

Bansilal Ramnath Agarwal Charitable Trust's

**Vishwakarma Institute of Information Technology, Pune-411048**

(An Autonomous Institute affiliated to Savitribai Phule Pune University)



**Curriculum for  
SY B. Tech.  
(Computer Science and Engineering Data  
Science)  
Pattern 2023- NEP**



## **Vision**

“Excellence in Data Science to empower the future of technology with holistic development”

## **Mission**

- To impart quality education with contemporary industry needs using emerging Machine Learning & Data Science techniques
- To cultivate a research-oriented mindset and comprehensive professional skills.
- To equip learners with interdisciplinary skill sets to cater the needs of the industry and society.

## **Program Outcomes**

**PO1.Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2.Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first` principles of mathematics, natural sciences and engineering sciences.

**PO3.Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4.Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems:

**PO5.Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**PO6.The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7.Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for



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sustainable development.

**PO8.Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9.Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10.Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11.Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12.Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

### **Program Specific Outcomes (PSOs)**

At the end of program, students should be able to

1. **PSO a:** Apply Data Science techniques to analyze, summarize, and comprehend data pertaining to real life.
2. **PSO b:** Apply AI techniques to synthesize given problem and solving it for multi-disciplinary use cases.

### **List of Abbreviations**

PCC - Programme Core Course  
MDM - Multidisciplinary Minor  
EEM - Entrepreneurship/Economics/  
Management Courses  
VEC - Value Education Course  
CEP - Community Engagement  
Project (Field project)  
OE - Open Elective  
AEC - Ability Enhancement Course  
TH - Theory

CE - Continuous Evaluation  
L - Lecture  
T - Tutorial  
P - Practical  
CIE - Continuous Internal Evaluation  
ISE - In-Semester Examination  
SCE - Skills & Competency Exam  
ESE - End Semester Examination  
PR/OR/TW - Practical/Oral/Term  
work



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**S.Y. B. TECH Computer Science and Engineering (Data Science)**

**SEMESTER I (PATTERN 2023-NEP) AY 2024-25**

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme									Total	Credit
						ISA						ESA				
			L	P	T	HA	TW	SCE	PPT	GD	CIE	ESE	PR	OR		
CD21231	Advance Data Structure & Algorithms	TH	3	2	0			20			20	40	20		100	4
CD21232	Database Management System	TH	3	2	0			20			20	40	20		100	4
CD21233	Software Engineering & Project Management	TH	3	0	1			20			20	40		20	100	3
MDM20234	Probability and Statistics	TH	2	-	-	20	-	20	-	-	20	40	--		100	2
EEM21236	Design thinking	CE	1	-	1		30	30	20		20				100	2
VEC21237	Universal Human Values	CE	2	-	-				20		10	-		20	50	2
CEP21238	Community Engagement Project	CE	-	4	-		50							-	50	2
QEUA21239	Open Elective-I	TH	2	-		20		20			20	40			100	2
	Total		16	8	2	40	80	130	40	-	130	200	40	40	700	21

**S.Y. Open Elective-1**

CSEOEA21239A: BASICS OF UI/UX
ETOEUA21239C: SENSOR TECHNOLOGY
MEOEUA21239D: RENEWABLE ENERGY
CVOEUA21239E: CLIMATOLOGY

**BOS Chairman**

**Dean Academics**

**Director**



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# SEMESTER-I

**Course Code: CD21231 (Advance Data Structures and Algorithms)**

Teaching Scheme	Examination Scheme
Credits: 4	Continuous Internal Evaluation (CIE): 20 Marks
Lectures: 3 Hrs/week	Skills & Competency Exam (SCE): 20 Marks
Practical: 2 Hrs/week	End Semester Examination (ESE): 40 Marks
	PR/OR: 20 Marks

**Prerequisites:**

- Programming Paradigm Methodology
- Introduction to Data Structure & Algorithm
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**Course Objectives:**

- To acquaint with the structural constraints and advantages in usage of the data
- To identify the appropriate data structure and algorithm design method for a specified application.
- To develop a logic for graphical modeling of the real-life problems.
- To understand advanced data structures to solve complex problems in various domains.
- To build the logic to use appropriate data structure in logical and computational solutions
- To understand various algorithmic strategies to approach the problem solution.

**Course Outcomes:**

After completion of the course, student will be able to

1. Illustrate stack operations, using both arrays and linked lists, and apply these skills in problem solving.
2. Illustrate concept, operations of Queues as a Linear Data Structure and applying them to solve various problems.
3. Apply tree data structure to solve the problems.
4. Use graph-based algorithms to solve the problems of various domains.
5. Use advanced search trees, to solve complex problem.
6. Apply indexed and multiway search tree to store and maintain data.

**Unit I: Stack**

Introduction to Data Structure, Linear and Non-Linear Data Structure.

Concept of Stack as a Linear Data Structure, Stack as an ADT, Stack Operations, Implementation of stack using Array and Linked List. Applications: Expression conversion (prefix, postfix and Infix) and Evaluation using stack. Recursion: Concept, Types: Direct, Indirect, Tail and Tree, use of stack in backtracking.

Case Studies:.4 Queens backtracking problem using stack.

**Unit II: Queue**

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Concept of Queue as Linear Data Structure, Queue as an ADT, Queue Operations, Implementation of Queue using Array and Linked List. Circular Queue and its advantages, Josephus Problem, Double Ended Queue (Deque) : Concept and types, Priority Queue: Concept and types(Ascending and Descending)

Case Studies: Job Scheduling using Priority Queue

**Unit III: Tree**

Concept of Tree as Non-Linear Data Structure, Basic terminology, General tree and its representation, converting general tree to binary tree, Binary tree- properties, representation using sequential and linked organization, Types of binary tree, Binary tree traversals (recursive and non-recursive)- In-order, Pre-order, Post-order, Depth First Search (DFS) and Breadth First Search (BFS), Operations on binary tree (Insert, Delete, Traverse). Binary Search Tree (BST), BST operations (Insert, Delete, Display, and Search), Threaded binary tree- concepts, threading, insertion and deletion of nodes in in-order threaded binary tree, in order traversal of threaded binary tree.

Case Studies: Use of binary tree in expression tree-evaluation.

**Unit IV: Graphs**

Concept of Graph as Non-Linear Data Structure, Basic Terminologies, Storage representation, Adjacency matrix, adjacency list. Traversals-depth first and breadth first, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prim's and Kruskal's Algorithms, Dijkstra's Single source shortest path, Topological Ordering.

Case Studies: Study the use of Dijkstra's Algorithm in Traffic Management.

**Unit V: Search Trees**

Symbol Table-Representation of Symbol Tables, WeightBalanced Tree - Optimal Binary Search Tree (OBST), Height Balanced Tree- AVL tree, operations on AVL tree. Heap Tree: Min Heap, Max Heap, Heap Sort Implementation. Self-Balanced Tree - Red Black Tree.

Case Studies: Study the use of AVL Tree in Compiler Implementation.

**Unit VI Indexing and Multiway Search Trees**

Hashing: Concepts-hash table, hash function, basic operations, bucket, collision, Collision resolution strategies, Double hashing, Rehashing. Multiway Search Trees: Concept. B Tree: Concept, Operations. B+ Tree: Concept, Operations. Huffman's Algorithm.

Case Studies: Study the use of B+ Tree in Transaction Management.

**Text Books:**

1	Horowitz, Sahani, Dinesh Mehata, "Fundamentals of Data Structures in C++"   , Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2	Peter Brass, "Advanced Data Structures"   , Cambridge University Press, ISBN: 978-1-107-43982-5

**Reference Books:**

1	Sartaj Sahani, "Data Structures, Algorithms and Applications in C++"   , Second Edition, University Press, ISBN:81-7371522 X.
2	Goodrich, Tamassia, Goldwasser, "Data Structures and Algorithms in Java", Wiley Publication, ISBN: 9788126551903

**Online Resources:**



	1	Introduction to Data Structures and Algorithms <a href="https://nptel.ac.in/courses/106102064">https://nptel.ac.in/courses/106102064</a>
	2	Programming, Data Structures and Algorithms, IIT Madras <a href="https://nptel.ac.in/courses/106106127">https://nptel.ac.in/courses/106106127</a>

**List of Assignments:**

1	<b>Write C++ program with functions a) To print original string followed by reversed string using stack b) To check whether given string is palindrome or not</b>
2	Simulate Job Scheduling in Operating System using Queue in FCFS basis 1. Insert 2. Delete 3. Display
3	Create Binary Tree and perform operations 1. Insert 2. Display 3. Display Leaf Nodes
4	Store the final marks of students for subject ADS using appropriate Data structure and perform following operations. 1. Print marks in ascending order 2. Print min and max marks 3. delete specified marks. (BST)
5	Construct Expression tree from given prefix expression.
6	Create a graph of popular places of your city use suitable algorithm to traverse all places with minimum cost.
7	Mr. A coming from abroad to meet his friends B, C, D, and E. Travelling distances between them represented in an adjacency matrix. Find the shortest distances required to visit each one from A.
8	Store the words of string with frequency and create OBST from it.
9	Implement linear probing with chaining concept in hashing.
10	Read the marks obtained by students of second year in an online examination of particular subject. Find out maximum and minimum marks obtained in that subject. Use heap data structure. Analyse the algorithm
	<b>Open Assignments</b>
1	In any language program mostly syntax error occurs due to unbalancing delimiter such as {}, [], (). Write C++ program using stack to check whether given expression is well parenthesized or not.
2	A Dictionary stores keywords & its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Binary Search Tree for implementation.
3	Tour operator organizes guided bus trips across the Maharashtra. Tourists may have different preferences. Tour operator offers a choice from many different routes. Every day the bus moves from starting city S to another city F as chosen by client. On this way, the tourists can see the sights alongside the route travelled from S to F. Client may have preference to choose route. There is a restriction on the routes that the tourists may choose from, the bus has to take a short route from S to F or a route having one distance unit longer than the minimal distance. Two routes from S to F are considered different if there is at least one road from a city A to a city B which is part of one route, but not of the other route.
4	A book consists of chapters, chapters consist of sections and sections consist of subsections. Construct a tree and print the nodes. Find the time and space requirements of your method.



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5	A Dictionary stores keywords & its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Height balance tree and find the complexity for finding a keyword
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**Course Code: CD21232 (Database Management System)**

Teaching Scheme	Examination Scheme
Credits: 4	Continuous Internal Evaluation (CIE): 20 Marks
Lectures: 3 Hrs/week	Skills & Competency Exam (SCE): 20 Marks
Practical: 2 Hrs/week	End Semester Examination (ESE): 40 Marks
	PR/OR: 20 Marks

<b>Prerequisites:</b>	
•	Fundamentals of programming
<b>Course Objectives:</b>	
1	To understand the fundamental concepts of database management
2	To provide a strong formal foundation in database concepts, technology
3	To give systematic database design approaches covering conceptual design and logical design
4	To learn basic issues of transaction management and concurrency control
5	To learn and understand various Database Architectures and Applications
6	To learn a powerful, flexible and scalable general-purpose database to handle big data
<b>Course Outcomes:</b>	
1.	Describe DBMS and RDBMS functionalities by recalling and reproducing knowledge.
2.	Apply DML/DDL queries and PL/SQL procedures and functions effectively through understanding and interpretation.
3.	Explain normalization concepts in RDBMS by applying acquired knowledge to new situations.
4.	Describe ACID properties to ensure transaction integrity by analyzing and synthesizing complex scenarios.
5.	Use database architecture for various applications by evaluating and generating solutions.
6.	Describe the concepts of Big Data and NoSQL databases by analyzing and synthesizing their principles and applications.

<b>Unit I</b>	<b>Introduction to DBMS</b>	<b>6 Hrs</b>
Overview of Database Management Systems, Advantages of DBMS over file-processing systems, Database system purpose, applications, and levels, Database languages and Data Models, Components of a DBMS, Database design and Entity-Relationship Model (ER Model), Design process and extended E-R features		
<b>Unit II</b>	<b>Relational Algebra, SQL and PL/SQL</b>	<b>6 Hrs</b>
Introduction to Relational Algebra and Calculus, SQL: Characteristics, advantages, and data types, SQL commands: DDL, DML, DCL, TCL, Tables, views, indexes, and constraints in SQL SQL DML queries, set operations, predicates, joins, Aggregate functions and nested queries, PL/SQL: Stored		

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procedures, functions, cursors, triggers, roles, and privileges		
<b>Unit III</b>	<b>Relational Database Design</b>	<b>6 Hrs</b>
Relational model: Attributes, domains, and CODD's Rules, Functional dependencies and normalization, Decomposition and Normalization: 1NF, 2NF, 3NF, BCNF		
<b>Unit IV</b>	<b>Database Transactions and Query Processing</b>	<b>6 Hrs</b>
Basic concepts of transactions and transaction management, Properties of transactions and serializability, Concurrency control: Locking methods, deadlocks, timestamping Crash recovery methods: Shadow-Paging, Log-Based Recovery, Query processing, optimization, and performance tuning		
<b>Unit V</b>	<b>Database architecture</b>	<b>6 Hrs</b>
Multi-user DBMS architectures and parallel databases, Architectures of parallel and distributed databases, Distributed database design and transaction management, Concurrency control in distributed databases		
<b>Unit VI</b>	<b>Advances in Databases and Big Data</b>	<b>6 Hrs</b>
Introduction to Big Data: 3 V's of Big Data, Solution for Big Data Introduction to NoSQL databases, NoSQL data models and MongoDB, CAP theorem, BASE properties, and comparative study of SQL and NoSQL, Introduction to Apache Spark: Advantages of Apache Spark, Resilient Distributed Dataset		
<b>Text Books:</b>		
	1	Abraham Silberschatz, Henry Korth, S.Sudarshan," Database System concepts",5th Edition, McGraw Hill International Edition.
	2	Elmasri R., Navathe S.," Fundamentals of Database Systems", 4*Edition, Pearson Education,2003, ISBN 8129702282.
	3	Pramod J. Sadalage and Martin Fowler, —NoSQL Distilled, Addison Wesley,ISBN10:0321826620,ISBN-13: 978-0321826626
	4	"Managing and Using MySQL", Reese G., Yarger R., King T., Williams H, 2nd Edition, Shroff Publishers and Distributors Pvt.Ltd.,ISBN81 -7366 - 465–X
	5	Mongo DB: The Definitive Guide by Kristina Chodorow
<b>Reference Books:</b>		
	1	Ramkrishna R.,Gehrke J., "Database Management Systems", 3rd Edition, McGraw-Hill, 2003, ISBN 0-07-123151 –X.
	2	CJDate, —An Introduction to Database Systems, Addison-Wesley, ISBN:0201144719.
	3	Connally T., BeggC., "Database Systems", 3rd Edition, Pearson Education, 2002, ISBN81-7808-861-4
<b>Web Links:</b>		
	1	<a href="https://dev.mysql.com/doc/">https://dev.mysql.com/doc/</a>

**List of Assignments:**

1	Design and Develop at least 10 SQL queries for DDL statements which demonstrate the use of SQL Table
2	Design at least 10 SQL queries for suitable database application using SQL DML statements: Insert, Select, Update, delete with operators, functions, Set operators, Clauses
3	Design at least 10 SQL queries for suitable database application using SQL DML statements: all types of Joins, Sub-Query and View
4	Write a PL/SQL code to implement all types of cursors (Implicit, Explicit) and display employee number, name and salary of 5 highest paid employees using cursor. Employee (employee_no, employee_name, join_date, designation, salary)

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5	PL/SQL Stored Procedure and Stored Function: Write a PL/SQL procedure to find the number of students ranging from 100-80%, 79-70% ,69-60%, 59-50 & below 49% in each course from the Student_course table given by the procedure as parameter. Student_course (Roll_no, Course, Couse_code, Semester, Total_ Marks, Percentage)
6	Database Trigger(Row level and Statement level triggers, Before and After Triggers): Write a database trigger on Employee table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted records should be added in to a new table when the Employee table is updated. Employee (employeenno, employeename, join_date, designation, salary).
7	Design and Develop Mongo DB Queries using CRUD operations
8	Implement aggregation and indexing with suitable example using Mongo DB
9	Implement MYSQL database connectivity with PHP for Database navigation operations such as insert, delete, and update etc.
10	Develop a web-based inventory management system for a retail store using PHP and MySQL. Ensure smooth database connectivity to facilitate operations such as adding, updating, and deleting products.

**Course: CD21233 (Software Engineering Project Management)**

Teaching Scheme	Examination Scheme
Credits: 3	Continuous Internal Evaluation (CIE): 20 Marks
sLectures: 3 Hrs/week	Skills & Competency Exam (SCE): 20 Marks
Practical: 2 Hrs/week	End Semester Examination (ESE): 40 Marks
	PR/OR: 20 Marks

<b>Prerequisites:</b>	
•	NA
<b>Course Objectives:</b>	
•	To learn and understand the principles of Software Engineering □
•	To know methods of capturing, specifying, visualizing and analyzing software requirements □
•	To understand the design process, model and architectural design □
•	To understand how to manage projects and manage the risks involved □
•	To learn to estimate cost and schedule of a software project
•	To provide exposure to modern tools used for Software Project Management.
<b>Course Outcomes:</b>	
	After completion of the course, student will be able to
1.	Select a proper process model for a software project development
2.	Prepare Software Requirements Specification (SRS) of a system
3.	Illustrate Agile design Principles
4.	Create project plan and RMMM plan
5.	Estimate cost and schedule of the software project



6.	Discuss and use modern tools for Software Project Management.
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Unit I:	Introduction to Software Engineering	
Nature of Software, Software Process, Software Engineering Practice, software Myths, Generic Process model, Process Models: Waterfall Model, Incremental Models, Evolutionary Models, Concurrent Process Model, Agile Process Model		
Unit – II	Requirements Engineering	
Requirements Engineering, Initiating the process, Eliciting Requirements, Building the Requirements Model, Negotiating, validating requirements, Scenario-Based requirement modelling, Class based requirement modelling, Software Requirement specification (SRS) writing.		
Unit – III	Design Engineering	
Design Process, Design Concepts, The Design Model: Data Design, Architectural, interface Design Elements. Agile Design: An Introduction to Agile Design, Phases and Life cycle of Agile, Agile design principles, Agile design methodology: benefits and conditions. Introduction to Scrum, Extreme Programming, JIRA.		
Unit – IV	Project Management Framework	
Overview of project Management, Project Organization, Planning a s/w project, Project management life cycle, Risk management, Identification of Risks, Risk Analysis, Risk Planning & Monitoring		
Unit – V	S/w Project Estimation and Scheduling	
Project Estimation, Different methods of estimation (COCOMO model, Delphi cost estimation etc.) , Function point analysis, PERT & Gantt Charts , Introduction to Microsoft Project, CM planning, Change Management , Version and Release Management, Configuration Management Tools		
Unit – VI	Applications of Software Project Management in Industry	
<b>Agile Project Management with Azure DevOps:</b> An Overview of Application Lifecycle Management & Azure DevOps, Traceability, Visibility, Collaboration, and Extensibility. Difference between Microsoft TFS and Azure DevOps.		
<b>Metrics in Agile Practice:</b> Introduction to Metrics in Agile Practice, Metrics for Project Management, Agile Project Management in Azure DevOps and TFS.		
<b>Text Books:</b>		
	1	Roger Pressman, “Software Engineering: A Practitioner’s Approach”, McGraw Hill 2.
	2	Ian Sommerville, “Software Engineering”, Addison and Wesley
	3	A Guide to the Project Management Book of Knowledge-Seventh Edition.
	4	“Software Project Management” a unified approach. Addison Wesley ISBN 0-201309580.
<b>Reference Books:</b>		
	1	Rajib Mall, “Fundamentals of Software Engineering, Prentice Hall India
	2	Pankaj Jalote, “An Integrated Approach to Software Engineering, Springer
	3	Carlo Ghezzi, ""Fundamentals of Software Engineering", Prentice Hall India
	4	Software Project management Edwin Bennatan
	5	Software Engineering concepts Richard Fairley
	6	Software Project Management S.A. Kelkar
	7	System Analysis and Design Methods Whitten, Bentley and Dittman

**Online Resources:**

	1	<a href="https://onlinecourses.nptel.ac.in/noc19_cs70/preview">https://onlinecourses.nptel.ac.in/noc19_cs70/preview</a>
	2	<a href="https://www.coursera.org/learn/introduction-to-software-engineering">https://www.coursera.org/learn/introduction-to-software-engineering</a>
	3	<a href="https://www.coursera.org/learn/introduction-to-software-engineering">https://www.coursera.org/learn/introduction-to-software-engineering</a>

**List of Assignments:**

1	Write a Software Requirement Specification (SRS) document for a project scenario "Online Bookstore Management System" following IEEE standard guidelines
2	Assign each group a specific design concept (e.g., data design, architectural design, interface design) for a specific problem statement/ project Scenario
3	Create a project plan using Gantt chart, identifying tasks, dependencies, and milestones using any project scenario
4	Demonstrate the COCOMO model, Delphi cost estimation, and function point analysis using real-world examples or case studies.
5	Develop an Online Shopping System Using Jira Software
6	Apply Agile project management principles using Azure DevOps by planning, tracking, and releasing a software project in an iterative and collaborative manner.

**Course Code: MDM20234 (Probability and Statistics)**

Teaching Scheme	Examination Scheme
<b>Credits: 2</b>	Continuous Internal Evaluation (CIE): 20 Marks
<b>Lectures: 2 Hrs/week</b>	Skills & Competency Exam (SCE): 20 Marks
	End Semester Examination (ESE): 40 Marks
	Home Work: 20 Marks

**Prerequisites:**

Expected to know the following concepts:  
Basics of Derivatives, Integration, Trigonometry, Vector algebra and complex number, Introduction of Statistics and Probabilities.

**Course Objectives:**

<input type="checkbox"/>	To give an exposure to the students the basic concepts of Probability and Statistical methods and their application.
<input type="checkbox"/>	To serve as a foundation to analyses problems in Science and Engineering applications through Statistical testing Method.
<input type="checkbox"/>	To introduce computing with Python

**Course Outcomes:**

After completion of the course, student will be able to

1.	Solve basic problems arising in engineering that involve discrete and continuous probability distributions.
2.	Learn descriptive statistics techniques for summarizing and visualizing data.

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3. Perform Hypothesis testing with theory of estimation

4. Develop regression model for data forecasting

**Unit I: Probability Distribution**

Discrete Distribution: Binomial, Poisson, Geometric distribution Continuous Distribution: Normal, standard normal, uniform, exponential distribution

**Unit II: Sampling Theory**

Population and Sample, Statistical inference, Sampling with and without replacement, Random samples, Population parameters, Sample statistics, Sampling distributions, Sample mean, Sampling distribution of means, Sample variances, Sampling distribution of variances, Case where population variances is unknown, Unbiased estimates and efficient estimates, point estimate and Interval Estimates, Confidence Interval estimates of population parameters, Confidence intervals for variance of a Normal distribution, Maximum likelihood estimates

**Unit III: Tests of Hypothesis and Significance**

Statistical hypothesis, Null and Alternate hypothesis, test of hypothesis and significance, Type I and Type II errors, Level of Significance, Tests involving the Normal distribution, One-Tailed and Two-Tailed tests, P value. Special tests of significance for large samples and small samples (F, chi-square, z, t- test), ANOV

**Unit IV: Correlation and Regression**

Correlation, Rank correlation, Regression Analysis, Linear and Non-linear Regression, Multiple regression, Curve fitting by method of least squares, fitting of straight lines, polynomials, exponential curves. Non parametric statistic test: Signed rank test, Wilcoxon Rank-sum tests

**Textbooks:**

A Modern Introduction to Probability and Statistics: Understanding Why and How: F.M. Dekking C. Kraaikamp, H.P. Lopuhaa L.E. Meester (Springer)

Probability And Statistics for Computer Scientists (Second Edition): Michael Baron (CRC Press)

**Reference Books:**

Probability & Statistics for Engineers & Scientists: Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers Keying Ye: Prentice Hall 2 Probability and Statistics for Data Science, Math + R + Data: Norman Matloff (CRC Press, Taylor and Francis group)





**Course Code: EEM21236 (DESIGN THINKING)**

Teaching Scheme	Examination Scheme
<b>Credits: 2</b>	Continuous Internal Evaluation (CIE): -
<b>Lectures: 1 Hrs/week</b>	Skills & Competency Exam (SCE): -
<b>Tut: 1 Hours/Week</b>	End Semester Examination (ESE): -
	PR/OR/TW: 50

<b>Prerequisites:</b>	Nil

**Course Objectives:**

- ☐ To learn design thinking concepts and principles.
- ☐ To learn the different phases of design thinking.

**Course Outcomes:**

After completion of the course, student will be able to

1. CO1: Understand(identify) the fundamentals of Design Thinking concepts, process and Principles.
2. CO2: Identify the methods to empathize and define the problem.
3. CO3: Apply the ideation techniques for problem solving.
4. CO4: Construct the prototype to evaluate a design

**Unit I: Introduction**

Introduction to Design Thinking, Design Thinking as a problem-solving tool, Principles of Design Thinking, Process of Design Thinking, Tools and techniques for Design Thinking process, Planning a Design Thinking project.

#Exemplar/Case Studies: Design Thinking to enhance urban redevelopment

\*Mapping of Course Outcomes for Unit 1: CO1

**Unit II: Empathize and define**

Search field determination, Problem clarification, understanding of the problem, Problem analysis, Reformulation of the problem, Observation Phase, Empathetic design, Tips for observing, Methods for Empathetic Design, Artifact Analysis, Behavioral Mapping and Tracking, Empathy Map,

#Exemplar/Case Studies: IBM: Design Thinking

\*Mapping of Course Outcomes for Unit II: CO2

**Unit III: Idea Generation**

Mastering the creative process, opening up sources of new ideas, Understanding the creative principles, factors for increasing creativity, Mind mapping, Generating ideas by brainstorming, Different brainstorming variation, Evaluation of ideas & Storytelling.

#Exemplar/Case Studies: IBM: Philips: Improving Patient experience

\*Mapping of Course Outcomes for Unit II: CO3

**Unit IV: Prototype**



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Prototype Phase - Lean Startup Method for Prototype Development, Visualization and presentation techniques, Ideas to presentable concepts, Storyboards, Developing mock-ups, models and prototypes,

#Exemplar/Case Studies: IBM: Developing Environmentally sustainable strategy

\*Mapping of Course Outcomes for Unit II: CO4

**Textbooks:**

**Text Books:**

1." Design Thinking" , Gavin Ambrose, Paul Harris, AVA Publishing

2."Handbook of Design Thinking - Tips & Tools for how to design thinking", Christian Mueller-Rotenberg.

3."Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation" by TimBrown

Probability And Statistics for Computer Scientists (Second Edition): Michael Baron (CRC Press)

**Reference Books:**

1."Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", IdrisMootee, Wiley.

2."Designing for Growth: a design thinking tool kit for managers", Jeanne Liedtka and Tim Ogilvie

Bryan Lawson, "How designers think: The design process demystified", 2 nd Edition, Butterworth Architecture

**Practice Tasks for Tutorial**

1. Choose a specific problem or challenge relevant to the students' interests or curriculum. (Apply design thinking principles and techniques to effectively solve a real-world problem or challenge, fostering creativity, empathy, and critical thinking skills.)
2. For a problem statement conduct user research. (Conduct interviews, surveys, or observations to gather insights about the problem from different perspectives.)
3. Use DT Techniques (Empathy map) to identify Top 3 problems of the problem selected. (Provide a brief overview of what design thinking is and why it's valuable in problem-solving)
4. Do ideation using any one or 2 techniques. (Identify specific user needs and pain points.)
5. Present prototype of the selected problem statement. (Prototypes can be physical models, sketches, wireframes, or digital prototypes depending on the nature of the problem.)



**Course Code: VEC21237 (UNIVERSAL HUMAN VALUES)**

Teaching Scheme	Examination Scheme
<b>Credits: 2</b>	Continuous Internal Evaluation (CIE): -
<b>Lectures: 2 Hrs/week</b>	Skills & Competency Exam (SCE): -
	End Semester Examination (ESE): -
	PR/OR/TW: 50

<b>Prerequisites:</b>	Desirable - Universal Human Values 1 (Student Induction)

**Course Objectives:**

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

**Course Outcomes:**

After completion of the course, student will be able to

1.	CO1: Recognize the significance of human values and advocate a value-based approach to problem-solving
2.	CO2: Commit to lead a life of responsibility by becoming aware of their individual reality
3.	CO3: Apply understanding of human-human relationship in family and society to behave ethically and professionally
4.	CO4: Demonstrate awareness and sensitivity towards nature/existence leading to ethical and sustainable solution to engineering problem

**Unit I: Introduction to Value Education and Understanding the Human**

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education. Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations. Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self.

**Sample Practice Tasks -**

1. Sharing about Oneself
2. Exploring Human Consciousness
3. Exploring Natural Acceptance
4. Exploring the difference of Needs of Self and Body

**Unit II: Harmony in the Human Being, Family and Society**



**Department of Computer Science and Engineering (Data Science)**

Understanding Harmony in the Self, Harmony of the Self with the Body, Programmed to ensure self-regulation and Health. Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship. 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship  
Understanding Harmony in the Society, Vision for the Universal Human Order.

**Sample Practice Tasks -**

5. Exploring Sources of Imagination in the Self
6. Exploring Harmony of Self with the Body
7. Exploring the Feeling of Trust
8. Exploring the Feeling of Respect

**Unit III: Harmony in Nature/Existence and a Look at Professional Ethics**

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature

Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct

A Basis for Humanistic Education, Humanistic Constitution and Universal

Human Order, Competence in Professional Ethics

**Sample Practice Tasks -**

9. Exploring Systems to fulfill Human Goal
10. Exploring the Four Orders of Nature
11. Exploring Co-existence in Existence
12. Exploring Ethical Human Conduct

**Textbooks:**

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1
2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, G P Bagaria, 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53

**Reference Books:**

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

Common Graduate Attributes (GAs) being impacted -

1. Holistic vision of life
2. Socially responsible behaviour
3. Environmentally responsible work



4. Ethical human conduct
5. Having Competence and Capabilities for Maintaining Health and Hygiene
6. Appreciation and aspiration for excellence (merit) and gratitude for all