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

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

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	
							Continuous Assessment (CA)							
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1	PC	RCP23DCPC301	Computer System Fundamentals	3			20	20	20	20	60	100	3	4
	PC	RCP23DLPC301	Computer System Fundamentals Laboratory			2	25				25	50	1	
2	PC	RCP23DCPC302	Database Systems	3			20	20	20	20	60	100	3	4
	PC	RCP23DLPC302	Database Systems Laboratory			2	25				25	50	1	
3	PC	RCP23DLPC303	Data Science Laboratory(Python)	1		2	50				50	100	2	2
4	MD	RCP23DCMD301	Mathematics for Intelligent Systems	3			20	20	20	20	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	1	1
7	HS	RCP23ICHSX04	Universal Human Values	3			20	20	20	20	60	100	3	3
8	EL	RCP23ILELX05	Community Engagement Service			2	25					25	1	1
9#	OE	RCP23OCOE301	Product Life Cycle Management	3			20	20	20	20	60	100	3	3
		RCP23OCOE302	Management Information System	3			20	20	20	20	60	100	3	
		RCP23OCOE303	Operations Research	3			20	20	20	20	60	100	3	
		RCP23OCOE304	Personal Finance Management	3			20	20	20	20	60	100	3	
		RCP23OCOE305	Public Systems and Policies	3			20	20	20	20	60	100	3	
		RCP23OCOE306	Fundamentals of Biomedical Instruments	3			20	20	20	20	60	100	3	
		RCP23OCOE307	IPR and Patenting	3			20	20	20	20	60	100	3	
		RCP23OCOE308	Entrepreneurship and Startup Ecosystem	3			20	20	20	20	60	100	3	
Total				16		12	275			100	425	800	22	

#Any 1 Elective Course

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R. C. Patel Institute of Technology, Shirpur
SES Shirpur Education Society
Autonomous

Computer System Fundamentals (RCP23DCPC301)

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

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Basic Mathematics

Course Objectives:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the fundamental organization of a computer system.	L1	Remember
CO2	Apply 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.	L4	Analyze

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, Uniprocessor 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 — 09 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 — 04 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

04 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.

Text Books:

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

Reference Books:

1. John Hayes, "Computer Architecture and Organization", McGrawHill, 3^{rd} Edition, 2017.
2. M. Morris Mano, "Computer System Architecture", Pearson, 2017.
3. Andrew S. Tanenbaum and Todd Austin, "Structured Computer Organization", 6^{th} 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.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

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

Computer System Fundamentals Laboratory (RCP23DLPC301)

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

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

Course Objectives:

1. To understand commands of Linux and shell script.
2. To learn thoroughly Booth's, Restoring, and Non-Restoring algorithm.
3. To solve problem of process/thread scheduling and synchronization.
4. To explore memory allocation strategies and disk scheduling algorithms.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate the fundamental Unix commands, system calls and shell scripting.	L2	Understand
CO2	Solve the scheduling algorithms for given problems.	L3	Apply
CO3	Identify the performance of Booth's, Restoring, and Non-Restoring algorithm.	L3	Apply
CO4	Illustrate an algorithm to detect and avoid deadlock.	L2	Understand
CO5	Demonstrate the various page replacement and disk scheduling algorithms.	L2	Understand

List of Laboratory Experiments

Suggested 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 Dinning Philosopher Problem of Process Synchronization.
  - Implementation of Multithreading using parent process and child process using UNIX calls like fork, exec and wait.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on RCP23DCPC301 with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks

3. Viva-voce: 05 Marks

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

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

End Semester Examination (C):

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

Database Systems (RCP23DCPC302)

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

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Computer Basics

Course Objectives:

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.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand different types of database systems.	L2	Understand
CO2	Construct SQL queries to perform operations on the database.	L5, L6	Evaluate, Create
CO3	Apply suitable data management techniques for efficient data retrieval.	L3	Apply

Course Contents

Unit-I — 07 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 — 07 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 — 06 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.

Text Books:

1. Korth, Silberchatz, Sudarshan, "Database System Concepts", 7^{th} Edition, McGraw – Hill, 2019.
2. Elmasri and Navathe, "Fundamentals of Database Systems", 7^{th} Edition, Pearson Education, 2021.
3. Alejandro Vaisman, Esteban Zimányi, "Data Warehouse Systems: Design and Implementation", Springer, 2^{nd} Edition, 2022.
4. Andreas Meier, Michael Kaufmann, "SQL & NoSQL Databases", Springer, 2019.

Reference Books:

1. Raghu Ramkrishnan and Johannes Gehrke, "Database Management Systems", 2^{nd} 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.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Database Systems Laboratory (RCP23DLPC302)

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

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

Course Objectives:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Build ER/EER diagram for the given application.	L3	Apply
CO2	Utilize ER/EER concepts to convert into relational schema with integrity constraints for given application.	L3	Apply
CO3	Design a database for given application using DDL and DML commands.	L6	Create
CO4	Implement Joins and Views, ETL Pipeline with SQL Server Integration Services (SSIS) tool, Data Cube with Pivot Tables and perform OLAP operations. CRUD Operations using NoSQL, Basic Data Lake using Open-Source Technologies.	L3	Apply

List of Laboratory Experiments(At Least 08)

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.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on RCP23DCPC302 with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

Data Science Laboratory (Python)(RCP23DLPC303)

Practical Scheme	**Examination Scheme**
Lecture : 01 Hrs./week	Teacher Assessment : 50 Marks
Practical : 02 Hrs./week	End Sem Exam : 50 Marks
Credits : 02	Total : 100 Marks

Prerequisite: Programming Fundamental, Fundamentals of Data Analysis.

Course Objectives:

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

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

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 — 02 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.

Suggested List of Laboratory 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.

A minimum of 10 experiments or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (A): 50 Marks:

Laboratory work will be based on RCP23DLPC303 with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 10 Marks
2. Journal Submission: 10 Marks
3. Viva-voce: 10 Marks
4. Subject Specific Lab Assignment/Case Study: 20 Marks

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

End Semester Examination (C): 50 Marks:

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

Mathematics for Intelligent Systems (RCP23DCMD301)

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

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Pre-requisites: Concepts of basic matrices, partial derivatives and basic probability.

Course Objectives:

To build the strong foundation in learners of mathematics needed for building concepts of machine learning.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze probability of random variables and probability distributions.	L4	Analyze
CO2	Demonstrate knowledge of linear algebra.	L2	Understand
CO3	Apply concepts of matrix theory.	L3	Apply
CO4	Demonstrate concepts of calculus.	L2	Understand
CO5	Analyze different optimization techniques.	L4	Analyze

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 07 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 04 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-Tucker 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", 44^{th} Edition, Khanna Publication, 1965.
2. Kanti B. Datta, "Mathematical Methods in Science and Engineering", 1^{st} Edition, Cengage Learning India, 2011.
3. Hamdy A. Taha, "Operations Research - An Introduction", Pearson, 10^{th} Edition, 2010.
4. P. K. Gupta, Mohan Man, "Operations Research", 1^{st} Edition, S. Chand Publication, 2005.

Reference Books:

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

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Semester Project-I (RCP23IPSC301)

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

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

Course Objectives:

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

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

Semester Project:

The purpose of 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.

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

Table 1: Log Book Format

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

Table 2: Continuous Assessment Table

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

Table 3: Evaluation Table

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

Design Thinking Laboratory (RCP23ILHSX02)

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

Examination Scheme
Teacher Assessment : 25 Marks
Total : 25 Marks

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 Objectives:

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.

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

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 — 04 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 — 04 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.

Unit-VI

02 Hrs.

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.

Suggested List of Laboratory 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 perfor better.

A minimum of 05 experiments or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Text Books:

1. I. Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School" Wiley, 2013.
2. M. Lewrick, P. Link, and L. Leifer, "The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems", Wiley, 2018.
3. T. Lockwood, "Design Thinking: Integrating Innovation, Customer Experience, and Brand Value", Allworth Press, 2010.
4. K. T. Ulrich and S. D. Eppinger, "Product Design and Development", McGraw-Hill Hill Education, 6^{th} 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 Lib... 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

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

Universal Human Values (RCP23ICHSX04)

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

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Course Objectives:

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

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

Course Contents

Unit-I — 07 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 — 06 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 of existence

Unit-V

06 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".

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Community Engagement Service (RCP23ILELX05)

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

Examination Scheme
Teacher Assessment : 25 Marks
Total : 25 Marks

Prerequisite: Fundamentals of core branch, Communication Skills

Course Objectives:

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

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

Course Contents

Unit-I

Open Activities

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

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

Unit-II

Technical (Program core related)

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

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

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

OR

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

Activities to be performed

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

Suggested Activities

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

Typical suggested tabulation.

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

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

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

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

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

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

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

5. Compulsion of having a borewell for non-potable water supply in city residential complexes is a modern day rule. Increased pace of re-development, as well as number of occupants in given area, has resulted in increased number of borewells being dug within and outside city limits.
Reduced yield, quality and quantity of water adds to the recurring maintenance cost of borewells, especially in the city areas. Poor water recharge systems along-with depleting open soil cover area in wake of wall-to-wall of concrete carpet aggravate the problem. Study, analyse and report a residential society's – capacity of water requirement, present day borewells in action, approximate yield, maintenance cost and frequency, borewell flushing iterations in wake of redevelopment in neighborhood. A typical tabulation mechanism for inferences can be as below:

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

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

YouTube link:

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

R. C. Patel Institute of Technology, Shirpur SES SHIRPUR EDUCATION SOCIETY Autonomous

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	

Product Life Cycle Management(RCP23OCOE301)

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

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of basic concepts of Management

Course Objectives:

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

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

Course Contents

Unit-I — 07 Hrs.

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

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

Unit-II — 07 Hrs.

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

Unit-III — 10 Hrs.

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

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

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

Unit-IV — 07 Hrs.

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

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

Unit-V

08 Hrs.

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

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

Text Books:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realization", Springer-Verlag, 2004, ISBN: 1852338105.
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis, 2006, ISBN: 0849327229.

Reference Books:

1. Saaksvuori Antti, Immonen Anselmie,"Product Life Cycle Management", Springer, Dreamtech, 2009, ISBN: 3540257314.
2. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265.
3. François Villeneuve, Luc Mathieu, Max Giordano, "Product Life-Cycle Management: Geometric Variations", United Kingdom: Wiley, 2010.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Management Information System (RCP23OCOE302)

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

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite:NIL

Course Objectives:

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

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

Course Contents

Unit-I — 04 Hrs.

Foundation Concepts:

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

Unit-II — 05 Hrs.

Information Technology Infrastructure:

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

Unit-III — 10 Hrs.

MIS Tools and applications for Decision making:

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

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

Unit-IV

08 Hrs.

Security and Ethical Challenges

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

Unit-V

06 Hrs.

Social Computing (SC)

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

Unit-VI

06 Hrs.

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

Textbooks:

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

Reference Books:

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

Web References:

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

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Operations Research (RCP23OCOE303)

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

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of 1. Mathematics, 2. Probability.

Course Objectives:

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

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

Course Contents

Unit-I — 12 Hrs.

Introduction to Operations Research:

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

Linear Programming:

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

Unit-II — 08 Hrs.

Transportation Problem:

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

Assignment Problem:

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

Unit-III — 06 Hrs.

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

Unit-IV — 06 Hrs.

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

Unit-V — 07 Hrs.

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

Text Books:

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

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

Reference Books:

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

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

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

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Personal Finance Management
(RCP23OCOE304)

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

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: NIL

Course Objectives:

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

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

Course Contents

Unit-I — 07 Hrs.

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

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

Consumer Credit: Advantages, Disadvantages, Sources and Costs.

Unit-II — 07 Hrs.

Personal Financial Management:

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

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

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

Unit-III — 09 Hrs.

Income Tax:

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

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

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

Unit-IV — 08 Hrs.

Goods and Services Tax:

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

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

Unit-V

08 Hrs.

Introduction to Micro – finance:

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

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

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

Public Systems and Policies (RCP23OCOE305)

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

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Basic Knowledge of Social science and Current affairs.

Course Objectives:

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

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

Course Contents

Unit-I — 10 Hrs.

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

Unit-II — 06 Hrs.

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

Unit-III — 08 Hrs.

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

Unit-IV — 10 Hrs.

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

Unit-V — 05 Hrs.

Case Studies in Expenditure Policy: Public Services

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

Reference Books:

1. Charles Wheelan, "Introduction to Public Policy", W.W. Norton & Company, New York, 2011.
2. Thomas R. Dye, "Understanding Public Policy", Prentice Hall, 2008.
3. Anderson J.E.,"Public Policy-Making: An Introduction", Boston, 2011.
4. Avasthi & Maheshwari, "Public Administration", Lakshmi Narain Agarwal, 2008.
5. Mohit Bhattacharya, "New Horizons of Public Administration", Jawahar Publishers, New Delhi, 2011.
6. Nicholas Henry,"Public Administration and Public Affairs", Prentice Hall of India, New Delhi, 2017.
7. Harvey S Rosen and Ted Gayer, "Public Finance", 10th Edition, McGraw-Hill Education, 2013.

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

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Fundamentals of Biomedical Instruments (RCP23OCOE306)

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

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

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

Course Objectives:

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

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

Course Contents

Unit-I — 04 Hrs.

Basic Human Physiology

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

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

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

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

Unit-II — 10 Hrs.

Biomaterial, Transducers and Sensors

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

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

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

Introduction of biomaterials, Classification of biomaterials

Unit-III — 08 Hrs.

Overview of Medical Instruments

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

Method of operation of these Bio Medical Instruments

ECG, EEG, EMG

Unit-IV — 09 Hrs.

Imaging Modalities and Analysis Radio graphic techniques, Computer Tomography

MRI, PET, SPECT

Ultrasonography

Endoscopy

Thermography, Retinal Imaging

Imaging application in Biometric systems

Analysis of digital images

Unit-V

08 Hrs.

Telemetry & Telemedicine

Introduction to Biotelemetry

Physiological parameters compliant to biotelemetry

Components of Biotelemetry system

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

Text Books:

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

Reference Books:

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

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

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

IPR and Patenting (RCP23OCOE307)

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

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: NIL

Course Objectives:

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

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

Course Contents

Unit-I — 03 Hrs.

Introduction to Intellectual Property Rights (IPR):

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

Unit-II — 09 Hrs.

Copyright and Design

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

Unit-III — 09 Hrs.

Basics of Patents

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

- International Patent Classification code.

Unit-IV

09 Hrs.

Patent Application Drafting

Patent application drafting:

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

Drafting response to communications from patent office.

- Reading and understanding examination reports.
- Drafting response.

Unit-V

09 Hrs.

Procedure for Filing a Patent Application, Timelines and Fees

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

Text Books:

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

Reference Books:

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

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

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

Online Resources:

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

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

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

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

1. Two term tests of 20 marks each will be conducted during the semester.

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

End Semester Examination (C):

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

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

Entrepreneurship and Startup Ecosystem (RCP23OCOE308)

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

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: NIL

Course Objectives:

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

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

Course Contents

Unit-I

06 Hrs.

Understanding the Entrepreneurial Ecosystem

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

Unit-II

08 Hrs.

Developing a Startup Mindset

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

Unit-III

10 Hrs.

Business Model Development

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

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

Unit-IV

08 Hrs.

Technological Innovation and Intellectual Property

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

Unit-V

07 Hrs.

Fundraising and Investment Strategies

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

Books Recommended:

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

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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