



Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur
(An Autonomous Institute)

Course Structure and Syllabus

Second Year B. Tech

Computer Science and Engineering(Data Science)

With effect from Year 2024-25



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R. C. PATEL
INSTITUTE OF TECHNOLOGY
An Autonomous Institute

R. C. Patel Institute of Technology, Shirpur

Institute Vision

To become a leading Institute in Technical education fostering innovation, research, ethical values, and sustainable development for the betterment of society.

Institute Mission

To impart high quality Technical Education through:

M1: Innovative and Interactive learning process and high quality, globally recognized instructional programs.

M2: Fostering a collaborative scientific temper among students with ethical responsibility towards the society.

M3: Preparing students from diverse backgrounds to have aptitude for employment, entrepreneurship and research with a spirit of professionalism.

M4: To contribute to nation's sustainable development.

Department of Computer Science & Engineering (Data Science)

Department Vision

To provide cutting-edge Computer Engineering education in Data Science while instilling socio-moral values.

Department Mission

M1: To deliver state-of-the-art, ICT-enabled teaching and learning to achieve excellence in Data Science education.

M2: To develop professionally competent Data Science Engineers, meeting evolving industrial and societal needs.

M3: To prepare employable professionals with ethical values and a commitment to professional and social responsibility.

Program Educational Objectives (PEOs) of the Department

PEO1: Graduates will achieve proficiency in Data Science and pursue lifelong learning to advance as professionals, entrepreneurs, and leaders.

PEO2: Graduates will operate effectively in diverse, dynamic professional and cultural environments, respecting societal perspectives.

PEO3: Graduates will demonstrate ethical values and social responsibility in their professional and personal lives.


Program Specific Outcomes (PSOs) of the Department

PSO1: Apply programming concepts, algorithms, and data structures to develop data-driven software and web solutions.


PSO2: Develop intelligent solutions using machine learning, data analysis, and cloud technologies for practical problem-solving.


Second Year B. Tech Computer Science and Engineering (Data Science) Semester-III (w.e.f. 2024-25)														
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	
				L	T	P	Continuous Assessment (CA)				ESE			
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)				
[A]	[B]	[C]	[A+B+C]											
1	PC	RCP23DCPC301	Computer System Fundamentals	3			25	15	15	15	60	100	3	4
	PC	RCP23DLPC301	Computer System Fundamentals Laboratory			2	25				25	50		
2	PC	RCP23DCPC302	Database Systems	3			25	15	15	15	60	100	3	4
	PC	RCP23DLPC302	Database Systems Laboratory			2	25				25	50		
3	PC	RCP23DLPC303	Data Science Laboratory(Python)	1		2	50				50	100	2	2
4	MD	RCP23DCMD301	Mathematics for Intelligent Systems	3			25	15	15	15	60	100	3	3
5	SC	RCP23IPSC301	Semester Project-I			2	25				25	50	1	1
6	HS	RCP23ILHSX02	Design Thinking Laboratory			2	25				25	50	1	1
7	HS	RCP23ICHSX04	Universal Human Values	3			25	15	15	15	60	100	3	3
8	EL	RCP23ILELX05	Community Engagement Service			2	25				25	50	1	1
9#	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		
		RCP23OCOE303	Operations Research	3			25	15	15	15	60	100		
		RCP23OCOE304	Personal Finance Management	3			25	15	15	15	60	100		
		RCP23OCOE305	Public Systems and Policies	3			25	15	15	15	60	100		
		RCP23OCOE306	Fundamentals of Biomedical Instruments	3			25	15	15	15	60	100		
		RCP23OCOE307	IPR and Patenting	3			25	15	15	15	60	100		
		RCP23OCOE308	Entrepreneurship and Startup Ecosystem	3			25	15	15	15	60	100		
Total				16		12	300			75	425	800		22

#Any 1 Open Elective Course

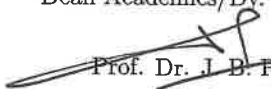
Prepared by: 
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Second Year B. Tech Computer Science and Engineering (Data Science) Semester-IV (w.e.f. 2024-25)														
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	
				L	T	P	Continuous Assessment (CA)				ESE			
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)				
[A]	[B]	[C]	[A+B+C]											
1	PC	RCP23DCPC401	Data Structures	3			25	15	15	15	60	100	3	4
	PC	RCP23DLPC401	Data Structures Laboratory			2	25				25	50	1	
2	PC	RCP23DCPC402	Machine Learning - I	3			25	15	15	15	60	100	3	4
	PC	RCP23DLPC402	Machine Learning - I Laboratory			2	25				25	50	1	
3	PC	RCP23DCPC403	Statistics for Data Science	3			25	15	15	15	60	100	3	4
	PC	RCP23DLPC403	Statistics for Data Science Laboratory			2	25				25	50	1	
4	MD	RCP23DLMD401	Web Engineering Laboratory			4	50				50	100	2	2
5@	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	
6	HS	RCP23ITHSX01	Professional and Business Communication Tutorial		2		25				25	2	2	
7	HS	RCP23ICHSX03	Economics and Financial Management	2			25	15	15	15	60	100	2	2
8	SC	RCP23IPSC401	Semester Project-II			2	25				25	50	1	1
Total				14	2	12	300			75	450	825	22	

#Any 1 Open Elective Course

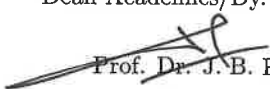
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Semester - III



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Computer System Fundamentals (RCP23DCPC301)		
Computer System Fundamentals Laboratory (RCP23DLPC301)		

Prerequisite: Basic Mathematics

Course Objective(s):

To understand the structure, functions and characteristics of computer system and operating systems.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the fundamental organization of a computer system.	L2	Understand
CO2	Solve problems using appropriate memory mapping, process scheduling, and disk scheduling methods.	L3	Apply
CO3	Identify the need of concurrency and apply appropriate method to solve the concurrency or deadlock problem.	L3	Apply
CO4	Differentiate between various processor architecture.	L2	Understand



Computer System Fundamentals (RCP23DCPC301) Course Contents

Unit-I

08 Hrs.

Introduction to System Fundamentals: Realization of half adder and full adder using Logic Gates, Von Neumann model, Fixed point representation, Register Transfer and Micro-operations: Floating point representation, Arithmetic MicroOperations, Arithmetic logical shift unit. Addition and subtraction, Multiplication Algorithms (Booth Multiplication Algorithm), Division Algorithms, Floating Point Arithmetic operations, Instruction Cycle with interrupt and DMA.

Operating System Architecture: Basic functions and services, System calls, Types of Operating Systems: Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real-time O.S.

Unit-II

06 Hrs.

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction format, Addressing Modes, data transfer and manipulation, Program Control, Reduced Instruction Set Computer (RISC).

Process Management: Process Concept, Process states, Process control Block, Threads, Uni-processor Scheduling: Types of scheduling: Pre-emptive, non-preemptive, Scheduling algorithms: FCFS, SJF, RR, Priority. Comparative study of process management in Windows, Linux and Android OS.

Unit-III

08 Hrs.

Memory Organization: Memory Hierarchy, Main Memory, Cache Memory, Memory Mapping, cache coherence, Pentium IV cache organization, ARM cache organization.

Memory Management: Memory partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit, and Worst Fit), Fragmentation, Swapping, Virtual Memory, Paging. Segmentation, Demand paging and Page replacement policies. Comparative study of memory management in Windows, Linux and Android OS.

Unit-IV

10 Hrs

Concurrency control: Concurrency: Principles of Concurrency, Mutual Exclusion: S/W approaches, H/W Support, Semaphores, Monitors, Classical Problems of Synchronization: Readers-Writers and Producer Consumer problems and solutions.

Deadlock: Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Dining Philosopher problem. Comparative study of concurrency control in Windows, Linux and Android OS.



Unit-V

05 Hrs.

File and I/O management: File access methods, I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), RAID, Disk Cache, Arbitration methods, Comparative study of file and I/O management in Windows, Linux and Android OS.

Unit-VI

05 Hrs.

Advance Computer Architecture: Characteristics of Multiprocessors, Flynn's taxonomy, Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Introduction to Multiprocessor network topologies.

Computer System Fundamentals Laboratory (RCP23DLPC301)

List of Laboratory Experiments

Suggested Experiments:(At least 08 experiments)

- Implement Booth's multiplication algorithm.
- Implement CPU Non-Preemptive scheduling algorithms like FCFS, SJF, Priority etc.
- Implement CPU Preemptive scheduling algorithms like SRTF, Round Robin, Preemptive priority etc.
- Explore the internal commands of Linux.
- Write shell scripts handling File, Directory, Networking and security aspects.
- Implement Best Fit, First Fit and Worst Fit Memory allocation policy.
- Implement Fully associative and set associative cache memory mapping.
- Implement various cache/page replacement policies.
- Implement order scheduling in supply chain using Banker's Algorithm.
- Implement Disk Scheduling Algorithms.

Study Experiments:

- Implement Restoring and Non-Restoring division algorithm.
- Implement Solution to Producer Consumer Problem of Process Synchronization.
- Implement Solution to Reader Writer Problem of Process Synchronization.



- Implement Solution to Dining Philosopher Problem of Process Synchronization.
- Implementation of Multithreading using parent process and child process using UNIX calls like fork, exec and wait.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Text Books:

1. William Stallings, “Computer Organisation and Architecture”, Pearson publication, 11th Edition, 2018.
2. Greg Gagne, Abraham Silberschatz, John Wiley & Sons, Inc. “Operating System Concepts”, 10th Edition, 2018.

Reference Books:

1. John Hayes, “Computer Architecture and Organization”, McGrawHill, 3rd Edition, 2017.
2. M. Morris Mano, “Computer System Architecture”, Pearson, 2017.
3. Andrew S. Tanenbaum and Todd Austin, “Structured Computer Organization”, 6th Edition, PHI, 2016.
4. M. Murdocca & V. Heuring, “Computer Architecture & Organization”, WILEY, 2017.
5. By Andrew S. Tanenbaum, “Modern Operating Systems”, PHI, 2009.
6. G. Meike, Lawrence Schiefer, “Inside the Android OS: Building, Customizing, Managing and Operating Android System Services (Android Deep Dive)”, 2021.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Database Systems (RCP23DCPC302)		
Database Systems Laboratory (RCP23DLPC302)		

Prerequisite: Computer Basics

Course Objective(s):

To introduce the students to the management of database systems, with an emphasis on how to design, organize, maintain and retrieve information efficiently and effectively from a database.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe different types of database systems.	L2	Understand
CO2	Create SQL queries to perform operations on the database.	L6	Create
CO3	Apply suitable data management techniques for efficient data retrieval.	L3	Apply



Database Systems (RCP23DCPC302)

Course Contents

Unit-I

08 Hrs.

Introduction Database Management System: Data Independence, DBMS system architecture, Database Administrator.

Entity Relationship Modeling: 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.

Relational Model and Algebra: Introduction, relational schema and concept of keys, Mapping the ER and EER Model to the Relational Model. Relational Algebra: Unary and Set operations, Relational Algebra Queries.

Unit-II

08 Hrs.

Structured Query Language (SQL): 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, aggregate function - group by, having, Views in SQL, joins, Nested and complex queries, Triggers, Security and authorization in SQL.

Unit-III

07 Hrs.

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

Transaction Management and Recovery: ACID properties, Transaction States, Concurrent Executions, Serializability, Concurrency Control Protocols: Lock-based, Timestamp based, Validation Based.

Unit-IV

05 Hrs.

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

Unit-V

08 Hrs.

Data Warehouse and ETL: Principles of Dimensional Modeling: The STAR Schema, STAR Schema Keys, Advantages of the STAR Schema, The Snowflake Schema, Dimension Tables, Fact Tables, ETL (Extract, Transform, Load) processes, Data Cube, Data Cube Computation Methods, Data Lake, OLAP, OLAP Characteristics, Major Features and Functions, OLAP Models.



Unit-VI

06 Hrs.

NoSQL Data Stores:BASE Properties, Comparison of BASE and ACID, Types of NoSQL, Overview of Key-Value, Document, Wide-Column, Graph databases, Concept of Polyglot persistence, Case Study on different NoSQL.

Database Systems Laboratory (RCP23DLPC302)

List of Laboratory Experiments

Suggested Experiments:(At least 08 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 Joins and Views.
6. Examine the consistency of database using concurrency control technique (Locks).
7. To implement an ETL Pipeline with SQL Server Integration Services (SSIS) tool.
8. To build a Data Cube with PivotTables and perform OLAP operations.
9. To Perform CRUD Operations using NoSQL.
10. To Create a Basic Data Lake using Open-Source Technologies.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

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, 2021.
3. Alejandro Vaisman, Esteban Zimányi, “Data Warehouse Systems: Design and Implementatio Springer, 2nd Edition, 2022.



4. Andreas Meier, Michael Kaufmann, “SQL & NoSQL Databases”, Springer, 2019.

Reference Books:

1. Raghu Ramkrishnan and Johannes Gehrke, “Database Management Systems”, 2nd Edition, McGraw – Hill.
2. Dr. P.S. Deshpande, “SQL and PL/SQL for Oracle 10g”, Black Book, Dreamtech Press, 2006.
3. Patrick Dalton, “Microsoft SQL Server Black Book”, Coriolis Group, U.S., 1997.
4. Paulraj Ponniah, “Data Warehousing Fundamentals a Comprehensive Guide for It Professionals”, John Wiley & Sons, Inc., 2004.
5. Jiawei Han, Micheline Kamber and Jian Pei, “Data Mining. Concepts and Techniques”, Elsevier Inc., 2012.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Data Science Laboratory (Python)(RCP23DLPC303)		

Prerequisite: Programming Fundamental, Fundamentals of Data Analysis.

Course Objective(s):

1. To learn the basic and OOP concepts of Python.
2. To learn basic of Data manipulation and Analysis.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement python programs to solve real world problems.	L3	Apply
CO2	Perform Data Manipulation and Analysis.	L3	Apply



Data Science Laboratory (Python)(RCP23DLPC303) Course Contents

Unit-I	01 Hrs.
Python Basics: Operators, Input and Output, Control statements, Arrays, String and Character.	
Unit-II	02 Hrs.
Functions and Collections in Python: Functions in python, Calling a Function, Arguments, Arbitrary Arguments, *args, Keyword Arguments, Arbitrary Keyword Arguments, **kwargs, The pass Statement, Recursion, Collections in Python, List, Tuples and Dictionaries	
Unit-III	02 Hrs.
Introduction to OOP: Classes, Objects, and Constructor, Methods and Abstraction, Inheritance, Magic Methods, Exception handling.	
Unit-IV	02 Hrs.
Advanced Python Concepts: Modules, Packages, Python Collections Module for Opening and Reading Files and Folders, Python OS Module, Python Date Time Module, Python Math and Random Modules, Text Processing & Regular expression.	
Unit-V	01 Hrs.
Python Numpy Module: Construct Numpy arrays, Printing arrays, Arithmetic Operations on matrix's using Numpy Module, numpy zeros ()	
Unit-VI	02 Hrs.
Exploratory Data Analysis (EDA): Descriptive Statistics, Correlation Analysis, Handling Missing Data, Outlier Detection.	
Unit-VII	03 Hrs.
Data Preprocessing: Introduction to Pandas Library, Working with Series and Data Frames, Data Cleaning and Preprocessing, Data Transformation and Aggregation, Indexing and Slicing Data, Combining and Merging DataFrames.	
Unit-VIII	01 Hrs.
Data Visualization: Matplotlib module, Seaborn module, Plotly, Heatmaps.	



Data Science Laboratory (Python)(RCP23DLPC303)

List of Laboratory Experiments

Suggested Experiments:(At least 10 experiments)

1. Implement python program to demonstrate different decision-making statements
2. Implement python program on Arrays.
3. Implement python program on String.
4. Implement python program on Collections (List, Tuples and Dictionaries).
5. Implement python program on function, recursion.
6. Implement python program on Text Processing & Regular expression.
7. Implement python program to construct numpy arrays, printing arrays, arithmetic operations on matrix's using Numpy Module, numpy zeros ().
8. Implement python program to perform Descriptive Statistics, Correlation Analysis.
9. Implement python program to Handling Missing Data, outlier detection.
10. Implement python program to perform data cleaning and data preprocessing.
11. Implement python program for working with series and data Frames.
12. Implement python program to perform to perform data transformation and aggregation.
13. Implement Python program to perform data visualization.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Text Books:

1. Zed Shaw, "Learn Python the Hard Way", Addison-Wesley, 5th Edition, 2024.
2. Jake VanderPlas, "Python Data Science Handbook", Reilly, 2nd Edition, 2022.

Reference Books:

1. Wes McKinney, "Python for Data Analysis", O'Reilly Media, Inc., 5th Edition, 2022.



2. “Just Into Data, Python for Data Analysis: Step-By-Step with Projects”, Packt Publishing, 2021.
3. John Paul Mueller, Luca Massaron, “Python for Data Science for Dummies”, Wiley, 3rd Edition, 2023.



Digital Resources:

1. The Python Tutorial: <http://docs.python.org/release/3.0.1/tutorial/>
2. <http://spoken-tutorial.org>
3. www.staredusolutions.org



Mathematics for Intelligent Systems (RCP23DCMD301) Course Contents

Unit-I Probability, Random Variables and Probability Distributions 10 Hrs.

Probability: Conditional Probability, Bayes' Theorem

Random Variables: Discrete Random Variable, Probability Mass Function, Discrete Distribution Function, Continuous Random Variable, Probability Density Function, Continuous Distribution Function, Mathematical Expectation, Moment Generating Function, Two-Dimensional Random Variable and its Joint Probability Mass and Density Function, Marginal Distribution Function, Conditional Distribution Functions, Covariance, Joint Moments.

Probability Distributions: Discrete Probability Distribution: Binomial Distribution, Poisson Distribution, Hypergeometric Distribution.

Continuous Probability Distribution: Uniform Distribution, Exponential Distribution, Normal Distribution, Beta Distribution, Gamma Distribution.

Unit-II Linear Algebra 09 Hrs.

Vectors in N-Dimensional Vector Space, Properties, Dot Product, Cross Product, Norm and Distance, Vector Spaces over Real Field, Properties of Vector Spaces over Real Field, Subspaces, Linear Independence and Dependence of Vectors, Span of Vectors, Basis of a Vector Space, Dimension of a Vector Space, Cauchy Schwarz Inequality, Linear Transformation.

Unit-III Matrix Theory 08 Hrs.

Characteristic Equation, Eigen Values and Eigen Vectors, Properties of Eigen Values and Eigen Vectors, Cayley-Hamilton Theorem ((verification and application), Similarity of Matrices, Diagonalization of Matrices, Functions of Square Matrix, Derogatory and Nonderogatory Matrices, Matrix Factorization.

Unit-IV Calculus 05 Hrs.

Gradient, Directional Derivatives, Jacobian, Hessian, Convex Sets, Convex Functions and its Properties.

Unit-V Optimization 10 Hrs.

Unconstrained Optimization Techniques: Newton's Method, Quasi Newton Method.

Constrained Optimization Techniques: Constrained optimization techniques: gradient descent, Lagrange's multiplier method with 2 or 3 variables and one equality constraint, Karush-Kuhn-Tuc



method with 2 variables and 1 or 2 constraints, Simplex method, Penalty and Duality, Dual Simplex method.

Text Books:

1. Dr. B. S. Grewal, “Higher Engineering Mathematics”, 44th Edition, Khanna Publication, 1965.
2. Kanti B. Datta, “Mathematical Methods in Science and Engineering”, 1st Edition, Cengage Learning India, 2011.
3. Hamdy A. Taha, “Operations Research - An Introduction”, Pearson, 10th Edition, 2010.
4. P. K. Gupta, Mohan Man, “Operations Research”, 1st Edition, S. Chand Publication, 2005.

Reference Books:

1. W. Cheney, “Analysis for Applied Mathematics”, 1st Edition, New York: Springer Science Business Media, 2001.
2. S. Axler, “Linear Algebra Done Right”, 3rd Edition, Springer International Publishing, 2015.
3. J. Nocedal and S. J. Wright, “Numerical Optimization”, 2nd Edition, New York: Springer Science+Business Media, 2006.
4. J. S. Rosenthal, “A First Look at Rigorous Probability Theory”, 2nd Edition, Singapore: World Scientific Publishing, 2006.
5. Seymour Lipschutz and Marc Lipson, “Linear Algebra Schaum’s outline series”, 4th Edition, Mc-Graw Hill Publication, 2009.
6. Erwin Kreyszig, John Wiley & Sons, Inc, “Advanced Engineering Mathematics”, 10th Edition, 2000.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech.	Semester: III
Semester Project-I (RCP23IPSC301)		

Course Objective(s): Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Describe various/alternate approaches to complete a project.	L2	Understand
CO3	Apply a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Use technical communication skills to present project work in the form of a technical report/paper.	L3	Apply
CO5	Apply teamwork and project management skills to plan, execute, and manage the research study.	L3	Apply



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 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.

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/ Methodology	Implementation	Result Verification	Presentation	Total
			5	5	5	5	5	25



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Design Thinking Laboratory (RCP23ILHSX02)		

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

Course Objective(s):

1. To instill an innovative mindset in students to solve the digital-age business, societal and wicked type 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 iterative approach to design.

Course Outcomes:

On completion of the course, the learner will be able to:

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



Design Thinking Laboratory (RCP23ILHSX02)

Course Contents

Unit-I

06 Hrs.

Introduction to Design Thinking : 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 contextualizing various macro & micro trends, Case Study - conduct their own research on how Design Thinking helped solve some of the biggest and critical problems of our time.

Unit-II

05 Hrs.

Empathize Phase: 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 on the problem statement selected, Use walk-a-mile immersion and heuristic reviews to first empathize with end users and then to build empathy map and customer journey map.

Unit-III

05 Hrs.

Define Phase: 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 HMW statement. Now highlight areas of opportunities in the journey map and enlist potential channels/touchpoints as well as stakeholders for proposed solution interventions.

Unit-IV

04 Hrs.

Ideate Phase: 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

06 Hrs.

Prototype and Validation: 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.



Design Thinking for Strategic Innovation: Types of innovations, strategic innovation, Features of strategic innovation, Design thinking and strategic innovation, Practices of integrating design thinking in strategic innovation.

Design Thinking Laboratory (RCP23ILHSX02)

List of Laboratory Experiments

Suggested Experiments:(At least 05 experiments) Below is a list of assignments / activities / experiments that would be carried out by students as a mini project in groups of size not more than Three students in each group.Problem statement for these assignments/ activities/ experiments will be provided by facilitator/ instructor/ faculty to the groups/ teams/ batches within each class. This list of experiment will help students to learn various design thinking methods and practice corresponding tools available.

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 SCAMPRE technique, Brainstorming and brain writing as a collaborative ideation technique to create multiple creative ideas / solution 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 prototype based on the ideas generated in 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.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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 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. A. Chakrabarti, “Engineering Design Synthesis: Understanding, Approaches and Tools”, Springer, 2002.
5. K. Otto, and K. Wood, “Product Design”, Prentice Hall, 2000.

Digital Resources:

- Design and Innovation
 - <https://openstax.org/books/entrepreneurship/pages/4-suggested-resources>
- 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 Hoffman — Medium
- https://www.tcgen.com/design-thinking/#What_is_Design_Thinking_and_How_Does_it_Relate_to_Product_Development
- 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>
- Ideation and prototyping
 - <https://www.interaction-design.org/literature/topics/prototyping>
 - <https://www.uxmatters.com/mt/archives/2019/01/prototyping-user-experience.php>
- 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>
- 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 Centred Design (<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): 25 Marks:

A minimum of five experiments from the above-suggested list or any other assignment based on the syllabus will be included, which would help the learner to apply the concept. The mini-project is mandatory.

1. Assignments (minimum 05): 15 Marks
2. Mini Project (individual or in a group of 3-4 students): 10 marks



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Universal Human Values (RCP23ICHSX04)		

Course Objective(s):

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.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify the need, relevance, and role of universal human values in personal, academic, and professional life.	L2	Understand
CO2	Demonstrate understanding of self-exploration, harmony in human relationships, and ethical conduct in daily interactions.	L3	Apply
CO3	Apply principles of trust, respect, and responsibility to foster sustainable and compassionate social environments.	L3	Apply
CO4	Analyze the interdependence between individual values, societal well-being, and ecological balance.	L4	Analyze
CO5	Use human values into decision-making processes for holistic development and responsible engineering practice.	L3	Apply



Universal Human Values (RCP23ICHSX04)

Course Contents

Unit-I

08 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

08 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, seer and enjoyer), Understanding the characteristics and activities of ‘I’ and harmony in ‘I’, Understanding the harmony of I with the Body; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Self-regulation and health.

Unit-III

12 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 fulfillment. Trust and Respect as the foundational values of relationship, Understanding the meaning of 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

07 Hrs.

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment 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



Unit-V

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

Reference Books:

1. A Nagaraj, “Jeevan Vidya: EkParichaya” Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi, “Human Values,” New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi, “The Story of My Experiments with Truth” .
5. E. F Schumacher, “Small is Beautiful”.
6. Cecile Andrews, “Slow is Beautiful”.
7. J C Kumarappa, “Economy of Permanence” .
8. PanditSunderlal, “Bharat Mein Angreji Raj”.
9. Dharampal, “Rediscovering India” .
10. Mohandas K. Gandhi, “Hind Swaraj or Indian Home Rule”.
11. Maulana Abdul Kalam Azad, ”India Wins Freedom” .
12. Romain Rolland , “Vivekananda”.
13. Romain Rolland, “Gandhi”.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Community Engagement Service (RCP23ILELX05)		

Prerequisite: Fundamentals of core branch, Communication Skills

Course Objective(s):

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

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement 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	Appraise commitment to community engagement activities that reinforce a sense of belongingness and gratitude towards societal causes.	L5	Evaluate
CO3	Demonstrate diversity in communities and cultures by adopting a change in approach and attitude as evidence of unconditional acceptance.	L3	Apply
CO4	Assess the effectiveness of working in a team by demonstrating the co-existence of the roles of a sincere worker and an effective leader.	L5	Evaluate



Community Engagement Service (RCP23ILELX05) 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.



nation 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](https://www.youtube.com/watch?v=Y8Lzbu)
2. Ex. 1 Milk Adulteration: <https://www.youtube.com/watch?v=pbnmeRUBxKk>
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	



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Product Life Cycle Management(RCP23OCOE301)		

Prerequisite: Knowledge of basic concepts of Management

Course Objective(s):

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.

Course Outcomes:

On completion of the course, the learner will be able to:

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



Product Life Cycle Management(RCP23OCOE301) Course Contents

Unit-I

10 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

08 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

08 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

08 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 analy.



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.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Management Information System (RCP23OCOE302)		

Prerequisite: NIL

Course Objective(s):

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.

Course Outcomes:

On completion of the course, the learner will be able to:

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



Management Information System (RCP23OCO302) Course Contents

Unit-I

05 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

08 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

8 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

06 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

07 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

08 Hrs.

- **Information System within Organization:** Acquiring Information Systems and Applications: Various System development life cycle models.



- **Enterprise and Global Management of Information Technology:** Managing 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”, 11th 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/>)



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Operations Research (RCP23OCOE303)		

Prerequisite: Knowledge of Mathematics and Probability.

Course Objective(s):

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.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze real-world optimization problems by formulating them as Linear Programming Problems (LPP) and interpreting optimal solutions using the Simplex Method or other suitable algorithms.	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 among available alternatives under conditions of certainty, risk, and uncertainty.	L3	Apply
CO4	Apply Game Theory for decision-making in conflicting situations involving one or more opponents (players).	L3	Apply
CO5	Analyze and solve complex problems by breaking them into smaller subproblems using Dynamic Programming models through recursive or iterative approaches.	L4	Analyze



Operations Research (RCP23OCOE303)

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 07 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 07 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 08 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.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Personal Finance Management (RCP23OCOE304)		

Prerequisite: NIL

Course Objective(s):

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 familiarise the students with microfinance for accelerating the expansion of local microbusinesses.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the Indian financial system.	L2	Understand
CO2	Apply a financial planning framework to illustrate the role of finances in personal life.	L3	Apply
CO3	Calculate income from salaries, house property, business/profession, capital gains, and input tax credit sources.	L3	Apply
CO4	Calculate the amount of CGST, SGST, and IGST payable after considering eligible input tax credit.	L3	Apply
CO5	Explain how microfinance contributes to financial inclusion.	L2	Understand



Personal Finance Management (RCP23OCO304) 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: Personal 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

08 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

10 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.



Unit-V

10 Hrs.

Introduction to Micro – finance:

Micro-Finance: Definitions, Scope & Assumptions, Types of Microfinance, Customers of Micro-finance, 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.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Public Systems and Policies (RCP23OCOE305)		

Prerequisite: Basic Knowledge of Social science and Current affairs

Course Objective(s):

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.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain 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	Analyze the impact of public policy on firms and the economy at large and work under various fields as policymakers.	L4	Analyze
CO5	Apply analytical skills through Expenditure Policy in public services case studies.	L3	Apply



Public Systems and Policies (RCP230COE305) 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 **12 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 **06 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 De. 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.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Fundamentals of Biomedical Instruments (RCP23OCOE306)		

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

Course Objective(s):

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.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe and associate the different physiological processes taking place within the human body.	L2	Understand
CO2	Identify the use of biomaterials and apply principles of various transducers and 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	Describe different processes used in telemetry and telemedicine.	L2	Understand



Fundamentals of Biomedical Instruments (RCP230COE306) Course Contents

Unit-I 07 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.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
IPR and Patenting (RCP23OCOE307)		

Prerequisite: NIL

Course Objective(s):

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

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Classify the appropriate Intellectual Property Right (IPR) category for a given project or innovation.	L2	Understand
CO2	Differentiate the fundamentals of the patents, copyrights, and design registrations.	L4	Analyze
CO3	Prepare applications for protecting various forms of intellectual property rights.	L3	Apply
CO4	Examine effective communication with national and international IP organizations to pursue IP protection.	L4	Analyze



IPR and Patenting (RCP230COE307)

Course Contents

Unit-I

06 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-IE 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



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Entrepreneurship and Startup Ecosystem (RCP23OCOE308)		

Prerequisite: NIL

Course Objective(s):

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.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply strategies to effectively navigate the global startup landscape.	L3	Apply
CO2	Analyze situations to develop an entrepreneurial mindset.	L4	Analyze
CO3	Apply strategies to navigate the global startup landscape.	L4	Analyze
CO4	Explain the significance of Intellectual Property rights.	L2	Understand
CO5	Apply appropriate fundraising strategies to match startup stages and investor profiles in practical scenarios.	L3	Apply



Entrepreneurship and Startup Ecosystem (RCP23OCO308) Course Contents

Unit-I

08 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

08 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.



Semester - IV



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Data Structures (RCP23DCPC401)		
Data Structures Laboratory (RCP23DLPC401)		

Prerequisite: C-Programming

Course Objective(s):

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 to various sorting and searching techniques, and their performance comparison.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Classify the various linear and non-linear data structures.	L2	Understand
CO2	Solve the problem using appropriate data structure.	L3	Apply
CO3	Analyze the problem and use suitable data structure for it.	L4	Analyze



Data Structures (RCP23DCPC401)

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.

Unit-II

09 Hrs.

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

Linear Data Structures – Linked 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.), Applications of linked lists -Polynomial Addition.

Unit-III

05 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.

Unit-IV

05 Hrs.

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-V

10 Hrs.

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

Height Balanced Tree: Creation of AVL Tree.

HEAP: Operations on heap, Heap Sort.

Applications: Huffman coding.

GRAPHS: Representation of Graph using arrays and Linked List.

Unit-VI

09 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.

Data Structures Laboratory (RCP23DLPC401)

List of Laboratory Experiments

Suggested Experiments:(At least 08 experiments)

1. Implementations 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. Implementations of stack using menu driven approach.
5. Implementations of Infix to Postfix conversion.
6. Implementation of prefix and postfix evaluation using menu driven approach.
7. Implementation of parenthesis checker using stack.
8. Implementations of Linear queue using menu driven approach.
9. Implementations of circular queue using menu driven approach.
10. Implementations of double ended queue using menu driven approach.
11. Implementation of Priority queue program using array and Linked list.
12. Implementations of Binary Tree using menu driven approach.
13. Implementation of Binary Tree Traversal.
14. Implementations 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. Implementations of Graph traversal using menu driven program (DFS & BSF).
17. Implementations of Selection sort, Radix sort using menu driven.
18. Implementations of Heap & Heap Sort using menu driven program.
19. Implementations of Advanced Bubble Sort and Insertion Sort using menu driven Program.



20. Implementations of searching methods (Index Sequential, Fibonacci search, Binary Search) using menu driven program.
21. Implementation of hashing functions with different collision resolution techniques.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Text Books:

1. Reema Thareja, “Data Structures using C”, 3rd Edition, Oxford, 2023.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, “Fundamentals of Data Structures in C”, 2nd Edition, W. H. Freeman and Company, 2010.
3. R. F. Gilberg and B. A. Forouzan, “Data Structures – A Pseudocode Approach with C”, 2nd Edition, Cengage Learning, 2007.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein, “Introduction to Algorithms”, 3rd Edition, MIT Pres, 2009.

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++”, 2nd Edition, Wiley, 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. Aho, Hopcroft, Ullman, “Data Structures and Algorithms”, Addison-Wesley, 2010.
6. Seymour Lipschutz, “Data Structures”, 1st Edition, Schaum’s Outline Series, Tata McGraw-Hill, 2014.

Web Links:

1. Tech Guide: <https://techdevguide.withgoogle.com/paths/data-structures-and-algorithms/>
2. NPTEL Course: <https://nptel.ac.in/courses/106102064>



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Machine Learning-I(RCP23DCPC402)		
Machine Learning-I Laboratory (RCP23DLPC402)		

Prerequisite: Mathematics for Intelligent Systems and Python Programming

Course Objective(s):

1. To introduce the concepts of computation learning theory and techniques of Machine Learning.
2. To become familiar with regression, classification and clustering tasks.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Summarize the given problems based on classification, clustering, and regression categories.	L2	Understand
CO2	Apply machine learning techniques for a given problem.	L3	Apply
CO3	Examine the dataset and select appropriate algorithm and evaluate the results.	L5	Evaluate
CO4	Design applications using machine learning algorithms.	L6	Create



Machine Learning-I(RCP23DCPC402)

Course Contents

Unit-I 04 Hrs.

Introduction to Machine Learning: Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps involved in developing a Machine Learning Application, Hypothesis and Inductive Bias, Bias-Variance Trade-off, Performance measures, Data Validation.

Unit-II 08 Hrs.

Supervised Machine Learning:

Regression: Linear Regression, Least Mean Square (LMS) algorithm, Gradient Descent, Lasso and Ridge Regression. Polynomial Regression. Logistic Regression, Maximum Likelihood Function.

Unit-III 08 Hrs.

Supervised Machine Learning:

Classification: Introduction to decision tree, Learning Decision tree using ID3 and Gini index; CART, Overfitting. Ensemble methods: Bagging (Random Forest) and Boosting (AdaBoost and Gradient Boost).

Unit-IV 06 Hrs.

Supervised Machine Learning: Bayesian Learning: Introduction to Bayesian Learning, Naïve Bayes, Bayesian Network: Representation in Bayesian Belief Network, Inference in Bayesian Network, Applications of Bayesian Network.

Unit-V 06 Hrs.

Supervised Machine Learning: Support Vector Machine: Support Vectors, Functional Margin, Geometric Margin, Optimization problem, Lagrange Duality, KKT condition, Maximum margin with noise, Non-linear SVM and Kernel Function.

Dimensionality Reduction: Singular Value Decomposition (SVD) and Principal Component Analysis (PCA), t-distributed Stochastic Neighbor Embedding (t-SNE).

Unit-VI 10 Hrs.

Unsupervised Machine Learning:

Association Rule Mining: Market Basket Analysis, Apriori algorithm and measures of association.

Clustering: Partition based clustering (K-means, K-Medoid), Hierarchical Clustering (Agglomerative Clustering), Density Based Clustering (DBSCAN) and Distribution Based Clustering (Expectation Maximisation (EM), Gaussian Mixture Model (GMM)).



Machine Learning-I Laboratory (RCP23DLPC402)

List of Laboratory Experiments

Suggested Experiments:

1. Perform Linear Regression.
2. Perform Logistic Regression.
3. Perform Decision Tree using GINI.
4. Perform CART decision tree algorithm.
5. Perform Ensemble methods.
6. Perform Bayesian Classification.
7. Perform Support Vector Machine.
8. Perform K-means clustering.
9. Perform Association Rule Mining.
10. Mini project based on any machine learning application.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Text Books:

1. Tom M. Mitchell, "Machine Learning", McGraw Hill, 1st Edition, 2017.
2. Ethem Alpaydm, "Introduction to Machine Learning", MIT Press, 4th Edition, 2020.
3. Peter Harrington, "Machine Learning In Action", DreamTech Press, 1st Edition, 2012.

Reference Books:

1. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'reilly, 1st Edition, 2016.
2. Stephen Marsland, "Machine Learning An Algorithmic Perspective", CRC Press, 2nd Edition 2014.



3. Kevin P. Murphy, “Machine Learning — A Probabilistic Perspective”, MIT Press, Illustrated Edition, 2012.
4. Han Kamber, “Data Mining Concepts and Techniques”, Morgan Kaufmann Publishers, 3rd Edition, 2011.

Web Links:

1. Towards Data Science: <https://towardsdatascience.com>
2. Machine Learning — Andrew Ng, Stanford University:
https://youtube.com/playlist?list=PLLsT5z_DsKh9vYZkQkYNWcItqhlRJLN
3. Commonly used Machine Learning Algorithms:
<https://www.analyticsvidhya.com/blog/2017/09/common-machinelearning-algorithms/>
4. A Tour to Machine Learning Algorithms:
<https://machinelearningmastery.com/a-tour-of-machine-learningalgorithms/Prepared>



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Statistics for Data Science(RCP23DCPC403)		
Statistics for Data Science Laboratory (RCP23DLPC403)		

Prerequisite: Probability and Statistics

Course Objective(s):

To build the strong foundation in statistics which can be applied to analyze data and make predictions.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Examine relations between data.	L2	Understand
CO2	Demonstrate sampling distributions and estimate statistical parameters.	L3	Apply
CO3	Classify data using LDA and evaluate model performance with metrics.	L5	Evaluate
CO4	Develop hypothesis based on data and perform testing using various statistical techniques.	L6	Create
CO5	Perform analysis of variance on data.	L4	Analyze



Statistics for Data Science(RCP23DCPC403)

Course Contents

Unit-I

10 Hrs.

Sampling distribution:

- Central limit theorem.
- Probability of sample mean using Sampling distribution.
- Chi-square distribution.
- Z-distribution.
- Student's t-distribution.
- F-Distribution.

Statistical Estimation:

- Confidence interval of population mean using large and small samples.
- Confidence interval of difference in population means using large and small samples.
- Confidence interval of population proportion.
- Confidence interval of difference in population proportions.
- Confidence interval of population variance and standard deviation.
- Confidence interval of ratio of population variances and standard deviations.
- Estimation of sample size for single mean and single proportion.

Unit-II

12 Hrs.

Hypothesis Testing for data driven decision making:

- Hypothesis testing: 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.
- Tests using z-statistics: 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.
- Test using t-statistics: difference between sample mean and population mean, difference between two independent sample means, difference between means from the same group, paired-t test



- Test using F-statistics: equality of population variances.
- Test using chi-square statistics: difference between population variance and sample variance, test of independence, goodness of fit, contingency table.

Unit-III

05 Hrs.

Analysis of Variance (ANOVA) for data analysis:

- One way ANOVA with POST-HOC Analysis (Tukey's Test)
- Two-way ANOVA.

Unit-IV

10 Hrs.

Correlation:

- Scatter plot
- Karl Pearson's coefficient of correlation,
- correlation vs causation
- limits of correlation coefficient
- Spearman's rank correlation coefficient, Repeated ranks

Regression:

- lines of regression
- regression coefficients,
- scatter plot with regression lines
- coefficient of determination
- multiple regression
- F-test for model significance

Unit-V

05 Hrs.

Statistical Analysis:

- Linear Discriminant Analysis (LDA).
- Metrics: FP measures, Confusion Matrix, Accuracy, Precision, Recall, F1-score, Area under the curve (AUC).

Statistics for Data Science Laboratory (RCP23DLPC403)

List of Laboratory Experiments



Suggested Experiments:(At least 08 experiments)

1. To perform correlation on data.
2. To visualize regression on data.
3. To prove central limit theorem.
4. To study sampling distributions and their parameters.
5. To perform statistical estimation tests on data.
6. To calculate confidence interval for different parameters.
7. To perform LDA on given datasets
8. To calculate metrics of regression on data
9. To perform hypothesis test using t statistics. (Single mean, difference between means, paired t test)
10. To perform hypothesis test using Chi square. (Contingency table)
11. To perform hypothesis test using Chi square. (Goodness of fit)

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Text Books:

1. S. P. Gupta, “Statistical Methods”, Sultan Chand, 46th Edition, 2021.
2. Thomas Hasalwanter, “An Introduction to Statistics with Python”, Springer, 1st Edition, 2016.
3. Allen B. Downey, “Think Stats: Probability and Statistics for Programmers”, Green Tea Press, 1st Edition, 2011.
4. E. L. Lehmann, Joseph P. Romano, “Testing Statistical Hypotheses”, Springer, 3rd Edition, 2008.

Reference Books:

1. Peter Bruce, Andrew Bruce, Peter Gedeck, “Practical Statistics for data scientists 50+ Essential Concepts Using R and Python”, Orelly, 2nd Edition, 2020.
2. Freedman, David, Robert Pisani, Roger Pervis, W. W. Norton, “Statistics”, 2007.



3. S. C. Gupta, V. K. Kapoor, Sultan Chand, “Fundamentals of mathematical statistics”, 10th Edition, 2002.

Web Links:

1. Essentials of Data Science With R Software_ 1: Probability and Statistical Inference, IIT Kanpur:
<https://nptel.ac.in/courses/111104146>
2. Probability and Statistics: https://onlinecourses.nptel.ac.in/noc21_ma74/preview Prepared



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Web Engineering Laboratory(RCP23DLMD401)		

Prerequisite: Programming Fundamentals

Course Objective(s):

To provide the basic framework of web development (MERN Stack) and cloud computing.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Develop a website as per the requirements.	L6	Create
CO2	Apply the concepts of cloud computing to improve the efficiency of web development.	L3	Apply
CO3	Evaluate the requirement of the problem and select appropriate method of web development.	L5	Evaluate



Web Engineering Laboratory(RCP23DLMD401) Course Contents

Unit-I	02 Hrs.
HTML:	
1. Create a static web page using HTML.	
2. Create a class timetable using HTML.	
3. Create a registration form using HTML.	
4. Create a web page using HTML5 tags.	
Unit-II	02 Hrs.
CSS:	
1. Design a responsive web page and CSS3 using external CSS (media queries).	
2. Design a web page using Bootstrap.	
3. Design the admission form using Bootstrap.	
Unit-III	06 Hrs.
Client-Side Scripting:	
1. Programs based on objects in JavaScript.	
2. Programs based on form validation.	
3. Fetch Data from an API Using the Fetch API in JavaScript.	
Unit-IV	08 Hrs.
React JS:	
1. Types of Components	
2. Single Page Application (Virtual DOM)	
3. State	
4. React Hooks	
Unit-V	02 Hrs.
Introduction to Git and GitHub:	
1. Adding files to the staging area	



2. Push new branch
3. Merge into the master
4. Auto Commit

Unit-VI

04 Hrs.

Server-Side Scripting:

1. Installation and Configuration of Node.js server
2. Program based on inbuilt functions in Node.js

Unit-VII

08 Hrs.

Express & MongoDB:

1. Using Mongoose to make schemas in MongoDB.
2. Making API end points using Express and testing using postman.
3. Develop a website and integrate it with pre-defined API.
4. Doing CRUD on database MongoDB using Express.
5. PostgreSQL & Sequelize

Unit-VIII

04 Hrs.

XML & XSL:

1. Design XML using XML DTD and schema.
2. Implementing XSL elements in XML.
3. Validate XML using Node.js

Unit-IX

04 Hrs.

Concepts of Cloud Computing:

1. Introduction to cloud computing.
2. NIST model
3. Service and Deployment models.

Unit-X

04 Hrs.

Networking and Security:

1. Identity and Access Management
2. Networking basics



3. VPC networking and security
4. Design a VPC
5. Build your own VPC and Launch a Web Server

Unit-XI

04 Hrs.

Compute Service:

1. Compute Services overview
2. Elastic Computing
3. Serverless Compute service
4. Deploying and scaling web applications

Unit-XII

04 Hrs.

Storage Service:

1. Cloud object storage
2. Cloud block storage
3. Elastic file system

Unit-XIII

04 Hrs.

Database Service:

1. Cloud Relational database services
2. Cloud NoSQL Databases
3. Elastic load balancing

Above experiments or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

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

Text Books:

1. Vasan Subramanian, “Pro MERN Stack”, 2nd Edition, Apress Publication, 2019.
2. Shama Hoque, “Full-Stack React Projects”, 2nd Edition, Packt Publication, 2020
3. Rajkumar Buyya, James Broberg, Goscinski, “Cloud Computing: Principles and Paradigm Wiley, 2013.



4. Shalabh Aggarwal, “Flask Framework Cookbook: Over 80 proven recipes and techniques for Python web development with Flask”, Packt publication, 2nd Edition, 2019.

Reference Books:

1. Benjamin LaGrone, “HTML5 and CSS3 Responsive Web Design Cookbook”, 1st Edition, Packt Publishing, 2013.
2. “DT Editorial Services, Web Technologies: Black Book”, 1st Edition, Dreamtech Press, 2018.
3. Christopher Schmitt, Kyle Simpson, “HTML5 Cookbook”, 1st Edition, O’Reilly Media Inc., 2011.
4. Uttam K. Roy, “Web Technologies”, 1st Edition, Oxford University Press, 2010.
5. Greg Sidelnikov, “React. Js Book: Learning React JavaScript Library from Scratch”, 1st Edition, Independently Published, 2017.
6. DT Editorial Services, “HTML5 Black Book”, 2nd Edition, Dreamtech Press, 2016.
7. Ben Frain, “Responsive Web Design with HTML5 and CSS3”, 2nd Edition, Packt Publishing, 2015.
8. Steve Suehring, “JavaScript Step by Step”, 3rd Edition, Pearson Education, 2013.
9. Stoyan Stefanov, “React Up Running Building Web Applications”, 1st Edition, O’Reilly Media Inc., 2016.
10. Velte, “Cloud Computing a Practical Approach”, Tata McGraw-Hill Education.
11. Sandip Bhowmik, “Cloud Computing”, Cambridge University Press, 2017.
12. Miguel Grinberg, “Flask Web Development”, O’Reilly publication, 2018
13. Sack Stouffer Daniel Gaspar, “Mastering Flask Web Development”, Packt Publication, 2018

Web Links:

1. Professional and Lifelong Learning: Web Development Courses — Harvard University
2. Virtual Lab: <https://html-iitd.vlabs.ac.in/exp/introduction-to-html/references.html>



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Project Management (RCP23OCOE401)		

Prerequisite: Basic concepts of Management

Course Objective(s):

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:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the project management life cycle, project phases, and the roles and responsibilities of a project manager.	L2	Understand
CO2	Apply project selection criteria to select an appropriate project from available alternatives.	L3	Apply
CO3	Apply project management tools to develop a Work Break-down Structure (WBS), prepare a basic project schedule, and identify major project risks.	L3	Apply
CO4	Analyze project performance using Earned Value Management techniques and evaluate lessons learned during project execution for future improvement.	L4	Analyze
CO5	Analyze the Waterfall and Agile Scrum methodologies for software development projects.	L4	Analyze



Project Management (RCP23OCOE401)

Course Contents

Unit-I

08 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

09 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

09 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, Char



teristics 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” , 11th Edition, Wiley India.
2. Erik Larson, Clifford Gray, “Project Management: The Managerial Process” , 8th 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), 7th Edition, Project Management Institute PA, USA.
2. Gido Clements, “Project Management” , Cengage Learning.
3. Gopalan, “Project Management” , Wiley India.
4. Dennis Lock, “Project Management” , 9th Edition, Gower Publishing England.
5. Kalpesh Ashar, “Agile Essentials You Always Wanted to Know” , Vibrant Publishers U.S.A.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Cyber Security, Policies and Laws (RCP23OCOE402)		

Prerequisite: Fundamentals of Computers

Course Objective(s):

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:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the types of cybercrimes and interpret relevant legal frameworks related to digital personal data protection.	L2	Understand
CO2	Apply cybersecurity strategies based on the National Cyber Security Policy to address common security threats.	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



Cyber Security, Policies and Laws (RCP23OCO402) 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 **09 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 **08 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 **09 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. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Advanced Operations Research (RCP23OCOE403)		

Prerequisite: Operation Research and Mathematics (Calculus)

Course Objective(s):

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:

On completion of the course, the learner will be able to:

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



Advanced Operations Research (RCP23OCOE403) Course Contents

Unit-I

07 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

07 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

06 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

11Hrs.

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:



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Corporate Finance Management (RCP23OCOE404)		

Prerequisite: Nil

Course Objective(s):

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:

On completion of the course, the learner will be able to:

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



Corporate Finance Management (RCP23OCOE404) Course Contents

Unit-I

09 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

09 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

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

Reference Books:

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



Corporate Social Responsibility (RCP23OCOE405) 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

09 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

09 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

09 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. Corporate Social Responsibility in India, Sanjay K Agarwal, Sage Publications, 2008.
4. Corporate Social Responsibility in India, Bidyut Chakrabarty, Routledge, New Delhi, 2015.

Reference Books:

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

Weblinks:

1. NPTEL: Corporate Social Responsibility by Prof. Aradhna Malik
<https://archive.nptel.ac.in/noc/courses/noc17/SEM2/noc17-mg20/>
2. Business Roundtable on CSR
<https://www.businessroundtable.org>
3. World Business Council for Sustainable Development
<https://www.wbcsd.org>
4. UN Global Compact on CSR
<https://www.unglobalcompact.org>
5. Ministry of Corporate Affairs, India – CSR Policy
<https://www.csr.gov.in/content/csr/global/master/home/aboutcsr/about-csr.html>
6. Harvard Business Review on CSR and Business Strategy
<https://hbr.org>



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Bioinformatics (RCP23OCOE406)		

Prerequisite: Nil

Course Objective(s):

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:

On completion of the course, the learner will be able to:

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



Bioinformatics (RCP23OCOE406)

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 09 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 09 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 09 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. Bioinformatics For Dummies, Jean-Michel Claverie and Cedric Notredame, For Dummies, 20



2. Bioinformatics Algorithms: An Active Learning Approach by Phillip Compeau and Pavel Pevzner, Active Learning Publishers, 2019.

Reference Books:

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



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Human Resource Management (RCP23OCOE407)		

Prerequisite: Nil

Course Objective(s):

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:

On completion of the course, the learner will be able to:

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



Human Resource Management (RCP23OCOE407) Course Contents

Unit-I

08 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

08 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, 2015, Himalaya Publishing, 15th Edition, 2015.
4. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Edition, 2013, Himalaya Publishing.
5. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications.
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, 2010, Excel publishing.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Digital Marketing Management (RCP23OCOE408)		

Prerequisite: Nil

Course Objective(s):

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:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the digital marketing framework, models, and consumer behaviour.	L2	Understand
CO2	Apply digital marketing strategies to promote a given product/service.	L3	Apply
CO3	Illustrate the terminology and concepts for developing web-specific media plans.	L3	Apply
CO4	Interpret concepts related to digital campaign management and revenue generation models.	L2	Understand
CO5	Apply global digital marketing technologies/tools to assess future trends.	L3	Apply



Digital Marketing Management (RCP23OCOE408) Course Contents

Unit-I

08 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

11 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 serv



delivery and payments, managing digital implementation challenges like ecommerce, internal & external and consumer specific challenges.

Unit-V

07 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. Fundamentals of Digital Marketing by Puneet Singh Bhatia, Pearson Education Limited,2017.
2. Digital Marketing by Seema Gupta- McGraw Hill Education, 2022.

Reference Books:

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



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Logistics and Supply Chain Management (RCP23OCOE409)		

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

Course Objective(s):

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:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain 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 information-based business logistics systems in improving accuracy and supporting decision-making at all levels of management.	L2	Understand
CO4	Describe current trends in supply chain information technology management.	L2	Understand
CO5	Use available technologies to enhance work performance and support supply chain functions, processes, transactions, and communications.	L3	Apply



Logistics and Supply Chain Management (RCP23OCOE409) 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

07 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

09 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

09 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-Interface 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.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Professional and Business Communication Tutorial (RCP23ITHSX01)		

Prerequisite: NIL

Course Objective(s):

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:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply group discussion techniques in professional situations.	L3	Apply
CO2	Use employability skills to optimise career opportunities.	L3	Apply
CO3	Employ storytelling techniques for corporate presentations.	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 & 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 concept 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.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Economics and Financial Management (RCP23ICHSX03)		

Prerequisite: Knowledge of Economics and Finance domain current affairs

Course Objective(s):

- 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:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze individual decision making, how prices and quantities are determined in product and factor markets, microeconomic and macroeconomic outcomes.	L4	Analyze
CO2	Analyze the performance and functioning of government, RBI, markets, and institutions in the context of social and economic problems.	L4	Analyze
CO3	Analyze 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	Analyze financial performance and make appropriate inferences.	L4	Analyze



Economics and Financial Management (RCP23ICHSX03) 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

10 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.



Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech.	Semester: IV
Semester Project-II (RCP23IPSC401)		

Course Objective(s): Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Describe various/alternate approaches to complete a project.	L2	Understand
CO3	Apply a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Use technical communication skills to present project work in the form of a technical report/paper.	L3	Apply
CO5	Apply teamwork and project management skills to plan, execute, and manage the research study.	L3	Apply



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/ Methodology	Implementation	Result Verification	Presentation	Total
			5	5	5	5	5	25

