination and hearing.
- Pre-grant and post-grant opposition.

Text Books:

1. A Durafe and D Toradmalle, "Intellectual Property Rights", Wiley, 2020.
2. H Rockman, "Intellectual property law for engineers, scientists, and entrepreneurs", Wiley-IEEE Press, 2020.

Reference Books:

1. Bare Act, "The Patents Act, 1970 with The Patents Rules, 2003", Universal, 2023.

2. Bare Act, "The Copyright Act, 1957", Universal and LexisNexis, 2021.

3. Bare Act, "The Designs ACT, 2000", Commercial Law Publishers (India) Pvt. Ltd. 2021

Online Resources:

1. W. Fisher, "Maps of Intellectual Property" https://cyber.harvard.edu/people/tfisher/IP/IPMaps.htm

2. World Intellectual Property Organisation courses https://www.wipo.int/academy/en/

3. Prof. Feroz Ali, "Patent Drafting for Beginners", https://onlinecourses.nptel.ac.in/noc24_hs59/preview

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.

2. Total duration allotted for writing the paper is 2 hrs.

Entrepreneurship and Startup Ecosystem (RCP23OCOE308)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: NIL

Course Objectives:

1. To foster an entrepreneurial mindset.
2. To guide in building effective Business Models.
3. To educate regarding Intellectual property and Fundraising for Innovative Ventures.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Effectively Navigate the Global Startup Landscape.	L3	Apply
CO2	Cultivate an Entrepreneurial Mindset.	L4	Analyze
CO3	Create Effective Business Models.	L6	Create
CO4	Understand the significance of Intellectual Property rights.	L2	Understand
CO5	Master Fundraising Strategies.	L5	Evaluate

Course Contents

Unit-I — 06 Hrs.

Understanding the Entrepreneurial Ecosystem

- Introduction to Entrepreneurship and Startups
- Role of Entrepreneurship in economy
- Global and Local Entrepreneurial Landscapes
- Role of Incubators and Accelerators
- Case Studies of Successful Startups

Unit-II — 08 Hrs.

Developing a Startup Mindset

- Cultivating an Entrepreneurial Mindset
- Market Analysis and Segmentation
- Opportunity Recognition
- Innovation and Idea Generation
- Feasibility Analysis of Business Ideas
- Role of innovation in Entrepreneurship
- Fostering creativity
- Practical Exercises and Workshops on Creative Problem Solving

Unit-III — 10 Hrs.

Business Model Development

- Introduction to Business Models
- Lean Startup Methodology
- Prototyping and Minimum Viable Product (MVP)
- Financial Projections and Budgeting
- Various forms of Business Ownership
- Compliance and Legal Regulations
- Operations and Supply Chain Management

- Human Resource Management
- Developing a marketing Strategy
- Managing Growth Challenges

Unit-IV 08 Hrs.

Technological Innovation and Intellectual Property

- Technology and Entrepreneurship
- Intellectual Property Basics (Patents, Trademarks, Copyrights)
- Patent Search and Analysis
- Strategies for Protecting Intellectual Property
- Ethical Considerations in Technology and Innovation

Unit-V 07 Hrs.

Fundraising and Investment Strategies

- Fundraising Options for Startups
- Angel Investors and Venture Capital
- Crowdfunding Platforms
- Financial Modelling for Startups
- Crafting an Effective Pitch

Books Recommended:

1. Alexander Osterwalder and Yves Pigneur, "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers", John Wiley & Sons, Jul2010.
2. Peter Thiel and Blake Masters, "Zero to One: Notes on Startups, or How to Build the Future", Virgin Books, 2015.
3. Alejandro Cremades, "The Art of Startup Fundraising: Pitching Investors, Negotiating the Deal, and Everything Else Entrepreneurs Need to Know", John Wiley & Sons, Inc., Hoboken, New Jersey, 2016.
4. Christensen, Clayton M. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail", Boston, MA: Harvard Business School Press, 1997.
5. Brad Feld and Jason Mendelson, "Venture Deals: Be Smarter Than Your Lawyer and Venture Capitalist", Wiley, 4th Edition, 1 October 2019.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Semester Project-I (RCP23IPSC301)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Conduct a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Demonstrate various/alternate approaches to complete a project.	L2	Understand
CO3	Ensure a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Present their project work in the form of a technical report / paper and thereby improve the technical communication skill.	L3	Apply
CO5	Demonstrate the ability to work in teams and manage the conduct of the research study.	L2	Understand

Semester Project:

The purpose of semester project is to provide exposure to students with a variety of projects based on the knowledge acquired from the semester subjects. This activity is supposed to enrich their academic experience and bring enough maturity in student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation and discussion of technical ideas/topics. Therefore, proper attention shall be paid to the content of semester project report which is being submitted in partial fulfillment of the requirements of the Second Year and it is imperative that a standard format be prescribed for the report.

Each student shall work on project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max allowed: 5 students in extraordinary cases, subject to the approval of the department committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. Semester Project Title or Theme should be based on knowledge acquired during semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Student is expected to:

- Select appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done(Log Book Format will be as per Table 1).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

Prescribed project report guidelines:

Size of report shall be of minimum 25 pages. Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation details

- Project Outcomes
- Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table 2.

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

Departmental committee (including project guide) will evaluate project as per Table 3.

Each group shall present/publish a paper based on the semester project in reputed/peer reviewed Conference/Journal/TechFest/Magazine before end of the semester.

Table 1: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 2: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintenance	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 3: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Simulation/ Logic	Hardware/ Programming	Result Verification	Presentation	Total
			5	5	5	5	5	25

Professional and Business Communication Tutorial (RCP23ITHSX01)

Practical Scheme	Examination Scheme
Tutorial : 02 Hrs./week	Teacher Assessment : 25 Marks
Credit 02	Total : 25 Marks

Prerequisite: Nil

Course Objectives:

1. To inculcate professional and ethical attitude at the workplace.
2. To enhance communication and interpersonal skills.
3. To develop effective employability skills .
4. To hone written skills for technical documentation .

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply group discussion techniques in professional situations	L3	Apply
CO2	Use employability skills to optimize career opportunities	L3	Apply
CO3	Employ storytelling techniques for effective presentation	L3	Apply
CO4	Prepare technical documents using appropriate style, format, and language	L6	Create
CO5	Analyze the concept of professional ethics.	L4	Analyze
CO6	Demonstrate interpersonal skills in professional and personal situations	L3	Apply

The course is designed to equip students with essential skills, crucial for navigating the contemporary job market successfully and fostering a positive work environment through effective communication and collaboration. The assignments comprise of a combination of interactive activities, discussions, case studies and real-world simulations, to help students, not only to ace job interviews and professional interactions, but also to contribute positively to the ethical and productive functioning of any organization. For the project work, students must prepare and present a well-researched and persuasive business proposal, in groups, integrating the skills and knowledge acquired throughout the course.

Description of Tutorial Activities

Unit-I — No of Assignment -01

Group Discussion

- Purpose of a GD, types of GD, criteria for evaluating GD, Dos and Don'ts of GD.
- **Activity:** Students will be divided into groups of 8-12 and each group will be given a topic/case to discuss within a given time frame. Each student will submit a write-up on their observations of the GD.

Unit-II — No of Assignments -02

Employment Skills

- **Resume Writing:** Types of resumes, structure, content, and formatting of resume.
- **Activity:** Students will prepare and submit their individual resume according to professional requirements.
- **Interview Skills:** Types and modes of interview, preparation for interview, Dos and Don'ts of interview, frequently asked questions during interview.
- **Activity:** Students will submit a write-up on the FAQs and participate in mock interviews.

Unit-III — No of Assignment -01

Corporate Storytelling

- Elevator pitch, product stories, event stories, stories in presentations, storytelling in SOPs and interviews, storytelling to manage conflict or to motivate.

- **Activity:** Students will be divided into groups of 8-12 and asked to give a team presentation using storytelling techniques and submit the hardcopy of the PPT.

Unit-IV — No of Assignment -01

Technical Writing and Documentation

- Business Proposal Writing: Types of business proposals, format of proposal, language and style, presentation of proposal.
- Meeting Documentation: Planning layout of meetings, observing meeting decorum, drafting notice, agenda, and minutes of meeting.
- **Activity:** Students will be divided into groups of 8-12 and each group will conduct a mock meeting based on an agenda and submit a write-up of the meeting documentation.

Unit-V — No of Assignment -01

Professional Ethics

- Effective work habits, accountability, integrity, and excellence.
- **Activity:** Students will be divided into groups of 8-12 and each group will analyze a case involving an ethical issue and submit the write-up.

Unit-VI — No of Assignment -02

Interpersonal Skills

- Team Building: Difference between group and team, importance of teamwork, strategies to be a good team player
- **Activity:** The students will be divided into groups of 8-12 and each group will be assigned a task to be accomplished as a team, for which they will submit the writeup.
- Leadership: Types of leadership, leadership styles, case studies.
- **Activity:** Each student will submit a writeup involving a leader they admire, analysing various aspects of his leadership style.
- Time Management: Importance of time management, cultural views of time, 80/20 rule, time wasters, setting priorities and goal.
- **Activity:** Each student will submit a writeup about a case involving time management.

Batchwise tutorial work of minimum eight assignments from the above suggested list or any other assignments based on the syllabus will be included, which would help the learner to apply the concepts learnt.

Books Recommended:

1. Fred Luthans, "Organizational Behavior", 12th Edition, McGraw Hill, 2010.
2. Lesika and Pettit, "Report Writing for Business", 9th Edition, McGraw Hill, 1994.
3. Huckin and Olsen, "Technical Writing and Professional Communication", 2nd Edition, McGraw Hill, 1991.
4. Wallace and Masters, "Personal Development for Life and Work", 12th Edition, Thomson Learning, 2010.
5. Herta Murphy, "Effective Business Communication", 7th Edition, McGraw Hill, 2017.
6. Sharma R. C. and Krishna Mohan, "Business Correspondence and Report Writing", 5th Edition, Tata McGraw-Hill Education, 2017.
7. Ghosh, B. N., "Managing Soft Skills for Personality Development", Tata McGraw Hill, 2017.
8. Bell, Smith, "Management Communication", 3rd Edition, Wiley India Edition, 2014.
9. Dr. Alex, K., "Soft Skills", 3rd Edition, S. Chand and Company, 2009.
10. Subramanian R., "Professional Ethics", 2nd Edition, Oxford University Press, 2017.
11. Sandeep Das, "How Business Story Telling Works: Increase Your Influence and Impact", Penguin Random House India Pvt. Ltd., 2023.

Evaluation Scheme:

Continuous Assessment (A):

Term Work: 25 marks.

Term Work shall comprise of: Minimum 8 assignments: 15 marks.

Business Proposal presentation: 10 marks.

Economics and Financial Management (RCP23ICHSX03)

Teaching Scheme
Lectures : 02 Hrs./week
Credits : 02

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of Economics and Finance domain current affairs.

Course Objectives:

- To describe the relationships among variables to analyse economic issues.
- To Explain the function of the market and prices as an allocative mechanism.
- To identify key macroeconomic indicators and measures of economic change, growth, and development.
- To understand basic concepts of financial management and their application in investment and financing decisions.
- To explore the relationship between Financial Management and Financial Statements.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyse individual decision making, how prices and quantities are determined in product and factor markets, microeconomic and macroeconomic outcomes.	L4	Analyze
CO2	Analyse the performance and functioning of government, RBI, markets, and institutions in the context of social and economic problems.	L4	Analyze
CO3	Analyse the current economic status of India at global levels and provision in budget to address economic issues at national level.	L4	Analyze
CO4	Describe an understanding of the overall role and importance of the finance function.	L2	Understand
CO5	Analyse financial performance and make appropriate inferences..	L4	Analyze

Course Contents

Unit-I — 06 Hrs.

Introduction to Economics: Fundamentals of Economics, Definition and scope of economics, the nature of the economic problem, finite resources and unlimited wants, definitions of the factors of production and their rewards, definition of opportunity cost, the influence of opportunity cost on decision making.

Microeconomics and Macroeconomics: The role of markets in allocating resources, the market system, introduction to the price mechanism, Demand, Supply and Price determination, Price elasticity of demand and supply (PED).

Unit-II — 04 Hrs.

Role of Government and RBI: Money, Banking, Households, Firms, economies and diseconomies of scale, Market Structure, Fiscal Policy, Monetary Policy, Economic Growth, causes and consequences of recession, causes of economic growth, measurement of economic growth inflation and deflation, living standards, indicators of living standards.

Unit-III — 04 Hrs.

Government Policies: Last 20 years Journey of Indian Economy, Measures taken to grow Indian Economy, Meaning of India is the world's fifth-largest economy by nominal GDP and the third-largest by purchasing power parity (PPP), On a per capita income basis, India ranked 139th by GDP (nominal) and 127th by GDP (PPP) (Data reference year 2023), Comparison of top 5 largest economies in world, Discuss key points of India latest union budget and its impact on Indian economy and citizens, Meaning of Initiatives like Make in India, Digital India, Skill India etc. and expected impact on Indian Economy.

Unit-IV — 04 Hrs.

Overview of Financial Management: Fundamentals of financial management, principles and functions of the financial management, Strategy, methods, and techniques of the financial management, Overview of financial instruments, financial markets, financial Institutions.

Unit-V — 08 Hrs.

Overview of Financial Statements: Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios.

Text Books:

1. Datt & Sundharam's Indian Economy by Gaurav Datt & Biswajit Nag, S. Chand Publications, 73rd Edition,

   2024.

2. Fundamentals of Financial Management by Prasanna Chandra, McGraw Hill Publications, 7th Edition, 2020.

Reference Books:

1. Public Economics: The Macroeconomic Perspective by Burkhard Heer, Springer International Publications, 2019.

2. Indian Economy: Economic Ideas, Development, and Financial Reforms by Raj Kumar Sen, Deep & Deep Publications, 2008.

3. Indian Economy: Performance and Policies by Dr. V. C. Sinha, SBPD Publications, 2021.

4. Financial Management by C. Paramasivan, T. Subramanian, New Age Publications, 2nd Edition, 2023.

5. Financial Management Practices in India by Sandeep Goel, Taylor & Francis Publications, 2016.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.

2. Total duration allotted for writing the paper is 2 hrs.

Community Engagement Service (RCP23ILELX05)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
Total : 25 Marks

Prerequisite: Fundamentals of core branch, Communication Skills

Course Objectives:

To sensitise the student / learner into recognising community level problems & challenges and give them an opportunity to engage in activities for solving the same.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Applies knowledge understandings acquired from one's academic study/ field/ discipline for community level education, information dissemination by participation and engagement in community welfare activities	L3	Apply
CO2	Identify and experience commitment for community engagement activities, that reinforce sense of belongingness and gratitude towards societal cause	L5	Evaluate
CO3	Witness diversity in communities and cultures and demonstrate change in approach / attitude as, an evidence of unconditional acceptance.	L3	Apply
CO4	Recognise, experience and value, effectiveness of working in a team, demonstrating co-existence of the roles - sincere worker and effective leader.	L5	Evaluate

Course Contents

Unit-I

Open Activities

Participation in: blood donation camps organizer / donor, day-long tree plantation or afforestation / seed dispersal / cleanliness (water bodies, surrounding etc.) drives.

Literacy drives for child / youth / adults. One day hand holding activities in work-shop conduct for under privilege kids in the areas of – basic science, math, technical skill demonstration and building.

Unit-II

Technical (Program core related)

Cyber-crime, security awareness and vulnerabilities – sensitization, information dissemination and awareness sessions in indicated focus areas.

Promotion and Sensitization for Sustainable living – focusing on solar power, water recycling, e-waste responsible disposal, waste recycling etc. in indicated focus areas.

Focus areas: residential societies, schools, under-privileged areas, governments /private offices, and similar other establishments.

OR

Field Survey Reporting on proactively conducted survey in the areas of resource management for – water, vegetables, electricity, crops etc.

Activities to be performed

Among the listed activities students are expected to complete one open activity mandatorily, and one technical (program core) OR field survey activity. The activities mentioned are exemplary in nature and any other additional activity of similar nature too can be undertaken by the learners, provided it is approved and endorsed by the faculty mentor / head of the department.

Suggested Activities

1.Undertaking cyber safety / security awareness sensitization drive / program especially for un-initiated students / individuals in schools / colleges / residential complex / offices etc.

Typical suggested tabulation.

Participant No.	Name	Age	School/College/ Residence/ Office	Email	Contact Number	Awareness Level	Remarks

2.Energy / Power assessment for establishments (societies, schools, colleges, residential complex, shops etc.) involving computing power devices ratings power consumption over operating period calculating energy cost from tariff card / rates for every group of appliances / devices or equipment.

Typical suggested tabulation pattern.

Device/Appliance Group	Number of appliances / devices	Power Rating (kW)	Operating Hours (h/day)	Energy Consumption (kWh/day)	Tariff Rate (Rs. / kWh)	Energy Cost (Rs.)
Lighting Fixtures						
Ceiling Fans						
Air Conditioner (AC)						
Security Systems						
Security Systems						
Water Pump						

3. Traffic light monitoring viz e viz average traffic density on road. Analysing the data and commenting on results. Evaluating and comparing impact on road repairs related lane blockage and proportional recommendation for lights timing variations.

Typical suggested tabulation pattern.

Sr.No.	Timestamp	Traffic Density	Traffic Light Status	Road Repair Status	Remarks

4. Help compute green footprint of select number of household (per member) - say 10 houses of 3+ members. This is for evaluating dependence upon non green energy sources and habits and changes in lifestyle for attempts at their reductions. Learners are encouraged to use typically available online carbon-footprint calculators. The table herewith maybe used for reference calculations.

House No.	Household Name	Number of Members	Energy Usage (kWh)	Water Usage (liters)	Waste Production (kg)	Transportation Habits	Green Footprint

5. Compulsion of having a borewell for non-potable water supply in city residential complexes is a modern day rule. Increased pace of re-development, as well as number of occupants in given area, has resulted in increased number of borewells being dug within and outside city limits.

Reduced yield, quality and quantity of water adds to the recurring maintenance cost of borewells, especially in the city areas. Poor water recharge systems along-with depleting open soil cover area in wake of wall-to-wall of concrete carpet aggravate the problem. Study, analyse and report a residential society's – capacity of water requirement, present day borewells in action, approximate yield, maintenance cost and frequency, borewell flushing iterations in wake of redevelopment in neighborhood. A typical tabulation mechanism for inferences can be as below:

Borewell No.	Location	Depth (ft)	Yield (Liters/Day)	Water Quality	Maintenance Cost (Rs.)	Remarks

6. Detection of Adulteration in food / fruits / vegetables / milk / mava /saffron etc. or contamination of potable drinking water.

Ex. Adulteration in fruits could be apple waxing, injecting chemicals in watermelon, pomegranate etc. to give it a bright red color, artificial ripening of mangos etc. For a given activity, samples from more than one area, specifically from mofussil /interiors / 'gaothans' etc, may be obtained, to evaluate sample purity or extent of adulteration. Learners are encouraged to use online resources provided by 'Food Safety and Standards Authority of India' (fssai), for handholding in requisite procedures.

YouTube link:

1. Food Safety and Standards Authority of India: goo.gl/Y8Lzbu
2. Ex. 1 Milk Adulteration: https://www.youtube.com/watch?v=pbumeRUBxKk
3. Ex.2 Watermelon Adulteration: https://www.youtube.com/watch?v=yrLAj7oJies

Product	Adulterant	Testing Method	Result	Remarks

Certificates and Formats:

Activity Endorsement Certificate

Date:

Community engagement service is a mandatory course, of one credit, introduced at second year of engineering under the autonomous structure of the institute.

Course objective: To sensitise the student / learner into recognising social problems and challenges and give them an opportunity to engage in activities for solving the same.

Course outcomes:

1. Knowledge application: Applies knowledge understandings acquired from one's academic study/ field/ discipline for community level education, information dissemination by participation and engagement in community welfare activities.
2. Commitment for cause: Identify and experience commitment for community engagement activities that reinforce sense of belongingness and gratitude towards societal cause.
3. Diversity: Witness diversity in communities and cultures and demonstrate change in approach / attitude as an evidence of unconditional acceptance.
4. Team: Recognise, experience and value effectiveness of working in a team, demonstrating co-existence of the roles - sincere worker and effective leader.

This is to certify that Mr./Ms._____ bearing PRN _____ is a student of S.Y. B.Tech., _____ branch of engineering. He / She is a bonafide student of SES's R. C. Patel Institute of Technology, Shirpur. He / She is reliable, sincere, hardworking and capable of conducting _____ _____ activity in your premises. We request you to kindly allow for the conduction of the activity and we also solicit your earnest co-operation in the same.

Signature

Name of Department Head:

Disclaimer

(This form must be read, signed, and submitted prior to the beginning of the community service activity.)

Student Details	**Activity Details**
Name	
PRN	Date
Program	Time
Class/Div	Address

I, the undersigned _____ accept the following terms and conditions unconditionally:

1. I accept and understand that the community activity identification and selection has been done willingly by me.
2. I undertake to convey that, I am apparently in good health and well-being, and suffer no physical impairment that would or should prevent my participation in the activity.
3. I undertake to bear all related expenses and risk of travel related to the activity and shall not hold any personnel from the institute responsible with regards to claims and / or loss in the process of conduct of activity.
4. I undertake that my parents or legal/local guardians are aware of said activity and agree to above mentioned terms and conditions.

Student's name & Signature: _____

Parent or Guardian's name & signature: _____

Guidelines for Assessment of the work

- The review/progress monitoring committee shall be constituted by the Head of the Department. The progress of selected/assigned activities is to be evaluated on a continuous basis, holding at-least one review in the semester.
- In the continuous assessment, focus shall also be on each individual student's contribution to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.
- Each group needs to submit following forms to respective supervisor after conducting both the activities,
  - Activity Conduction Report
  - Participant Feedback (online / offline)
  - Participant Attendance (online / offline)
  - Survey Report
  - Participation certification

Forms for Technical Activity:

1. Activity Conduction Report

Sr. No.	**Name of the Activity**	
1	Date of Activity	
2	Activity type Open / Technical	
3	Activity objectives	
4	Place of Activity	
5	PRN and Names of students	
6	Name of the Association	
7	Activity description	
8	No. of participants	
9	Photos (Geo tagged)	

2. Participant feedback (online / offline):

Sr. No.	Indicators	Scale: 1 (Lowest) to 5 (Highest)
1	The objectives of the training were clearly defined.	
2	The content was organized and easy to follow.	
3	This training experience will be useful to me.	
4	The trainer was knowledgeable about the training topics.	
5	The training objectives were met.	

Evaluation Scheme:

Continuous Assessment (A):

Term Work:- 25 marks, distribution as herewith:

1. Rubric for Open Ended Activity (10 marks)
   - Participation certificate/proof
2. Rubric for Technical Activity (15 marks)

Sr.No.	Performance Indicators (Maximum marks per indicator are given in bracket)	Marks
1	Pre-requisite documents (permission letter, presentation material etc.) [05 marks]	
2	Participant Feedback [05 marks]	
3	Participant attendance [05 marks]	
	TOTAL	

OR

3. Rubric for Field Survey Activity:

Sr.No.	Performance Indicators (Maximum 03 marks per indicator)	Marks
1	Topic selection	
2	Survey preparation	
3	Field work	
4	Analysis	
5	Report writing	
	TOTAL	

Semester - IV

Probability and Statistical Inference (RCP23ACPC401)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Calculus, Descriptive Statistics, Basics of probability.

Course Objectives:

1. To understand random variables with their probability distributions to build a model.
2. To estimate population parameters from random samples and perform error analyses and use statistical estimation in training and evaluating AI/ML algorithms.
3. To understand and apply the basic concepts of statistical inference, confidence limits and hypothesis testing to validate AI/ML models.
4. To understand and apply the concepts of analysis of variance for feature selection and model comparison in AI/ML.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the concepts of probability and distributions to some case studies.	L3	Apply
CO2	Demonstrate sampling distributions and estimate statistical parameters.	L3	Apply
CO3	Develop hypothesis based on data and perform testing using various statistical techniques.	L6	Create
CO4	Perform analysis of variance on data.	L4	Analyze

Course Contents

Unit-I — 08 Hrs.

Random Variables and Probability Distributions: Concept of a Random Variable, Discrete Probability Distributions, Continuous Probability Distributions, Mathematical Expectation, Statistical Independence.

Discrete Probability Distributions: Binomial Distribution, Poisson distribution.

Continuous Probability Distributions: Normal Distribution, Areas under the Normal Curve, Applications of the Normal Distribution, Normal Approximation to the Binomial. Application of probability distributions in predicting outcomes (e.g., classification probabilities).

Unit-II — 06 Hrs.

Sampling distribution: Random Sampling, Sampling Distributions, Sampling Distribution of Means and the Central limit theorem, population distribution, Z - distribution, Student's t-distribution, F-Distribution, Chi-square distribution, Chi-square test for feature independence in machine learning datasets.

Statistical Estimation Theory: Characteristics of estimators, consistency, unbiasedness, unbiased estimates, efficient estimates, sufficient estimators, point estimates, interval estimates, determination of sample size for estimating mean and proportions, estimates of population parameters, probable error.

Confidence interval: Population mean, difference between two population means, population proportion, difference between two population proportions, variance, ratio of variances of two populations. Application of confidence intervals to evaluate model performance metrics.

Unit-III — 07 Hrs.

Test of Hypothesis: Test of significance, null and alternative hypothesis, type I and type II error, factors affecting Type II error, probability of Type II error, power of test, p Value, critical region, level of significance.

Parametric Test: Test the difference between sample proportion and population proportion, difference between two sample proportion, difference between sample mean and population mean with known σ and unknown σ, difference between two sample means, one tailed and two tailed tests using z-statistics and t-statistics. Test the equality of population variance using F-statistics.

Non-parametric Test: Test of independence, goodness of fit using chi- square statistics. Application of hypothesis testing to validate given model assumptions.

Unit-IV — 05 Hrs.

Analysis of Variance (ANOVA) for data analysis: Sample size calculation, one-way ANOVA.

POST-HOC Analysis (Tukey's Test), randomized block design, two-way ANOVA. Use of ANOVA in feature selection and evaluating multiple machine learning models. Application of two-way ANOVA for analyzing the impact of hyper parameters and data preprocessing techniques on model performance.

Text Books:

1. S. P. Gupta, Sultan Chand, "Statistical Methods", 46^{th} revised Edition, 2021.
2. T. Veerarajan, "Probability - Statistics and Random Processes", McGraw Hill Education, 3^{rd} Edition, 2017.
3. Allen B. Downey, "Think Stats: Probability and Statistics for Programmers", Green Tea Press, 2011.
4. E. L. Lehmann, Joseph P. Romano, "Testing Statistical Hypotheses", Springer, 2008, 3^{rd} Edition.
5. Thomas Hasalwanter, "An Introduction to Statistics with Python", Springer, 2016.

Reference Books:

1. S. C. Gupta, V. K. Kapoor, Sultan Chand, "Fundamentals of mathematical statistics", 12^{th} Edition, 2020.
2. Peter Bruce, Andrew Bruce, Peter Gedeck, "Practical Statisticsfor data scientists 50+ Essential Concepts Using R and Python", 2^{nd} Edition, Orelly, 2020.
3. Freedman, David, Robert Pisani, Roger Pervis, W. W. Norton, "Statistics", 2007.
4. Sheldon M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, 5^{th} Edition, 2014.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Design and Analysis of Algorithms (RCP23ACPC402)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Computer Programming, Data structure.

Course Objectives:

1. To provide mathematical approach for Analysis of Algorithms.
2. To solve problems using various algorithmic strategies.
3. To analyze algorithms for solving problems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the performance of algorithms using asymptotic analysis.	L4	Analyze
CO2	Apply the concept of Greedy method to solve all feasible solutions of problems.	L3	Apply
CO3	Find optimal solution of problem by applying the concept of dynamic programming strategy.	L3	Apply
CO4	Understand the concepts of backtracking, branch and bound to represent solution by state space tree.	L2	Understand
CO5	Implement string matching techniques.	L3	Apply

Course Contents

Unit-I — 05 Hrs.

Introduction: Analysis of control statements and loops, solving recurrence relations using tree, substitution, master method, analysis of quick sort and merge sort Problem Solving using divide and conquer algorithm - Max-Min problem, Strassen's Matrix Multiplication

Unit-II — 06 Hrs.

Greedy Method: Introduction, Problem solving using - fractional knapsack problem, activity selection problem, job sequencing with deadline, Graph: Minimum Spanning trees(Kruskal's algorithm (Use find and union concept, Prim's algorithm), Single source shortest path (Dijkstra's algorithm), coin change problem.

Unit-III — 08 Hrs.

Dynamic Programming: Introduction, principle of optimality, Components of dynamic programming, characteristics of dynamic programming, Fibonacci problem, Coin Changing problem, 0/1 knapsack (table method), All pairs shortest paths (Floyd Warshall Algorithm), Single source shortest path (Bellman-Ford Algorithm), Matrix Chain Multiplication, Travelling salesperson problem, Longest Common Subsequence (LCS), Analysis of all Algorithms.

Unit-IV — 04 Hrs.

Backtracking and Branch-and-Bound:

Basics of backtracking, N-queen problem, Sum of subsets, Graph coloring, Analysis of all Algorithms. Branch-and-Bound: Introduction, Types of BB and its properties, Fifteen Puzzle problem

Unit-V — 03 Hrs.

String Matching Algorithms: The naive string-matching algorithm, The Rabin Karp algorithm, String matching with finite automata, The Knuth Morris Pratt algorithm

Text Books:

1. S. Sridhar, "Design and Analysis of Algorithms", 1st Edition, Oxford Education, 2018.
2. Goodrich M T, "Design and Analysis of Algorithms", Wiley, New Delhi, 2021.
3. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran, "Fundamentals of computer algorithms", University Press.

Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, "Introduction to Algorithms", 4th Edition, The MIT Press, 2022.

2. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw-Hill Edition.

3. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI.

4. John Kleinberg, Eva Tardos, "Algorithm Design", Pearson.

5. Michael T. Goodrich, Roberto Tamassia, "Algorithm Design", Wiley Publication.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.

2. Total duration allotted for writing the paper is 2 hrs.

Design and Analysis of Algorithms Laboratory (RCP23ALPC402)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

1. Design and implement efficient algorithms for a specified application.
2. Strengthen the ability to identify and apply the suitable algorithm for the given real world problem.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Compare different algorithms based on Divide and Conquer approach.	L4	Analyze
CO2	Make use of Greedy method and Dynamic programming to solve real worls problems.	L3	Apply
CO3	Demonstrate working of Backtracking method and string matching algorithms.	L3	Apply

List of Laboratory Experiments

Suggested Experiments:

1. Implementation of Min Max algorithm.
2. Implementation of Strassen's Matrix Multiplication.
3. Implementation of Karatsuba algorithm for long integer multiplication.
4. Fractional Knapsack implementation using greedy approach.
5. Implementation of Activity selection using greedy approach.
6. Implementation of Kruskal's/ Prim's algorithm using greedy approach.
7. Implementation of job sequencing with deadline using greedy approach.
8. Implementation of other greedy algorithms eg: tree vertex split, subset cover, container loading, coin changing, optimal; merge patterns (Huffman tree).
9. Implementation of Single source shortest path (Dijkstra's algorithm).
10. Implementation of Bellman Ford algorithm using Dynamic programming.
11. Implementation of Longest Common Subsequence algorithm using Dynamic programming.
12. Implementation of Travelling Salesperson problem using Dynamic programming.
13. Implementation of all pair shortest path using dynamic programming.
14. Implementation of N-queen problem using Backtracking.
15. Implementation of 15 Puzzle problem using Backtracking.
16. Implementation of Knuth Morris Pratt string matching algorithm.

A minimum of 08 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on RCP23ACPC402 with minimum 08 experiments to be incorporated.

The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks

2. Journal Submission: 05 Marks

3. Viva-voce: 05 Marks

4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Artificial Intelligence (RCP23ACPC403)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Foundation of Artificial Intelligence

Course Objectives:

1. The course aims to introduce the concepts of artificial intelligence, search algorithms, knowledge representation, and data analysis.
2. To apply various AI techniques, including search algorithms, knowledge representation methods, and data mining techniques, to solve real-world problems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply various search algorithms (uninformed and informed) to solve a wide range of problems, from simple puzzles to complex optimization tasks. Represent knowledge using logical and probabilistic models and perform reasoning tasks effectively.	L3	Apply
CO2	Discover local search and optimization problem.	L5	Evaluate
CO3	Develop intelligent agents that can play games optimally or near-optimally using techniques.	L6	Create
CO4	Inference techniques like forward chaining, backward chaining, and resolution to solve problems and draw conclusions from given knowledge bases as well as planning.	L5	Evaluate

Course Contents

Unit-I — 05 Hrs.

Uninformed Search Algorithms: Best-first search, Search data structures, Redundant paths, Measuring problem-solving performance, Uninformed Search Strategies: Breadth-first search, Uniform-cost search, Depth-first search and the problem of memory, Depth-limited and iterative deepening search, Bidirectional search, Comparing uninformed search algorithms.

Unit-II — 05 Hrs.

Informed Search Algorithms: Greedy best-first search, A* search, Search contours, Satisficing search: Inadmissible heuristics and weighted A*, Memory-bounded search, Bidirectional heuristic search, The effect of heuristic accuracy on performance, Generating heuristics from- relaxed problems, sub problems and landmarks.

Unit-III — 05 Hrs.

Local Search and Optimization Problems: Hill-climbing search, Simulated annealing, Local beam search, Evolutionary algorithms- Genetics Algorithm, Ant Colony Optimization, Particle Swarm Optimization.

Unit-IV — 06 Hrs.

Adversarial Search and Games: Game Theory, Optimal Decisions in Games- The minimax search algorithm, Alpha–Beta Pruning, Monte Carlo Tree Search, Stochastic Games, Limitations of Game Search Algorithms.

Unit-V — 05 Hrs.

Inference in FOL and Planning: Unification and First-Order Inference, Forward Chaining, Backward Chaining, Resolution, Practical uses of resolution theorem provers. Definition of Classical Planning, Algorithms, Heuristics for Planning, Hierarchical Planning.

Text Books:

1. Saptarsi Goswami, "AI for Everyone: a beginner's Handbook for AI", Pearson Publication, 2024.
2. Russell/Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, 2022.
3. "Artificial intelligence a modern approach", Mikan Ltd ISBN- No 978-1914063183, 2020.
4. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education (India), 2013.

Reference Books:

1. Nils J. Nilsson, "Principles of Artificial Intelligence", Narosa Publication.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Publication.
3. Patrick H. Winston, "Artificial Intelligence", 3rd Edition, Pearson Education.

Online References:

1. https://nptel.ac.in/courses/106105079
2. https://thestempedia.com/blog/simple-ai-and-machine-learning-projects-for-students-and-beginners/
3. https://nptel.ac.in/courses/106105078

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Artificial Intelligence Laboratory (RCP23ALPC403)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

1. The course aims to introduce the search algorithms, knowledge representation, and data analysis.
2. The course aims to apply various AI techniques to solve real-world problems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement various search algorithms to reach goal state.	L3	Apply
CO2	Apply various techniques to solve problems and draw conclusions from given knowledge bases.	L3	Apply

List of Laboratory Experiments

Suggested Experiments:

1. One case study on AI applications published in IEEE/ACM/Springer or any prominent journal.
2. Implement breadth-first, depth-first, uniform-cost, and iterative deepening search on various problem domains (e.g., 8-puzzle, sliding tile puzzle, maze solving). Compare their performance in terms of nodes expanded, solution path length, and execution time.
3. Implement BFS/DFS/DFID search algorithms to reach goal state.
4. Implement A* search algorithm to reach the goal state.
5. Implement iterative deepening A* or recursive best-first search to handle memory constraints. Compare their performance on large problem instances.
6. Implement steepest ascent, hill climbing with random restarts, and simulated annealing. Test them on optimization problems like the traveling salesman problem or the knapsack problem.
7. Explore different genetic operators (e.g., crossover, mutation) and their impact on the convergence rate and solution quality of genetic algorithms.
8. Implement a minimax algorithm for a two-player game.
9. Experiment with different exploration and exploitation strategies in Monte Carlos Tree Search. Test its effectiveness on games like Go or chess.
10. Implement a resolution-based theorem prover and test it on various logical problems.
11. Implement forward and backward chaining planning algorithms. Compare their performance on planning domains like the blocks world or the logistics domain.
12. Case study on AI applications:
    (a) Introduction to NLP- Language models, Grammars, Parsing.
    (b) Robotics - Robots, Robot hardware, Problems Robotics can solve.
    (c) AI applications in Healthcare, Retail, Banking.

A minimum of 08 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on RCP23ACPC403 with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

(a) Performance in Experiments: 05 Marks

(b) Journal Submission: 05 Marks

(c) Viva-voce: 05 Marks

(d) Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Programming Laboratory-II (Web Development) (RCP23ALPC404)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Prerequisite: Basics of programming.

Course Objectives:

1. To get familiar with the basics of Web Programming.
2. To expose students to Basics and Advanced concepts in REACT.
3. To orient students to Fundamentals of node.js and express framework.
4. To understand REST API and MongoDB for Frontend and Backend Connectivity, validation, and security measures to protect sensitive information within a database.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement interactive web page(s) using HTML5, CSS3 and JavaScript.	L3	Apply
CO2	Implement Single Page Application using React.js and Node.js Framework.	L3	Apply
CO3	Construct web based Node.js applications using Express.	L6	Create
CO4	Apply MongoDB for frontend and backend connectivity using REST API.	L3	Apply

Course Contents

Unit-I — 04 Hrs.

HTML5, CSS3 and Bootstrap5:

HTML5: Introduction and Advantages of HTML5, HTML formatting, Hyperlinks, Images, tables, Lists, Elements (Block & Inline), Attributes, Page Layout, Semantic Elements, HTML5 Web Forms, HTML5 Media (Video & Audio).

CSS3: Introducing CSS3, Selectors, Border, Box Model, Margin & Padding, Background Images & Colors and Other Decorative (Texts, Fonts, Links, Lists, Tables), Positioning, Combinators, Pseudo-class and Pseudo-element, CSS Attribute Selectors, 2D and 3D Transformations, Transitions and Animations, @property, Flexbox, CSS3-Multi Column Layout, Media Queries.

Bootstrap5: Introduction to Bootstrap, Containers, Bootstrap Grids, Bootstrap Cards, Bootstrap JS (Navbar, Offcanvas, Collapse, Modal, Carousel), Flex, Bootstrap Forms.

Unit-II — 04 Hrs.

JavaScript: Introduction to JavaScript, JavaScript DOM Model, var, let, const, Operators, primitive data types & strings, conditional, loop, for each loop, operators, ternary operators, RegExp. Arrow functions, normal functions - Lexical this - Events, Handling events - Spread operator, Destructuring - named imports, default import, map, filter, reduce, Date and Objects. Call back system, Asynchronous, promises - Async, await, JSON Introduction, Syntax.

Unit-III — 06 Hrs.

React Fundamental: Installation, installing libraries, Folder and file structure, Components, Component lifecycle, Props, State, Events, React Conditional, map, keys, React Router and Single page applications, Forms, Form Handling.

Advance React: Refs, Use effects, Hooks, Flow architecture, Model View Controller(MVC) framework, Flux.

Unit-IV — 06 Hrs.

Node.js: Node.js, Setup Development Environment: Installation of Node.js, Working in REPL, NodeJS Console, Event Loop, working with an MVC framework, apply concepts like data types, objects, methods, object- oriented programming, and classes in the context of backend development, Creating simple Node Server, Request and Response, Routing responses, NPM JavaScript Build Processes, Event Loop and Emitters, File System Interaction, Modules, Native Node driv[illegible]

Unit-V — 01 Hrs.

Express.js: Introduction, Installation, Express router, REST API, Generator, Aut[illegible]ion, ses-

sions, Integrating with React, Commercial deployment.

Unit-VI 02 Hrs.

Database Connectivity: MongoDB Installation, connecting to MongoDB, CRUD Operations, Frontend Integration with React (Fetching data, State Management, Displaying Data), User Authentication (JWT), Role-based Access Control. Hosting Backend (e.g., Heroku, Vercel), Hosting Frontend (e.g., Netlify, Vercel).

Suggested List of Experiments:

1. Using HTML5 layout tags develop informative page with sections which include various images, links to other pages for navigation, make use of all possible formatting (for example font, color etc.).
2. Create form in HTML5 with all form elements. Apply form validations (e.g., Email, mobile, Pin code, Password) using JavaScript.
3. Apply CSS properties, Border, margins, Padding, Navigation, dropdown list to page created in First and Second Experiments.
4. Create an application to implement a counter application in JavaScript.
5. Create an application to demonstrate JSX, Components, Props, State in React.
6. Create an application to demonstrate Forms, Events, Routers, Refs, Keys in React.
7. Create an application to demonstrate use of Conditional rendering in React JS.
8. Create an application to build a simple web server that serves static content. They can learn how to use the http module to create a server, and how to handle requests and responses.
9. Create an application to demonstrate the implementation of Call back system, Asynchronous, promises - Async, await in node js.
10. Build a RESTful API using MongoDB.

A minimum of 08 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Text Books:

1. John Dean, "Web Programming with HTML5, CSS3 and JavaScript", Jones & Bartlett Learning, 2019.
2. Glenn Johnson, "Programming in HTML5 with JavaScript and CSS3", Microsoft Press, 2013 Edition.
3. Adam Bretz and Colin J. Ihrig, "Full Stack JavaScript Development with MEAN", SitePoint Pty. Ltd., 2015.

4. Simon Holmes Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node", Manning Publications, 2015.
5. Venkat Subramaniam, "Rediscovering JavaScript, Master ES6, ES7, and ES8", The Pragmatic Bookshelf, 2018.
6. Alex Banks and Eve Porcello, "Learning React Functional Web Development with React and Redux", 1st Edition, O'Reilly, 2017 Edition 5.
7. Andrew Mead, "Learning Node.js Development", 6th Edition, Packt Publishing, 2018.
8. Valentin Bojinov, "RESTful Web API Design with Node.js 10", Packt Publication, 2018.

Reference Books:

1. Ethan Brown, "Web Development with Node and Express", O'Reilly, 2019.
2. Shama Hoque "Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js", 2nd Edition, Packt Publication, 2020.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on RCP23ALPC404 with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Database Management Systems (RCP23ACMD401)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Computer Basics.

Course Objectives:

1. Understanding Database Fundamentals.
2. Develop Structured Query Language (SQL) for data definition, manipulation, and retrieval, including complex queries and transactions.
3. Learn how to design efficient and normalized database schemas using Entity-Relationship (ER) modeling and normalization techniques.
4. Understand the principles of data integrity, validation, and security measures to protect sensitive information within a database.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Design an optimized database.	L3	Apply
CO2	Construct SQL queries to perform operations on the database.	L6	Create
CO3	Demonstrate appropriate transaction management and recovery techniques for a given problem.	L3	Apply
CO4	Apply indexing mechanisms for efficient retrieval of information from database.	L3	Apply

Course Contents

Unit-I — 06 Hrs.

Introduction to Database Concepts and Relational Data Model: Introduction, Characteristics of databases, File system v/s Database system, Users of Database system, Schema and Instance, Data Independence, DBMS system architecture, Database Administrator.

The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation.

Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation, Introduction to the Relational Model, relational schema and concept of keys, Mapping the ER and EER Model to the Relational Model.

Unit-II — 05 Hrs.

Structured Query Language: Overview of SQL, Data Definition Commands, Data Manipulation commands, Integrity constraints - key constraints, Domain Constraints, Referential integrity, check constraints, Data Control commands, Transaction Control Commands, Set and String operations, group by, having, Views in SQL, joins, Nested and complex queries.

Unit-III — 04 Hrs.

Relational–Database Design: Pitfalls in Relational-Database designs, Concept of normalization, Function Dependencies, Normal Forms- 1NF, 2NF, 3NF.

Unit-IV — 07 Hrs.

Transaction Management and Recovery: Transaction Concept, ACID properties, Transaction States, Concurrent Executions, Serializability, Concurrency Control Protocols: Lock-based, Deadlock Handling, Recovery System: Failure classification, Log based recovery.

Unit-V — 04 Hrs.

Indexing Mechanism: Hashing techniques, Types of Indexes: Single Level Ordered Indexes, Multilevel Indexes, Overview of B-Trees and B+ Trees.

Text Books:

1. Korth, Silberchatz, Sudarshan, "Database System Concepts", 7th Edition, McGraw –Hill, 2019.
2. Elmasri and Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016.
3. Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", 5th Revised Edition, Thomson Learning, 2002.

4. G. K. Gupta, "Database Management Systems", 3rd Edition, McGraw – Hill, 2018.

Reference Books:

1. Dr. P. S. Deshpande, "SQL and PL/SQL for Oracle 10g, Black Book", Dreamtech Press, 2012.
2. Sharaman Shah, "Oracle for Professional", 1st Edition, Shroff Publishers & Distributers Private Limited, 2008.
3. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", 3rd Edition, McGraw – Hill, 2014.
4. Patrick Dalton, "Microsoft SQL Server Black Book", 11th Edition, Coriolis Group, U.S., 1997.
5. Lynn Beighley, "Head First SQL", 1st Edition, O'Reilly Media, 2007.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Database Management Systems Laboratory (RCP23ALMD401)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

1. To design an Entity-Relationship (ER)/ Extended Entity-Relationship (EER) Model for a given application.
2. To define schema by converting conceptual model to relational model.
3. To understand the use of Structured Query Language (SQL) syntax for design of given application.
4. To implement a database using B-trees/B+ trees.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Build ER/EER diagram for the given application.	L3	Apply
CO2	Utilize ER/EER concepts to convert into relational schema with integrity constraints for given application.	L3	Apply
CO3	Design a database for given application using DDL and DML commands and apply string, SET and Join operations, Aggregate functions and nested queries on given application database.	L6	Create
CO4	Apply indexing algorithm on database using B-trees/B+ trees.	L3	Apply

List of Laboratory Experiments

Suggested Experiments:

1. To draw an ER diagram for a problem statement.
2. Map the ER/EER to relational schema.
3. To implement DDL and DML commands with integrity constraints.
4. To access & modify Data using basic SQL.
5. To implement aggregate functions.
6. To implement Joins and Views.
7. To implement Subqueries.
8. To implement triggers.
9. To implement security and authorization in SQL.
10. Examine the consistency of database using concurrency control technique (Locks).
11. To implement B-trees/B+ trees.

A minimum of 08 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on RCP23ACMD401 with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Project Management (RCP23OCOE401)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Basic concepts of Management

Course Objectives:

1. To familiarize the students with the use of a structured methodology/approach for every unique project undertaken, utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain project management life cycle and the various project phases as well as the role of project manager.	L2	Understand
CO2	Apply selection criteria and select an appropriate project from different options.	L3	Apply
CO3	Create a work break down structure for a project and develop a schedule based on it. Manage project risk strategically.	L6	Create
CO4	Use Earned value technique and determine & predict status of the project. Capture lessons learned during project phases and document them for future reference.	L6	Create
CO5	Differentiate between traditional waterfall approach and agile scrum methodology for software development projects	L4	Analyze

Course Contents

Unit-I — 07 Hrs.

Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical). Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Introduction to project leadership, ethics in projects, Multicultural and virtual projects, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI).

Unit-II — 08 Hrs.

Initiating Projects: How to get a project started, selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter, Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics.

Unit-III — 08 Hrs.

Project Planning: Work Breakdown structure (WBS) and linear responsibility chart, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques, PERT, CPM. Crashing project time & Resource loading and levelling (Only Theory), Project Stakeholders and Communication plan.

Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability, and impact matrix. Risk response strategies for positive and negative risks.

Unit-IV — 08 Hrs.

Monitoring and Controlling Projects: Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, communication and project meetings. Earned Value Management techniques for measuring value of work completed, using milestones for measurement, change requests and scope creep, Project audit, Project Contracting: Project procurement management, contracting and outsourcing.

Closing the Project: Customer acceptance, Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report, doing a lessons learned analysis, acknowledging successes and failures.

Unit-V — 08 Hrs.

Agile project management:: Agile principle, Agile Manifesto, Agile process framework, Characteristics of Agile Approaches and Scrum, Benefits of Agile project management, Implementing Agile

project management.

Agile Project Planning: Comparison of Agile Project Management with Traditional Waterfall Approach, Project Planning with Scrum, Scrum Artifacts Supporting Project Planning , Scrum Events for Project Planning. Scheduling with scrum, Techniques for scrum scheduling- Poker estimation.

Agile Tools for Tracking Project Progress: Task Boards, Burnup and Burndown Charts.

Text Books:

1. Jack Meredith & Samuel Mantel, "Project Management: A managerial approach", 11^{th} Edition, Wiley India.
2. Erik Larson, Clifford Gray, "Project Management: The Managerial Process", 8^{th} Edition, McGraw Hill Education.
3. Jim Highsmith, Pearson Education, "Agile Project Management", Low Price Edition, India.

Reference Books:

1. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 7^{th} Edition, Project Management Institute PA, USA.
2. Gido Clements, "Project Management", Cengage Learning.
3. Gopalan, "Project Management", Wiley India.
4. Dennis Lock, "Project Management", 9^{th} Edition, Gower Publishing England.
5. Kalpesh Ashar, "Agile Essentials You Always Wanted to Know", Vibrant Publishers U.S.A.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Cyber Security, Policies and Laws (RCP23OCOE402)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Fundamentals of Computers.

Course Objectives:

1. Familiarize with the provisions and implications of the Digital Personal and Data Protection Act, the obligations of data fiduciaries, the rights and duties of data principals, and mechanisms for resolving breaches.
2. Equip individuals and organizations with the knowledge and tools to create secure cyber ecosystems, strengthen regulatory frameworks, and develop incident response plans.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand and describe the major types of cybercrime and navigate legal frameworks and regulations concerning digital personal and data protection.	L2	Understand
CO2	Implement strategies for cybersecurity outlined in the National Cyber Security Policy.	L3	Apply
CO3	Apply appropriate law enforcement strategies to both, prevent and control cybercrime.	L3	Apply
CO4	Comprehend regulations and strategies pertaining to AI (Artificial Intelligence) and large language models.	L2	Understand

Course Contents

Unit-I — 08 Hrs.

Cyber Crime: Definition and Origin of the Word, Cyber Crime and Information Security, who are Cyber Criminals, Classification of Cybercrimes, E-mail Spoofing, Spamming, Cyber Defamation, Internet Time Theft, Salami Attack, Salami technique Data Diddling, Forgery, Newsgroup Spam, Online Frauds, Pornographic Offenders, Email Bombing, Password Sniffing, Credit Card Frauds.

Unit-II — 08 Hrs.

Cyber Offenses: How Criminals plan them, Categories of Cyber Crimes, How Criminal Plans the Attack: Active Attacks, Passive Attacks, Social Engineering, Classification of Social Engineering, Cyber Stalking: types of Stalkers, Cyber Cafe and Cyber Crimes, Botnets, Attack Vectors, Cyber Crime and Cloud Computing.

Unit-III — 08 Hrs.

Indian IT Act: Cyber Crime and Criminal Justice, Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments Security aspect in Cyber-Law, The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, Security Standards: SOX, GLBA, HIPAA, NIST Cyber Security Framework (CSF).

Unit-IV — 07 Hrs.

India's Digital Personal and Data Protection Act (2023): Preliminary, Obligations of Data Fiduciary, Rights and Duties of Data Principal, Special Provisions, Data Protection Board of India, Powers, Functions and Procedure to Be Followed by Board, Appeal and Alternate Dispute Resolution, Penalties and Adjudication.

Unit-V — 08 Hrs.

India's AI Regulation and Strategy: Privacy, Security and Artificial Intelligence, Differential Privacy, Security in AI. National Artificial Intelligence Strategy, Principles for Responsible AI, Information Technology (Intermediary Guidelines and Digital Media Ethics Code-2021), Draft National Data Governance Framework Policy (NDGFP), Rules against Deepfakes, Due diligence advisory for AI, AI regulations framework (June 2024).

Text Books:

1. Nina Godbole, Sunit Belapur, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley-2011.
2. Gurdip Kaur, "Understanding Cybersecurity Management in Decentralized Finance: Challenges, Strategies, and Trends", Springer-2023.

Reference Books:

1. "The Information Technology Act, 2000", Bare Act- Professional Book Publishers, New Delhi.
2. Izzat Alsmadi, "The NICE Cyber Security Framework: Cyber Security Intelligence and Analytics", Springer-2023.

References (Web Resources):

1. Digital Personal Data Protection Act 2023.pdf (meity.gov.in)
2. National Cyber Security Policy (draft v1 (meity.gov.in)
3. CISO_Roles_Responsibilities.pdf
4. Standards(bis.gov.in)
5. AI, Machine Learning & Big Data Laws & Regulations | India (globallegalinsights.com)

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Advanced Operations Research (RCP23OCOE403)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Operation Research, Mathematics (Calculus)

Course Objectives:

1. To develop an ability to analyse the structure and mathematical model of various complex system occurring in manufacturing system, service system, and business applications.
2. To develop knowledge of the mathematical structure of linear and nonlinear optimization models.
3. To develop an understanding of the techniques used to solve linear and nonlinear optimization models using their mathematical structure.
4. To develop an understanding of the use of modelling languages for expressing and solving optimization models.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply Duality theory to solve linear programming problem and analyse optimum solution.	L3	Apply
CO2	Construct linear integer programming models and apply the O.R. algorithms and techniques to solve linear integer programming problems.	L3	Apply
CO3	Determine best satisfying solution under a varying quantity of resources and priorities of the goals.	L5	Evaluate
CO4	Set up decision models and solve nonlinear programming- unconstrained optimization problems.	L3	Apply
CO5	Set up decision models and solve nonlinear programming- constrained optimization problems.	L3	Apply

Course Contents

Unit-I — 06 Hrs.

Dual Linear Programs: Primal, dual, and duality theory - The dual simplex method -The primal-dual algorithm-Duality applications. Post optimization problems: Sensitivity analysis.

Unit-II — 06 Hrs.

Integer Programming: Pure and mixed integer programming problems, Solution of Integer programming problems – Gomory's all integer cutting plane method and mixed integer method, branch and bound method, Zero-one programming.

Unit-III — 05 Hrs.

Goal Programming : Concept of Goal Programming, GP model formulations, Graphical method of GP, The simplex method of GP, Application areas of GP.

Unit-IV — 11 Hrs.

Nonlinear Programming- Unconstrained optimization : Minimization and maximization of convex functions- Local & Global optimum- Convergence-Speed of convergence. one-dimensional unconstrained optimization – Newton's method – Golden-section search method , multidimensional unconstrained optimization –Gradient method — steepest ascent (descent) method – Newton's method.

Unit-V — 11 Hrs.

Nonlinear Programming- Constrained optimization : Constrained optimization with equality and inequality constraints. Constrained optimization: Lagrangian method - Sufficiency conditions - Kuhn-Tucker optimality conditions Rate of convergence - Engineering Applications Quadratic programming problems-convex programming problems.

Text Books:

1. Gupta, P. K. and Hira, D. S., "Operations Research", S. Chand Publications, 2014.
2. Srinivasan, G., "Operations research: Principles and applications", Prentice Hall of India, 2007.
3. Nita H. Shah, Poonam Prakash Mishra, "Non-Linear Programming-A Basic Introduction", CRC Press, 2020.

Reference Books:

1. Frederick S. Hillier & Gerald J. Lieberman, "Introduction to Operations Research", 8^{th}(International) Edition, McGraw-Hill: Boston MA, 2005.
2. Ravindran, Philips and Soleberg, "Operations Research – Principle and Practice", 2^{nd} Edition, John Wiley and Sons, 2007.
3. Taha, H. A., "Operations Research - An Introduction", Pearson Education, 2022.
4. Paul A. Jensen, Jonathan F. Bard, "Operations Research: models and methods", Wiley Publications, 2003.
5. C. B Gupta, I.K., "Optimization Techniques in Operation Research", International Publishing House Pvt. Limited, 2008.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Corporate Finance Management (RCP23OCOE404)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Course Objectives:

1. Overview of Indian financial system, instruments and market.
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management.
3. Knowledge about sources of finance, capital structure, dividend policy.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand Indian finance system	L2	Understand
CO2	Apply concepts of time value money and risk returns to product, services and business.	L3	Apply
CO3	Understand corporate finance and working capital management.	L2	Understand
CO4	Take Investment and finance decisions.	L3	Apply
CO5	Take dividend decisions.	L3	Apply

Course Contents

Unit-I — 08 Hrs.

Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market. Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges.

Unit-II — 08 Hrs.

Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.

Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.

Unit-III — 07 Hrs.

Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance-investment Decision, Financing Decision, and Dividend Decision.

Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.

Unit-IV — 08 Hrs.

Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value (NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR).

Unit-V — 08 Hrs.

Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches — Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value.

Concept of Optimal Capital Structure.

Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches — Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach

Text Books:

1. Prasanna Chandra, "Financial Management, Theory & Practice", 8th Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2011.
2. M. Y. Khan, "Indian Financial System", 9th Edition, McGraw Hill Education, New Delhi, 2015.
3. I. M. Pandey, "Financial Management", 11th Edition, S. Chand (G/L) & Company Limited, New Delhi, 2015.

Reference Books:

1. Eugene F. Brigham and Joel F. Houston, "Fundamentals of Financial Management", 13th Edition, Cengage Publications, New Delhi, 2015.
2. Robert C. Higgins, "Analysis for Financial Management", 10th Edition, McGraw Hill Education, New Delhi, 2013.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Corporate Social Responsibility (RCP23OCOE405)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Nil.

Course Objectives:

1. To make students understand the concept, theories and application of CSR for the Development of the Society.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	To analyse and critique the ethical dimensions of Corporate Social Responsibility initiatives, demonstrating a comprehensive understanding of CSR principles and their ethical underpinnings	L4	Analyze
CO2	To understand the legislative frameworks shaping Corporate Social Responsibility both in India and globally, alongside recognizing the key drivers fostering CSR practices within the Indian context.	L2	Understand
CO3	To identify and discuss the significance of social responsibility and community engagement initiatives, demonstrating an understanding of their impact on both businesses and society.	L2	Understand

Course Contents

Unit-I 07 Hrs.

Introduction to Corporate Social Responsibility (CSR): Understanding the concept of CSR ,Historical evolution and development of CSR,Importance and benefits of CSR for businesses and society ,Stakeholder theory and its relevance to CSR .

Unit-II 08 Hrs.

Ethical Foundations of CSR: Ethical theories relevant to CSR (Utilitarianism, Deontology, Virtue Ethics), Ethical decision-making frameworks in business, Corporate governance and ethics, Ethical issues in supply chain management.

Unit-III 08 Hrs.

CSR-Legislation in India and the World: Section 135 of Companies Act 2013.Scope for CSR Activities under Schedule VII, Appointment of Independent Directors on the Board, and Computation of Net Profit's Implementing Process in India.

Unit-IV 08 Hrs.

The Drivers of CSR in India: Market based pressure and incentives, civil society pressure, the regulatory environment in India Counter trends, Review of current trends and opportunities in CSR, Review of successful corporate initiatives and challenges of CSR. Case Studies of Major CSR Initiatives Corporate Social Responsibility and Public-Private Partnership (PPP).

Unit-V 08 Hrs.

Social Responsibility and Community Engagement: Social issues and challenges in contemporary society, Corporate philanthropy and community development initiatives, Stakeholder engagement strategies, Corporate volunteering and employee engagement programs, CSR as a strategic business tool vital for sustainable development.

Text Books:

1. Andrew Crane, Dirk Matten, "Corporate Social Responsibility: Definition, Core Issues, and Recent Developments", Oxford University Press.
2. O. C. Ferrell, John Fraedrich, Linda Ferrell, "Business Ethics: Ethical Decision Making & Cases", Cengage Learning.
3. Sanjay K. Agarwal, "Corporate Social Responsibility in India", Sage Publications, 2008.
4. Bidyut Chakrabarty, "Corporate Social Responsibility in India", Routledge, New Delhi, 2016.

Reference Books:

1. Mark S. Schwartz, "Corporate Social Responsibility: An Ethical Approach", Broadview Press, 2011.
2. George Pohle and Jeff Hittner, "Attaining Sustainable Growth through Corporate Social Responsibility", IBA Global Business Services, 2008.
3. William B. Werther Jr. and David Chandler, "Strategic Corporate Social Responsibility: Stakeholders in a Global Environment", 2nd Edition, Sage Publications, 2011.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Bioinformatics (RCP23OCOE406)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Course Objectives:

1. To provide an overview of bioinformatics and its significance in modern biological research.
2. To enable students to apply bioinformatics methods in practical scenarios for biological data analysis and interpretation.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the structure and function of cells, organelles, and biomolecules	L2	Understand
CO2	Understand the types of data stored in bioinformatics databases and their relevance to biological research.	L2	Understand
CO3	Explore genomic databases and understand the structure and content of protein databases.	L2	Understand
CO4	Understand system biology concepts and molecular evolution	L2	Understand
CO5	Apply knowledge of cellular and molecular biology concepts to analyze a biological problem.	L3	Apply

Course Contents

Unit-I — 08 Hrs.

Foundations of Molecular and Cellular Biology:

Introduction to molecular biology: DNA, RNA, proteins, and their roles in cellular processes

Cell structure and function: Organelles, membrane structure, and cellular transport

Cell cycle regulation: phases of the cell cycle, checkpoints, and cell cycle control mechanisms

Unit-II — 08 Hrs.

Genetics and Genomics:

Mendelian genetics: Inheritance patterns, Punnett squares, and genetic crosses

Chromosome structure and organization: karyotyping, gene mapping, and genetic linkage

Introduction to genomics: genome structure, organization, and variation

Techniques in molecular genetics: PCR, DNA sequencing, and gene cloning

Unit-III — 08 Hrs.

Genomic and Protein Databases:

Types of genomic databases such as GenBank, Ensemble, and UCSC Genome Browser, Understand the structure and content of protein databases such as UniProt and Protein Data Bank (PDB), Searching, Retrieving, and Analysing Genomic and Protein data from online databases.

Unit-IV — 08 Hrs.

Systems Biology:

Introduction to Systems Biology: Modeling biological systems and network analysis, Bioinformatics tools for systems biology and modeling complex biological processes.

Principles of molecular evolution: Mutation, Selection, and genetic drift.

Phylogenetic analysis: Tree construction, sequence alignment, and molecular clock.

Unit-V — 07 Hrs.

Applications and Case Studies: Applications of Bioinformatics in Medicine, Agriculture, and Biotechnology, Case Studies (Integrating Cellular and Molecular Biology with Bioinformatics) and Research Examples, Ethical and Legal Issues in Bioinformatics, Future Trends and Emerging Technologies in Bioinformatics.

Text Books:

1. Jean-Michel Claverie and Cedric Notredame, "Bioinformatics For Dummies", 2019.
2. Phillip Compeau and Pavel Pevzner, "Bioinformatics Algorithms: An Active Learning Approach", Active Learning Publishers, 2019.

Reference Books:

1. Arthur Lesk, "Introduction to Bioinformatics", Biologist & Bioinformatics Expert, 2019.
2. Robert Hoyt, "Introduction to Biomedical Data Science", Informatics Education, 2019.
3. Martin Jones, "Python for Biologists: A Complete Programming Course for Beginners", Oxford University Press, 2013.
4. Neil C. Jones, and Pavel A. Pevzne, "An Introduction to Bioinformatics Algorithms", MIT Press, 2004.
5. Caroline St. Clair, and Jonathan E. Visick, "Exploring Bioinformatics: A Project-Based Approach", Jones & Bartlett Learning, 2014.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Human Resource Management (RCP23OCOE407)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Course Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource managements.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students about the importance of the labour relations in the organization.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand and distinguish the changing environment of the HRM and the role of the HR managers.	L2	Understand
CO2	Understand and analyse the recruitment process and the application of the IT.	L3	Apply
CO3	Understand and examine the importance of the training and development.	L4	Analyze
CO4	Understand and determine the pay plans, performance appraisal and compensation.	L4	Analyze
CO5	Understand and explain the importance of the labour relation, the employee security and collective bargaining.	L2	Understand

Course Contents

Unit-I — 07 Hrs.

Human Resource Function: Human Resource Philosophy – Changing environments of HRM – Strategic human resource management – Using HRM to attain competitive advantage – Trends in HRM – Organisation of HR departments – Line and staff functions – Role of HR Managers.

Unit-II — 10 Hrs.

Recruitment & Placement: Job analysis: Methods - IT and computerised skill inventory - Writing job specification - HR and the responsive organisation.

Recruitment and selection process: Employment planning and forecasting - Building employee commitment: Promotion from within - Sources, Developing and Using application forms - IT and recruiting on the internet.

Employee Testing & selection: Selection process, basic testing concepts, types of test, work samples & simulation, selection techniques, interview, common interviewing mistakes, Designing & conducting the effective interview, small business applications, computer aided interview.

Unit-III — 08 Hrs.

Training & Development: Orientation & Training: Orienting the employees, the training process, need analysis, Training techniques, special purpose training, Training via the internet.

Developing Managers: Management Development - The responsive managers - On-the-job and off the-job Development techniques using HR to build a responsive organisation.

Performance appraisal: Methods - Problem and solutions - MBO approach - The appraisal interviews - Performance appraisal in practice.

Managing careers: Career planning and development - Managing promotions and transfers.

Unit-IV — 08 Hrs.

Compensation & Managing Quality: Establishing Pay plans: Basics of compensation - factors determining pay rate - Current trends in compensation - Job evaluation - pricing managerial and professional jobs - Computerised job evaluation.

Pay for performance and Financial incentives: Money and motivation - incentives for operations employees and executives - Organisation wide incentive plans - Practices in Indian organisations.

Benefits and services : Statutory benefits - non-statutory (voluntary) benefits - Insurance benefits -retirement benefits and other welfare measures to build employee commitment.

Unit-V

06 Hrs.

Labour relations and employee security: Industrial relation and collective bargaining: Trade unions - Collective bargaining - future of trade unionism. Discipline administration - grievances handling - managing dismissals and separation.

Labour Welfare: Importance & Implications of labour legislations - Employee health - Auditing HR functions, Future of HRM function.

Text Books:

1. Pattanayak, Biswajeet, "Human Resource Management", 6th Edition, PHI Learning Pvt. Ltd., 1 Jul 2020.
2. Gary Dessler, "Human Resource Management", 16th Edition, Pearson Publications, 2020.

Reference Books:

1. Stephen Robbins, "Organizational Behavior", 16th Edition, 2013.
2. Aswathapa, "Human resource management: Text & cases", 6th Edition, 2011.
3. C. B. Mamoria and S V Gankar, "Dynamics of Industrial Relations in India", 15th Edition, Himalaya Publishing, 2015.
4. P. Subba Rao, "Essentials of Human Resource management and Industrial relations", 5th Edition, Himalaya Publishing, 2013.
5. Laurie Mullins, "Management & Organizational Behavior", Latest Ed, Pearson Publications, 2016.
6. Raymond J. Stone, Anne Cox, Mihajla Gavin, "Human Resource Management", 10th Edition, John Wiley & Sons, 14 Dec 2020.
7. V S P Rao, "Human Resource Management", 3rd Edition, Excel publishing, 2010.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Digital Marketing Management (RCP23OCOE408)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Course Objectives:

1. Explain the evolution and technology of digital marketing, including underlying frameworks.
2. Understand digital business strategy and emerging business structures.
3. Cover digital marketing planning, operations setup, and implementation of search campaigns, alongside emerging concepts like Big Data, IoT, SMB, B2B marketing, and SoLoMo.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the digital marketing framework & model and consumer behaviour.	L2	Understand
CO2	Develop digital marketing strategy roadmap.	L6	Create
CO3	Explain the terminology and concepts for developing web-specific media plans.	L2	Understand
CO4	Understand concepts related to digital campaign management and revenue generation models.	L2	Understand
CO5	Get a perspective on global digital marketing technology/tools and future trends	L3	Apply

Course Contents

Unit-I — 06 Hrs.

Introduction to Digital Marketing: Emergence of Digital Marketing as a tool, media consumption drivers for new marketing environment, applications and benefits of digital marketing.

Digital Marketing Framework: Delivering enhanced customer value, market opportunity analysis and digital services development, ASCOR framework.

Digital Marketing Models Creation: Factors impacting digital marketplace, value chain digitization, business models.

The Consumer for Digital Marketing: Consumer behavior on the internet, evolution of consumer behavior models, managing consumer demand, integrated marketing communications (IMC).

Unit-II — 12 Hrs.

Digital marketing Strategy Development: Elements of assessment phase, macro-micro environmental analysis, marketing situation analysis.

Digital Marketing Internal Assessment and Objectives Planning: Analyzing present offerings mix, marketing mix, core competencies analysis and internal resource mapping. Digital presence analysis, digital marketing objectives development and review.

Digital Marketing Strategy Definition: Understanding digital business strategy and structures, consumer development strategy, offering mix for Digital, digital pricing models, managing promotional channels and developing the extended Ps- People, process, programs and performance.

Digital marketing Strategy Roadmap: Developing digital marketing strategy roadmap, the 6s digital marketing implementation strategy, marketing across the product life cycle.

Unit-III — 08 Hrs.

Digital Marketing Planning and Setup: Understanding digital media planning terminology and stages, steps to creating marketing communications strategy, introduction to search marketing, display marketing, social media marketing.

Digital Marketing Operations Setup: Basics of lead generation and conversion marketing, website content development and management, elements of user experience, web usability and evaluation.

Unit-IV — 08 Hrs.

Digital marketing Execution: Basic elements of digital campaign management, search execution, display execution, social media execution, content marketing.

Digital marketing Execution Elements: Digital revenue generation models, managing service delivery and payments, managing digital implementation challenges like ecommerce, internal vs external and consumer specific challenges.

Unit-V 05 Hrs.

Digital Business – Present and Future: Digital Marketing – Global Landscape, digital marketing overview – global spend, advertising spend, and technology/tools landscape.

Data technologies (Big data and IOT) impacting marketing, segment based digital marketing and SoLoMo – the next level of hyperlocal marketing.

Text Books:

1. Puneet Singh Bhatia, "Fundamentals of Digital Marketing", Pearson Education Limited, 2017.
2. Seema Gupta, "Digital Marketing", McGraw Hill Education, 2022.

Reference Books:

1. Dave Chaffey and P. R. Smith, "Digital Marketing Excellence: Planning, Optimizing and Integrating Online Marketing", 5^{th} Edition, Taylor & Francis, 2017.
2. Dave Chaffey Fiona Ellis-Chadwick, "Digital Marketing: Strategy, Implementation and Practice", 6^{th} Edition, Pearson Education Limited, 2019.
3. Vandana Ahuja, "Digital marketing", Oxford University Press, 2015.
4. Ian Dodson, "The Art of Digital Marketing", John Wiley & Sons, 2016.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Logistics and Supply Chain Management (RCP23OCOE409)

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs./week	Term Test : 15 Marks
Credits : 03	Teacher Assessment : 25 Marks
	End Sem Exam : 60 Marks
	Total Marks : 100 Marks

Prerequisite: Latest trend of information technology in retail industry and logistic applications.

Course Objectives:

1. To develop advanced strategic thinking skills in supply chain management and logistics to effectively analyse and optimize supply networks.
2. To attain proficiency in leveraging cutting-edge tools and technologies to enhance supply chain efficiency and supply chain transformation.
3. Design and implement collaborative supply chain and sourcing strategies to promote information sharing and optimise coordination.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Develop a sound understanding of the important role of supply chain management in today's business environment.	L2	Understand
CO2	Develop criteria and standards to achieve improved business performance by integrating and optimizing the total logistics and supply-chain process.	L6	Create
CO3	Summarize the value of focusing on information business logistics systems which drives improved accuracy and decision-making at all levels of management.	L2	Understand
CO4	Become familiar with current supply chain information technology management trends.	L2	Understand
CO5	Use available technologies to enhance work performance and support supply chain functions, processes, transactions, and communications.	L3	Apply

Course Contents

Unit-I — 05 Hrs.

Introduction: What Is Supply Chain Management? The Development Chain, Global Optimization, Managing Uncertainty and Risk, The Complexity in Supply Chain Management, Key Issues in Supply Chain Management.

Unit-II — 06 Hrs.

Network Planning: Introduction, Network Design- Data Collection, Data Aggregation, Transportation Rates, Mileage Estimation, Warehouse Costs, Warehouse Capacities, Potential Warehouse Locations, Service Level Requirements, Future Demand, Model and Data Validation, Solution Techniques, Key Features of a Network Configuration Supply Chain Planning; Inventory Positioning and Logistics Coordination -Strategic Safety Stock.

Unit-III — 08 Hrs.

The Value of Information: Introduction, The Bullwhip Effect-Quantifying the Bullwhip Effect, The Impact of Centralized Information on the Bullwhip Effect, Methods for Coping with the Bullwhip Effect, Information Sharing and Incentives, Effective Forecasts, Information for the Coordination of Systems, Locating Desired Products, Lead-Time Reduction, Information and Supply Chain Trade-offs-Conflicting Objectives in the Supply Chain, Designing the Supply Chain for Conflicting Goals ,Decreasing Marginal Value of Information.

Unit-IV — 08 Hrs.

Supply Chain Integration : Introduction, Push, Pull, and Push-Pull Systems-Push-Based Supply Chain, Pull-Based Supply Chain, Push-Pull Supply Chain ,Identifying the Appropriate Supply Chain Strategy, Implementing a Push-Pull Strategy The Impact of Lead Time Demand-Driven Strategies The Impact of the Internet on Supply Chain Strategies-what is E-Business, the Grocery Industry , the Book Industry , the Retail Industry and Impact on Transportation and Fulfillment.

Unit-V — 06 Hrs.

Information Technology and Business Process : Introduction, The Importance of Business Processes, Goals of Supply Chain IT, Supply Chain Management System Components, Decision-Support Systems, IT for Supply Chain Excellence, Sales and Operations Planning Integrating Supply Chain Information Technology. Implementation of ERP and Decision Support System.

Unit-VI — 06 Hrs.

Technology Standards: Introduction, IT Standards, Information Technology Infrastructure, Interfaces

Devices, System Architecture and Electronic Commerce. Service-Oriented Architecture (SOA)-Technology Base: IBM and Microsoft and ERP Vendor Platform: SAP and Oracle. Radio Frequency Identification (RFID)- applications, point of sale data, business benefits and supply chain efficiency.

Text Books:

1. Sunil Chopra, Peter Meindl, "Supply Chain Management-Strategy, Planning, and Operation", Pearson Publications, 2016.
2. David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, "Designing and Managing the Supply Chain-Concepts, Strategies, and Case Studies", McGraw-Hill/Irwin, 2008.

Reference Books:

1. Ian Sadler, "Logistics and Supply Chain Integration", SAGE Publications, 2007.
2. Donald Waters, "Supply Chain Management - An Introduction to Logistics", Bloomsbury Publishing, 2019.
3. Dimitris Folinas, "E-Logistics and E-Supply Chain Management-Applications for Evolving Business , IGI Global publications, 2013.
4. Martin Christopher, "Logistics & Supply Chain Management", Pearson Education publications, 2016.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Design Thinking Laboratory (RCP23ILHSX02)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
Total : 25 Marks

Prerequisite:

1. Understanding of product/ process/ software/ service development life cycle.
2. Knowledge of agile frameworks (or any similar iterative framework) would be an added advantage but will not be mandatory.

Course Objectives:

1. To instill an innovative mindset in students to solve the digital-age business, societal, and wicked types of problems using design thinking methods and tools, and its application.
2. To equip students with techniques to empathize with users, and ideate innovative and sustainable solutions for real-world problems through an iterative approach to design.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the importance of a Human-Centric design approach for developing a solution.	L2	Understand
CO2	Generate innovative ideas to design sustainable solutions for real-world problems.	L3	Apply
CO3	Apply design thinking principles to solve real-world problems.	L3	Apply

Course Contents

Unit-I Introduction to Design Thinking — 06 Hrs.

Understanding the fundamentals of design thinking.

Exploring the history and evolution of design thinking.

The importance of empathy in the design thinking process.

Conduct market & industry research by observing and context ualizing various macro & micro trends.

Case Study - conduct their research on how Design Thinking helped solve some of the biggest and most critical problems of our time.

Unit-II Empathize Phase — 04 Hrs.

Techniques for conducting user research and gathering insights.

Creating user personas and empathy maps.

Practicing active listening and observation skills.

To apply various empathizing techniques to the problem statement selected.

Use walk-a-mile immersion and heuristic reviews to first empathize with end users and then to build an empathy map and customer journey map.

Unit-III Define Phase — 04 Hrs.

Defining problem statements and reframing challenges.

Tools for synthesizing research findings.

Developing a clear and actionable problem statement.

Start building from Persona map and conduct interviews/ Gemba walk to plot user's journeys from start to end.

Define the problem space using the HMW statement. Now highlight areas of opportunities in the journey map and enlist potential channels/touch points as well as stakeholders for proposed solution interventions.

Unit-IV Ideate Phase — 04 Hrs.

Generating creative ideas through brainstorming sessions.

Techniques for divergent and convergent thinking.

Prototyping and experimenting with ideas.

Apply suitable ideation technique to quickly generate diverse ideas that could be applied to target problem space – either partially or in full.

Brain Writing – Build on each other's ideas and constructively & creatively develop better ideas using SCAMPER technique.

Unit-V Prototype and Validation 06 Hrs.

Introduction to prototyping tools and techniques.

Rapid prototyping methods.

Testing prototypes with users and gathering feedback.

Refining solutions based on user insights.

Develop user storyboard to layout solution proposition in visual and easily explainable form. Run a quick peer validation.

peer-validated the storyboard.

Build an interactive digital prototype using any digital rapid prototyping platform and seek user validation.

Unit-VI Design Thinking for Strategic Innovation 02 Hrs.

Types of innovations, strategic innovation.

Features of strategic innovation.

Design thinking and strategic innovation.

Practices of integrating design thinking in strategic innovation.

Suggested Experiments:

1. To conduct market and industry research and analyze case studies demonstrating the application of design thinking. (Increased understanding of how design thinking has been applied to solve critical problems in various contexts.)
2. To exercise empathizing techniques to understand the needs and pain points of a target audience.
3. Developing empathy maps and customer journey maps based on collected insights.
4. To exercise different tools and techniques (such as affinity diagrams, journey mapping, and user story mapping) for synthesizing research findings.
5. Develop user personas to represent different user archetypes and their needs concerning the problem at hand.
6. To practice the SCAMPER technique, Brainstorming, and brain-writing as a collaborative ideation technique to create multiple creative ideas/ solutions for the problem at hand.
7. Create a mind map to generate a wide range of solutions to a problem at hand.
8. To explore different prototyping tools and platforms, such as Adobe XD, Figma, Sketch, and InVision.
9. To Conduct rapid prototyping sessions to build low-fidelity / High fidelity prototypes based on the ideas generated in the Ideation phase and iterate based on feedback received.
10. Develop a plan for implementing the final solution, considering factors like scalability and feasibility.

11. • Conduct usability testing to gather feedback on prototypes.
    • Use A/B testing to compare different versions of a solution and determine which performs better.

Mini Project (individual or in a group of 3-4 students): 10 marks

Any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Text Books:

1. I. Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", Wiley, 2013.
2. M. Lewrick, P. Link, and L. Leifer, "The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems", Wiley, 2018.
3. T. Lockwood, "Design Thinking: Integrating Innovation, Customer Experience, and Brand-Value", Allworth Press, 2010.
4. K. T. Ulrich and S. D. Eppinger, "Product Design and Development", McGraw-Hill Education, 6th Edition, 2016.
5. C. J. Meadows and C. Parikh, "The Design Thinking Workbook: Essential Skills for Creativity and Business Growth", Emerald Publishing, 2022.

Reference Books:

1. T. Kelley and D. Kelley, "Creative Confidence: Unleashing the Creative Potential Within Us All", HarperCollins Publisher, 2013.
2. T. Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", HarperCollins, 2013.
3. J. Knapp, J. Zeratsky, and B. Kowitz, "Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days", Simon & Schuster, 2016.
4. Chakrabarti, "Engineering Design Synthesis: Understanding, Approaches and Tools", Springer, 2002.
5. K. Otto, and K. Wood, "Product Design", Prentice Hall, 2000.

Online References:

1. Design and Innovation:
    • https://openstax.org/books/entrepreneurship/pages/4-suggested-resources
2. Overview of Design Thinking:
    • https://www.interaction-design.org/literature/topics/design-thinking
    • 10 Models for Design Thinking. In 2004, business consultants Hasso... | by Libby Bofinger — Medium

- https://www.tcgen.com/designthinking/#What_is_Design_Thinking_and_How_Does_it_Relate_to_Product_Development

3. Understand, observe and define the problem:
   - https://www.nngroup.com/articles/empathy-mapping/
   - https://uxdesign.cc/the-purpose-of-a-journey-map-and-how-can-it-galvanize-action-9a628b7ae6e
4. Ideation and prototyping:
   - https://www.interaction-design.org/literature/topics/prototyping
   - https://www.uxmatters.com/mt/archives/2019/01/prototyping-user-experience.php
5. Testing and implementation:
   - https://www.nngroup.com/articles/usability-testing-101/
   - https://www.interaction-design.org/literature/article/test-your-prototypes-how-to-gather-feedback-and-maximise-learning
6. Design thinking in various sectors:
   - https://www.tutorialspoint.com/design_thinking/design_thinking_quick_guide.htm

Web References:

1. Creative Engineering Design (https://nptel.ac.in/courses/107108010)
2. Understanding Creativity and Creative Writing (https://nptel.ac.in/courses/109101017)
3. Understanding Design Thinking & People CentredDesign (https://nptel.ac.in/courses/109104109)
4. Design Thinking - A Primer (https://nptel.ac.in/courses/110106124)
5. Product Engineering and Design Thinking (https://nptel.ac.in/courses/112105316)

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on RCP23ILHSX02. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Universal Human Values (RCP23ICHSX04)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Course Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society.	L2	Understand
CO2	Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.	L3	Apply
CO3	Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society.	L2	Understand
CO4	Understand the harmony in nature and existence and work out their mutually fulfilling participation in the nature.	L2	Understand
CO5	Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.	L3	Apply

Course Contents

Unit-I — 04 Hrs.

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities - the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Unit-II — 05 Hrs.

Understanding Harmony in the Human Being - Harmony in Myself: Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body'.Understanding the Body as an instrument of 'I' (I being the doer, seerand enjoyer), Understanding the characteristics and activities of'I' andharmony in 'I', Understanding the harmony of I with theBody; correctappraisal of Physical needs, meaning of Prosperity in detail, Programsto ensure Self-regulation and health.

Unit-III — 09 Hrs.

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship: Understanding harmony in the Family- the basic unit of human interaction, understanding values in human-human relationship;meaning of Justice and program for its fulfilment. Trust and Respect as the foundational values of relationship, Understanding the meaningof Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family). Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family!

Unit-IV — 04 Hrs.

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence: Understanding the harmony in the Nature, Interconnectedness, and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature.

Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

Unit-V 04 Hrs.

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

Text Books:

1. Human Values and Professional Ethics, R. R. Gaur, R. Sangal, G. P. Bagaria, Excel Books, New Delhi, 2010.

Reference Books:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age International Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth, 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, Dharampal.
10. Hind Swaraj or Indian Home Rule, Mohandas K. Gandhi.
11. India Wins Freedom, Maulana Abdul Kalam Azad.
12. Vivekananda, Romain Rolland (English).
13. Gandhi, Romain Rolland (English).

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Semester Project-II (RCP23IPSC401)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Conduct a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Demonstrate various/alternate approaches to complete a project.	L2	Understand
CO3	Ensure a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Present their project work in the form of a technical report / paper and thereby improve the technical communication skill.	L3	Apply
CO5	Demonstrate the ability to work in teams and manage the conduct of the research study.	L2	Understand

Semester Project:

The purpose of introducing semester project at second year level is to provide exposure to students with a variety of projects based on the knowledge acquired from the semester subjects. This activity is supposed to enrich their academic experience and bring enough maturity in student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation and discussion of technical ideas/topics. Therefore, proper attention shall be paid to the content of semester project report which is being submitted in partial fulfillment of the requirements of the Second Year and it is imperative that a standard format be prescribed for the report.

Each student shall work on project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max allowed: 5 students in extraordinary cases, subject to the approval of the departmental committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. Semester Project Title or Theme should be based on knowledge acquired during semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Student is expected to:

- Select appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done(Log Book Format will be as per Table 4).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

Prescribed project report guidelines:

Size of report shall be of minimum 25 pages. Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation Details
- Project Outcomes
- Conclusion

- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table 5.

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

Departmental committee (including project guide) will evaluate project as per Table 6.

Table 4: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 5: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintenance	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 6: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Simulation/ Logic	Hardware/ Programming	Result Verification	Presentation	Total
			5	5	5	5	5	25