Pimpri Chinchwad Education Trust's

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

(An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune)

Curriculum Structure and Syllabus
of
Second Year B. Tech. Computer Engineering
(Regulations 2023)



Effective from Academic Year 2026-27

(Updated with minor changes)

Institute Vision

To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers.

Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education.
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with an ability to think and act independently in demanding situations.

EOMS Policy

"We at PCCOE are committed to offer exemplarily Ethical, Sustainable and Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders.

We shall strive for technical development of students by creating globally competent and sensible engineers, researchers, and entrepreneurs through Quality Education.

We are committed for Institute's social responsibilities and managing Intellectual property.

We shall achieve this by establishing and strengthening state-of-the-art Engineering Institute through continual improvement in effective implementation of Educational Organizations Management Systems (EOMS)."

Course Approval Summary

Board of Studies - Department of Computer Engineering

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1.	Data Structure and Algorithm	BCE23PC05	11	Chairman BoS, Computer Engineering PCET's Pimpri Chinchwad College of Engineering Sector No. 26, Pradhikaran, Nigdi, Pune-44
2.	Microprocessor Architecture	BCE23PC06	15	
3.	Android App Development with Kotlin	BCE23OE03	46	
4.	Data Exploration and Visualization Laboratory	BCE23VS03	48	
5.	Design Thinking	BCE23EM01	50	
6.	Design and Analysis of Algorithm	BCE24PC07	56	
7.	Database Management System	BCE24PC08	59	
8.	Community Engagement Project (CEP) Field Project (FP)	BCE24EL01	72	
9.	Management Information System	BCE24EM01	74	

Board of Studies – Applied Science and Humanities

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1	Statistical Data Analysis using R	BSH23OE04	18	Chairman BoS, Applied Sciences & Humanities PCET's Pimpri Chinchwad College of Engineering Sector No. 26, Pradhikaran, Nigdi, Pune-44
2	Advanced Materials and Characterizations	BSH23OE05	20	
3	Neural Network and Fuzzy Logic Control	BSH23OE06	33	
4	Universal Human Values	BSH23VE01	52	
5	Applied Mathematics (Suggested for Mechanical branch)	BSH23OE01	62	
6	Computational Techniques (Suggested for E&TC branch)	BSH23OE02	64	
7	Applied Mathematics (Suggested for Civil branch)	BSH23OE03	66	
8	Computational Techniques (Suggested for Computer and IT branches)	BSH24OE07	68	
9	Mathematical Optimization (Suggested for CSE -AIML branch)	BSH24OE08	70	
10	Professional Development Training	BSH24AE05	76	
11	Constitution of India	BSH24VE02	78	

Board of Studies – Civil Engineering

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1	E-Waste Management	BCI23OE01	31	Chairman BoS, Civil Engineering PCET's, Pimpri Chinchwad College of Engineering Sector No. 26, Pradhikaran, Nigdi, Pune-44
2	Total Quality Management	BCI23OE02	44	
3	Building Services and Maintenance	BCI23OE03	45	

Board of Studies – Electronics & Telecommunication

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1	Electrical Machines	BET23OE01	22	Chairman BoS, Electronics & Telecommunication Engineering PCET's, Pimpri Chinchwad College of Engineering Sector No. 26, Pradhikaran, Nigdi, Pune-44
2	Introduction to Signals and Systems	BET23OE02	24	
3	Biology for Engineers	BET23OE03	35	
4	Human Behavior, Ethics & Wisdom	BET23OE04	37	

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Board of Studies – Mechanical Engineering

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1	Material Science	BME23OE01	26	Chairman BoS, Mechanical Engineering PCET's, Pimpri Chinchwad College of Engineering Sector No. 26, Pradhikaran, Nigdi, Pune-44
2	Drawing for Engineers	BME23OE02	27	
3	Fundamentals of Mechanical Components and Systems	BME23OE03	29	
4	Industry 4.0	BME23OE04	41	
5	Energy Storage Management	BME23OE05	42	

Board of Studies – Computer Science and Engineering (AIML)

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1	AI for Financial Modelling	BCS23OE01	39	

Chairman, Board of Studies
Computer Science & Engineering (AI & ML)
PCET's Pimpri Chinchwad College of Engineering
Sector 26, Pradhikaran, Nigdi, Pune - 411044.

Approved by Academic Council:

Chairman
Academic Council
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

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CURRICULUM FRAMEWORK
(Academic Regulations 2023)

LIST OF ABBREVIATIONS

Sr. No.	Abbreviation	Type of Course
1	BSC	Basic Science Course
2	ESC	Engineering Science Course
3	PCC	Programme Core Course
4	PEC	Programme Elective Course
5	MDM	Multidisciplinary Minor
6	OEC	Open Elective Course
7	VSEC	Vocational and Skill Enhancement Course
8	AEC	Ability Enhancement Course
9	EEM	Entrepreneurship/Economics/Management Course
10	IKS	Indian Knowledge System
11	VEC	Value Education Course
12	ELC	Experiential Learning Courses
13	LLC	Liberal Learning Courses

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COURSE WISE CREDIT DISTRIBUTION

Sr. No.	Type of Course	No. of Courses	Total Credits	
			No.	%
1	Basic Science Course (BSC)	8	14	9
2	Engineering Core Course (ECC)	5	12	8
3	Programme Core Course (PCC)	15	46	29
4	Programme Elective Course (PEC)	6	20	13
5	Multidisciplinary Minor (MDM)	6	14	9
6	Open Elective Course (OEC)	3	6	4
7	Vocational and Skill Enhancement Course (VSEC)	4	8	5
8	Ability Enhancement Course (AEC)	2	4	3
9	Entrepreneurship/ Economics/ Management Course (HSSM)	2	4	3
10	Indian Knowledge System (IKS)	1	2	1
11	Value Education Course (VEC)	2	4	3
12	Experiential Learning Courses	4	22	14
13	Liberal Learning Courses	2	4	3
	Total	**60**	**160**	**100**

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SEMESTER-WISE COURSE DISTRIBUTION

Course Distribution: Semester Wise										
Sr. No.	Type of Course	No. of Courses / Semester								Total
		1	2	3	4	5	6	7	8	
1.	Basic Science Course (BSC)	4	4	-	-	-	-	-	-	8
2.	Engineering Core Course (ECC)	3	2	-	-	-	-	-	-	5
3.	Programme Core Course (PCC)	-	1	2	2	5	3	2	-	15
4.	Programme Elective Course (PEC)	-	-	-	-	1	2	1	2	6
5.	Multidisciplinary Minor (MDM)	-	-	1	1	2	1	1	-	6
6.	Open Elective Course (OEC)	-	-	2	1	-	-	-	-	3
7.	Vocational and Skill Enhancement Course (VSEC)	1	1	-	1	-	1	-	-	4
8.	Ability Enhancement Course (AEC)	1	-	-	1	-	-	-	-	2
9.	Entrepreneurship/ Economics/ Management Course (HSSM)	-	-	1	1	-	-	-	-	2
10.	Indian Knowledge System (IKS)	-	1	-	-	-	-	-	-	1
11.	Value Education Course (VEC)	-	-	1	1	-	-	-	-	2
12.	Experiential Learning Courses	-	-	1	-	-	-	1	2	5
13.	Liberal Learning Courses	2	2	-	-	-	-	-	-	4
Total		11	1	8	8	8	7	5	4	61

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SEMESTER-WISE CREDIT DISTRIBUTION

Credit Distribution: Semester Wise										
Sr. No.	Type of Course	No. of Credits / Semester								Total
		1	2	3	4	5	6	7	8	
1.	Basic Science Course (BSC)	7	7	-	-	-	-	-	-	**14**
2.	Engineering Core Course (ECC)	7	5	-	-	-	-	-	-	**12**
3.	Programme Core Course (PCC)	-	2	8	8	12	8	8	-	**46**
4.	Programme Elective Course (PEC)	-	-	-	-	4	8	4	4	**20**
5.	Multidisciplinary Minor (MDM)	-	-	2	2	4	2	4	-	**14**
6.	Open Elective Course (OEC)	-	-	4	2	-	-	-	-	**6**
7.	Vocational and Skill Enhancement Course (VSEC)	2	2	2	-	-	2	-	-	**8**
8.	Ability Enhancement Course (AEC)	2	-	-	2	-	-	-	-	**4**
9.	Entrepreneurship/ Economics/ Management Course (HSSM)	-	-	2	2	-	-	-	-	**4**
10.	Indian Knowledge System (IKS)	-	2	-	-	-	-	-	-	**2**
11.	Value Education Course (VEC)	-	-	2	2	-	-	-	-	**4**
12.	Experiential Learning Courses	-	-	-	2	-	-	4	16	**22**
13.	Liberal Learning Courses	2	2	-	-	-	-	-	-	**4**
Total		**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**160**

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Curriculum Structure
Second Year B. Tech.
Computer Engineering

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CURRICULUM STRUCTURE

Second Year B.Tech. (Computer Engineering) Semester – III

Second Year B.Tech Computer Engineering (Regulations 2023) (With effect from Academic Year 2026-27)															
Semester III															
Course Code	Course Name	Credit Scheme				Teaching Scheme (Hours/Week)			Evaluation Scheme and Marks						
		L	P	T	Total	L	P	T	FA		SA	TW	PR	OR	Total
									FA1	FA2					
BCE23PC05	Data Structures and Algorithms	5		-	5	3	4	-	20	20	60	50	50	-	200
BCE23PC06	Microprocessor Architecture	3		-	3	2	2	-	10	10	30	25	-	25	100
-	OE -Engineering Sciences	2	-	-	2	2	-	-	10	10	30	-	-	-	50
-	OE - Department Specific Open Elective	2	-	-	2	2	-	-	10	10	30	-	-	-	50
-	Multidisciplinary Minor 1#	2	-	-	2	2	-	-	10	10	30	-	-	-	50
BCE23VS03	Data Exploration and Visualization Laboratory	-	2	-	2	-	4	-	-	-	-	50	50	-	100
BCE23EM01	Design Thinking	1	-	1	2	1	-	1	25	25	-	-	-	-	50
BSH23VE01	Universal Human Values	2	-	-	2	2	-	-	25	25	-		-	-	50
Total		**14**	**5**	**1**	**20**	**14**	**10**	**1**	**110**	**110**	**180**	**125**	**100**	**25**	**650**

#Refer separate booklet for Multidisciplinary Minor (MDM Courses)

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L-Lecture, **P**-Practical, **T**-Tutorial, **FA**–Formative Assessment, **SA** – Summative Assessment, **TW**-Term Work, **OR**-Oral, PR-Practical

Note: - Exit Policy: Available as a separate document

List of Courses – Open Elective Engineering Sciences

Course Code	Department	Course Name	
BSH23OE04	AS&H	Statistical Data Analysis using R	Choose any one
BSH23OE05	AS&H	Advanced Materials and Characterizations	
BET23OE01	E&TC	Electrical Machines	
BET23OE02	E&TC	Introduction to Signals and Systems	
BME23OE01	MECH	Material Science	
BME23OE02	MECH	Drawing for Engineers	
BME23OE03	MECH	Fundamentals of Mechanical Components and Systems	
BCI23OE01	CIVIL	E-Waste Management	

List of Courses – Open Elective Department Specific

Course Code	Department	Course Name	
BSH23OE06	AS&H	Neural Network and Fuzzy Logic Control	Choose any one
BET23OE03	E&TC	Biology for Engineers	
BET23OE04	E&TC	Human Behavior, Ethics & Wisdom	
BCS23OE01	CSE(AI&ML)	AI for Financial Modelling	
BME23OE04	MECH	Industry 4.0	
BME23OE05	MECH	Energy Storage Management	
BCI23OE02	CIVIL	Total Quality Management	
BCI23OE03	CIVIL	Building Services and Maintenance	

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Second Year B.Tech. (Computer Engineering) Semester – IV

Second Year B.Tech Computer Engineering (Regulations 2023) (With effect from Academic Year 2026-27)															
Semester IV															
Course Code	Course Name	Credit Scheme				Teaching Scheme (Hours/Week)			Evaluation Scheme and Marks						
		L	P	T	Total	L	P	T	FA		SA	TW	PR	OR	Total
									FA1	FA2					
BCE24PC07	Design and Analysis of Algorithms	3		-	3	2	2	-	10	10	30	25	25	-	100
BCE24PC08	Database Management System	5		-	5	3	4	-	20	20	60	50	50	-	200
-	OE – Applied Mathematics	2	-	-	2	2	-	-	10	10	30	-	-	-	50
-	Multidisciplinary Minor 2#	2	-	-	2	2	-	-	10	10	30	-	-	-	50
BCE24EL01	Community Engagement Project (CEP) Field Project (FP)	-	2	-	2	-	4	-	-	-	-	100	-	-	100
BCE24EM01	Management Information System	2	-	-	2	2	-	-	10	10	30	-	-	-	50
BSH24AE05	Professional Development Training *	-	2	-	2	-	4	-	-	-	-	100	-	-	100
BSH24VE02	Constitution of India	2	-	-	2	2	-	-	25	25	-		-	-	50
Total		13	7	-	20	13	14	-	85	85	180	275	75	-	700

#Refer separate booklet for Multidisciplinary Minor (MDM Courses)

L-Lecture, **P**-Practical, **T**-Tutorial, **FA**–Formative Assessment, **SA** – Summative Assessment, **TW**-Term Work, **OR**-Oral, PR-Practical

Note: - Exit Policy: Available as a separate document

List of Courses – Open Elective: Applied Mathematics

Course Code	Department	Course Name	
BSH23OE01	AS&H	Applied Mathematics (Suggested for Mechanical branch)	Choose any one
BSH23OE02		Computational Techniques (Suggested for E&TC branch)	
BSH23OE03		Applied Mathematics (Suggested for Civil branch)	
BSH24OE07		Computational Techniques (Suggested for Computer and IT branches)	
BSH24OE08		Mathematical Optimization (Suggested for CSE -AIML branch)	

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Course Syllabus
Semester III

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Program:	SY B. Tech. (Computer Engineering)	Semester: III
Course:	Data Structure and Algorithm	Code: BCE23PC05

Credit			Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks					
			Lecture	Practical	Tutorial	FA		SA	TW	OR	PR	Total
L	P	T				FA1	FA2					
5		-	3	4	-	20	20	60	50	-	50	200

Prior knowledge of

Decision control structures, loop control structures, arrays, Functions, pointers, structure and union, searching and sorting techniques

is essential

Course Objectives:

This course aims at enabling students:

1. To gain knowledge about different types of Linked Lists
2. To elaborate the concepts of Stack and queue with respect to problem solving
3. To develop the knowledge for the application of trees and graphs in real-world scenarios.

Course Outcomes:

After learning the course, the students will be able to:

1. Illustrate the concepts, representation, and applications of data structures.
2. Implement operations on fundamental data structures.
3. Construct efficient solutions for real-world applications using given data structures
4. Select appropriate data structures based on efficiency requirements for problem solving

Guidelines for Laboratory/Term Work Assessment:

1. Soft Copy of Program codes with sample output of all performed assignments should be submitted online.
2. Continuous assessment of laboratory work is to be done based on overall performance and Laboratory performance of students.
3. Suggested parameters for overall assessment include timely completion, performance, innovation, efficiency, punctuality.
4. Each Laboratory assignment will be assessed based on parameters with appropriate weightage.

Guidelines for Laboratory Conduction

1. All assignments are mandatory.
2. Student should be encouraged for appropriate use of Hungarian notation, proper indentation, and comments.
3. Use of open-source software is to be encouraged.
4. Operating System recommended: - 64-bit Open-source Linux or its derivative.
5. Programming tools recommended: - G++/GCC, Eclipse.
6. Debugging of existing code is to be encouraged
7. Facilitate instruction on GitHub and GitBash by faculty prior to commencement of lab assignments.
8. Best Practices: Leetcode, Hacker Rank and other similar platforms.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Linked List:** Basics of Linked List, Comparison of sequential and linked organizations, Types of linked list: Singly linked list, Circular linked list; Various operations (insertion, deletion, searching, updating and printing) for linked list	9

	manipulation; Application of linked list: Polynomial, Music/Playlist Management **Self Study:** Doubly linked list, Sparse Matrix representation	
II	**Stacks** Stack as a ADT, Implementations using arrays and dynamic memory allocation, operations on stack, applications of stack: expression conversion and evaluation; converting recursion into iteration **Self Study:** Parentheses checking, Tower of Hanoi	9
III	**Queue** Queue as a ADT, implementation using array and dynamic memory allocation, operations on queue, types of queues: linear queue, circular queue, applications of queue: job scheduling, simulation of real-life waiting lines **Self Study:** Josephus problem, double ended queue	9
IV	**Tree:** Introduction to tree data structure, basic tree terminologies, representation using array and linked list, **Binary Tree:** Properties, operations, traversals: recursive and nonrecursive construction of binary tree from traversals; **Binary Search tree (BST) as an ADT:** Operations: Insertion, deletion and search **Threaded Binary tree (TBT):** Creation and traversals on TBT. **Self Study:** Max Heap and Min Heap	9
V	**Graph** Basic concept, graph representation: adjacency list and adjacency matrix; Graph traversals: depth first search and breadth first search; Minimum Spanning Tree: Prim's and Kruskal's algorithms, Topological Sort, Dijkstra's Shortest Path Algorithm. **Self Study:** Single-source shortest path: Bellman–Ford algorithm (negative weights), All-pairs shortest path: Floyd–Warshall	9
	Total	45

Suggested Lab Assignments

1. Consider the playlist in a music player. Implement a playlist feature in music player application using singly linked list. Each song in the playlist is represented as a node in the linked list. Each node contains information about the song (such as title or artist or duration, etc.).
   The playlist should allow users to:
   a. Add songs
   b. Remove songs
   c. Display the entire playlist
   d. Play specific songs

2. Implement a simple text editor application using a doubly linked list to manage the text buffer. Text editor should support the following functionalities:
   a. Insert text
   b. Delete text
   c. Display text
   d. Search text
   e. Print text in reverse

3. Implement a browser history management system using a stack data structure to track the user's browsing history. The system should support the following functionalities:
   a. Add visited page
   b. Navigate back

c. View current page
d. Check if history is empty or not
Assume no upper bound on number of pages visited

4. Write a program to convert infix expression to postfix, infix expression to prefix and evaluation of postfix and prefix expression.

5. Implement a restaurant waitlist system using the queue data structure. Restaurant waitlist provide following facility:
   a. Add Party to Waitlist
   b. Seat Party
   c. Display Waitlist

6. Implement a checkout system for a supermarket to efficiently manage customer queues during peak hours. The system should support the following operations using a circular queue data structure:
   a. Customer arrival
   b. Customer checkout
   c. Close Checkout Counter
   d. View customer

7. Consider the Dictionary Implementations which allow for efficient storage and retrieval of key-value pairs using binary search trees. Each node in the tree store (key, value) pair. The dictionary should support the following operations efficiently:
   a. Insert word (Handle insertion of duplicate entry)
   b. Delete word
   c. Search specific word
   d. Display dictionary (Traversal)
   e. Mirror image of dictionary
   f. Create a copy of dictionary
   g. Display dictionary level wise

8. Design and implement a Library Book Index System using a Threaded Binary Search Tree (TBT) to efficiently store and manage book information. Each node of the TBST maintains a *(Book ID, Book Title)* pair. The threading must support fast inorder traversal without recursion or stack usage.

9. Consider the scenario of a maze. The maze is represented as a grid of cells, where each cell can be either open or blocked. Each cell in the maze represents a vertex. The goal is to find a path from the starting point to the goal within a given maze using DFS and BFS.

10. Represent a graph of your college campus using adjacency list /adjacency matrix. Nodes should represent the various departments and links should represent the distance between them. Find a minimum spanning tree using Kruskal's algorithm or using Prim's algorithm.

11. Consider the scenario of the supply chain management system. The supply chain involves multiple locations, such as suppliers, warehouses, distribution centers, and retail stores, connected by transportation networks. Find the shortest possible route using Dijkstra's algorithm to optimize transportation path and inventory management

Text Books:

1. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structures in C++", University Press(India) Pvt. Ltd., 2nd Edition, 2008, ISBN-10: 8173716064/ ISBN-13:978-8173716065.
2. Varsha H. Patil, "Data Structures using C++", Oxford University Press, 1st Edition, 2012, ISBN-10: 0-19-806623-6/ ISBN-13: 978-0-19-806623-1.

Reference Books:

1. Y. Langsam, M. Augenstin and, A. Tannenbaum. "Data Structures using C & C++," Pearson Education India, Second Edition,2015, ISBN 10: 9332549311, ISBN 13: 978-9332549319.
2. Richard F. Gilberg; Behrouz A. Forouzan. "Data Structures. Pseudo code Approach with C," Cengage Learning India Edition, 2nd Edition, 2007. ISBN 10: 8131503143 ISBN 13: 9788131503140.

Online Sources:

1. http://nsm.iitm.ac.in/cse/services/pds/
2. https://nptel.ac.in/courses/106102064
3. https://www.w3schools.com/dsa/dsa_intro.php

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Program:			B. Tech. (Computer Engineering)						Semester: III				
Course:			Microprocessor Architecture						Code: BCE23PC06				
Credit			Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks							
			Lecture	Practical	Tutorial	FA		SA	TW	PR	OR	Total
L	P	T				FA1	FA2					
3		-	02	01	-	10	10	30	25	-	25	100

Prior Knowledge of Digital Electronics and Computer Organization **is essential**

Course Objectives:

This course aims at enabling students:

1. To understand basic architectural features of processor.
2. To learn and distinguish the architecture and programmer's model of 80386DX processor
3. To identify the system level features and processes of processor.
4. To acquaint the learner with application instruction set and logic to build Assembly Language Programs (ALP).

Course Outcomes:

After learning the course, the students will be able to:

1. Identify the architectural components and functions of the 80386DX microprocessor.
2. Apply the 80386DX instruction set to perform different types of operations.
3. Apply the concepts of memory management techniques.
4. Assimilate emerging processor architectures.

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment.
3. Each assignment write-up should have Title, Objectives, Out comes, Theory- Concept in brief, Algorithm, Flowchart, Testcases, Conclusion.

Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work is based on overall performance and Laboratory assignments performance of student.
2. Each Laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality, and neatness.

Guidelines for Laboratory Conduction

1. Operating System: 64-bit Open-source Linux or its derivative.
2. Programming Tools: Preferably using Linux equivalent or MASM/TASM/NASM/FASM.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Evolution of Intel processor architecture-** 4 bit to 64 bit performance assessment. Introduction to 80386dx Processor - 80386dx Features and Architecture. **Basic Programming Model-** Memory Organization and Segmentation, Operating modes.Registers: General, Segment, Flags System registers: Control, Debug, Test, Addressing modes . Case Study-80386dx addressing modes	9

	Self Study: Case Study of 80386dx addressing modes	
II	**Instruction Set-** Data Movement Instructions, Binary Arithmetic Instructions, Logical Instructions, Control Transfer Instructions, String and character translation Instructions, Flag Control Instructions. **Self Study:** Case Study of Intel 8086/80386dx Instruction Set Systems Architecture	8
III	**Memory Management:** Segmentation, Paging, Combined translation.Cache Memory: Cache hierarchy,. Mapping methods – Direct, Associative, Set-Associative, Replacement algorithms, Memory hierarchy and performance optimization. **Self Study:** Combined Translation-Segmentation with paging: architecture and address translation	7
IV	**Emerging Processor Architectures and Introduction to Microcontroller :** RISC vs CISC architectures, The Pentium's Superscalar Architecture, Pipelining, Branch Prediction, The Instruction & Data Caches, The Floating Point Unit. **Introduction to Microcontrollers:** Architecture of typical Microcontroller, Difference between Microprocessor and Microcontroller. **Self Study:** Generations and advancements of i7 processors,Role of i7 processors in modern computing systems	6
	Total	**30**

Suggested Lab Assignments:

1. Using the concepts of Macro, syscall , data section and text section, develop X86/64-bit program.
2. Develop X86/64-bit program to accept a string and to display its length.
3. Develop X86/64-bit program to count number of positive and negative numbers from the array.
4. Using logic of Hex to BCD conversion, develop X86/64-bit program to convert 4 bit Hex number to equivalent BCD number.
   Display proper strings to prompt the user while accepting the input and displaying the result. (Wherever necessary, use 64-bit registers).
5. Develop X86/64-bit program to perform non-overlapped block transfer without string specific instructions. Block containing data can be defined in the data segment.
6. Develop X86/64-bit program to perform overlapped block transfer with string specific instructions Block containing data can be defined in the data segment
7. Case Study: Performance Analysis of Cache Memory Management Techniques in a Multicore Processor System
8. Case Study: ARM Processor Architectures, Features and Difference between ARM and 80386, Real time applications of ARM Processor.

"Knowledge Brings Freedom"

Text Books:

1. Douglas Hall, "Microprocessors & Interfacing", McGraw Hill, Revised 4th Edition, 2018 .
2. Ray, K. Bhurchandi, "Advanced Microprocessors and peripherals: Arch, Programming & Interfacing", Tata McGraw Hill, 2016.
3. James Turley, "Advanced 80386 Programming Techniques", McGraw-Hill, 3rd edition , 2015
4. Ray Seyfarth, "Introduction to 64-bit Intel Assembly Language Programming for Linux", 2nd Edition, 2012, ISBN 10: 1478119209, ISBN-13: 9781478119203.

Reference Books:

1. Jeff Duntemann, "Assembly Language Step-by-step: Programming with Linux", Wiley, 3rd Edition, 2009, ISBN 10 0470497025, ISBN-13: 978-0470497029.
2. Brey, Barry B, "8086/8088, 80286, 80386 and 80486 Assembly Language Programming", 3rd edition 2005 Prentice Hall,ISBN: 13: 9780023142475.
3. Chris H. Pappas, William H. Murray, "80386 Microprocessor Handbooks", McGraw-Hill Osborne Media, 2nd edition 2004 ISBN-10: 0078812429, 13: 978-0078812422.
4. Mohammad Rafiquzzaman, "Microprocessors: Theory and Applications: Intel and Motorola", 2nd edition 2007 PrenticeHall, ISBN 10:0966498011, 13:978:0966498011.

Online Sources:

1. http://intel80386.com/386htm/toc.html
2. Intel 80386 Programmer's Reference Manual https://css.csail.mit.edu/6.858/2014/readings/i386.pdf
3. https://aws.amazon.com/solutions/case-studies/arm-limited-case-study/

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Program :	B. Tech. (Computer Engineering)					Semester: III	
Course :	Statistical Data Analysis Using R (OE – Engineering Sciences) (Offered by AS&H)					Code : BSH23OE04	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of Basics of Statistics and Probability **is essential**.

Course Objectives:

After completion of the course, students will have an adequate background, conceptual clarity, and knowledge of mathematical principles related to data, preprocessing techniques for data visualization, and statistical techniques for prediction and decision-making.

Course Outcomes:

After learning the course, the students should be able to:

1. **Apply** R software and data handling techniques for the given data.
2. **Apply** data pre-processing techniques to clean and transform datasets.
3. **Draw** inferences from data using appropriate visualization techniques.
4. **Analyse** the data for decision-making using statistical methods

Detailed Syllabus

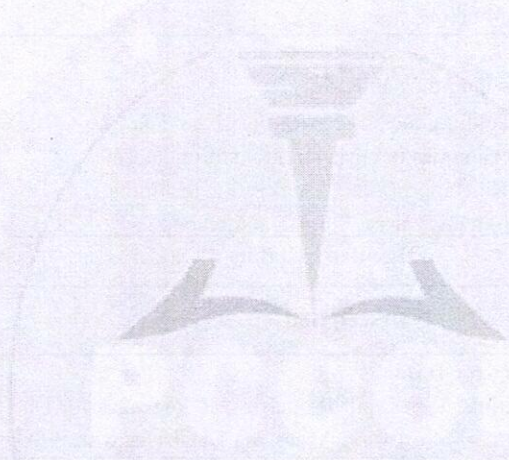
Unit	Description	Duration [Hrs]
I	**Fundamentals of R Software for Data** Introduction to Data: Definition, Types and Properties, R Packages for Data Science, Importing and Exporting Data in R Software, Accessing Databases with R Software.	7
II	**Data Wrangling** Pre-processing Data in R Software, Dealing with Missing Values in R Software, Data Formatting in R Software, Data Normalization in R Software, Binning in R Software, and Conversion of type of data	7
III	**Data Visualization** Data visualization for various data categories like Categorical, Numerical, or both using plots like histograms, Bar/ Line Chart, Box Plots (including group-by option), Scatter Plots, Mosaic Plot, etc., and their interpretations	8
IV	**Data Analysis** Sampling, Descriptive Statistics, Linear regression, and Multiple linear regression. Model evaluation using visualization, prediction, and decision-making.	8
	Total	30

Reference Books:

1. Montgomery and Runger, "Applied Statistics and Probability for Engineers", Wiley, India, 6 Edition, ISBN: 9788126562947.
2. R. Johnson, "Probability and Statistics for Engineers", Prentice India Ltd, 8 Edition, ISBN 13:978-8120342132.
3. S.P. Gupta, "Statistical Methods", Paperback publication, 43 edition, ISBN: 9788180549892, 8180549895.
4. Victor A. Bloomfield, "Using R for Numerical Analysis in Science and Engineering", CRC Press, First Edition, ISBN: 9781315360492

Online Sources:

1. https://www.youtube.com/watch?v=VVYLpmKRfQ8&list=PL6C92B335BD4238AB (Probability)
2. https://nptel.ac.in/courses/111104100 (Introduction to R software)
3. https://www.youtube.com/watch?v=WbKiJe5OkUU&list=PLFW6lRTa1g83jjpIOte7RuEYCwOJa-6Gz (Descriptive statistics using R software)



Program :	B. Tech. (Computer Engineering)					Semester: III	
Course :	Advanced Materials and Characterizations (OE – Engineering Sciences) (Offered by AS&H)					Code : BSH23OE05	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
02	02	-	-	10	10	30	50

Prior knowledge of basic physics, chemistry and nanotechnology **is essential.**

Course Objectives:

This course aims at enabling students,

1. To learn the principles of advanced materials, technologies and characterizations.
2. To undertake research projects with applications of advanced materials.

Course Outcomes:

After learning the course, the students should be able to:

1. Interpret structure, properties and applications of advance engineering materials.
2. Explain the properties and requirements of materials for some advanced applications
3. Analyze structural, optical, elemental & morphological properties of the materials
4. Interpret electrochemical & thermal properties of the materials

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Engineering Materials** Polymer Composite eg. fiber- reinforced polymer (FRP) composites Advanced carbon materials eg. Graphene & CNT Alloys: a] Nano alloy eg. Cu-Ni nano alloy b] Memory alloy-Nitinol CdSe Thin films for solar cells.	7
II	**Materials for Special applications** Battery and Supercapacitor: working principles, components, Superconductors, material requirement and properties of electrodes, electrolytes and spacers, Superconductors: metallic, nonmetallic and ceramic superconductors, Applications, Gas Sensing: working principle and required material properties. Substrate Materials for quantum computer, Invar and Elinvar Materials: properties and applications, 2D materials: properties and their applications	7
III	**Structural, Optical, Elemental & Morphological Characterizations** X-Ray Diffraction and phase identification, indexing lattice parameter determination, Grain size analysis, EDAX, Electron microscopy, scanning electron microscopy, Transmission electron microscopy (TEM), Fourier Transform Infrared Spectroscopy, Band gap measurements-UV Vis- IR Spectroscopy	8
IV	**Electrochemical Characterization** Cyclic voltammetry: Instrumentation, current-potential relation applicable for Linear Sweep Voltammetry (LSV) and Cyclic Voltammetry (CV), interpretation of cyclic voltammograms, charging-discharging behaviors of supercapacitor and batteries, Thermo-gravimetric analysis (TGA),Differential thermal analysis (DTA) analysis, Thermal expansion measurements, Thermal conductivity measurements, Ionic conductivity measurements. Specific heat capacity measurements, Debye temperature measurements	8
	Total	**30**

Text Books:

1. Transmission electron microscopy: a textbook for materials science, David B. Williams, C. Barry Carter, Springer, 2009
2. Advanced solid state physics-Graduate Texts in Condensed Matter, Hendrik Bluhm, Thomas Brückel, Markus Morgenstern, Gero Plessen, Christoph Stampfer, de Gruyter 2019

Reference Books:

1. Elements of X-ray Diffraction, B.D. Culity and S.R. Stock, Pearson Publication, Third edition 2014.
2. Introduction to Fuel Cells, Electrochemistry and Materials, San Ping Jiang, Qingfeng Li, SpringerPublication, 2022.
3. Solid State Physics, S.O.Pilli, New age, International Publication Tenth edition 2022.
4. Introduction to Solid State Physics, C. Kittle, 8th edition Wiley, 2005.
5. Introduction to Superconductivity, Michael Tinkham, 2nd edition, Dover Publication 2004.
6. Electrochemical super capacitors, B. E. Conway, Springer, 1999.
7. Spectroscopy, G.R. Chatwal and S.K. Ananad, Himalaya Publications, 2016.
8. Introduction to Thermal Analysis, M.E. Brown, Kluwer academic Publishers, 2nd edition 2001.
9. Electrochemical Methods: Fundamentals and Applications, A, J Bard, Allen J. Bard, Larry R. Faulkner, Henry S. White, John Wiley & Sons, 31 May 2022.
10. Microscopy A Very Short Introduction by Srivastava, Oxford University Press, 2015.
11. Practical Guide to materials Characterization, Khalid Sultan, Wiley-VCH, 2023
12. Engineering Chemistry by Wiley India Pvt.Ltd.First edition 2011.
13. Introduction to Nanotechnology by Charles P. Poole, Frank Owens, John Wiley & Sons (2003)
14. Gas Sensing Fundamentals-Springer Series on Chemical Sensors and Biosensors- Claus-Dieter Kohl, Thorsten Wagner, Springer 2014

Online Sources:

1. https://archive.nptel.ac.in/courses/113/106/113106034/

"Knowledge Brings Freedom"

Program :	B. Tech. (Computer Engineering)					Semester: III	
Course :	Electrical Machines (OE – Engineering Sciences) (Offered by E&TC)					Code : BET23OE01	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of Fundamental knowledge of electromagnetism & electrical parameters **is essential.**

Course Objectives:

This course aims at enabling students,

1. To impart basic knowledge for conceptual understanding of DC machines.
2. To explore the construction and performance characteristics of three phase AC machines.
3. To explore the construction and performance characteristics of single-phase AC machines.
4. To relate the applications of electrical machines to practical and industrial scenarios.

Course Outcomes:

After learning the course, the students should be able to:

1. Describe the constructional features and working principles of DC Machines.
2. Explain the constructional features and operation of three phase induction motors
3. Explain the constructional features and operation single phase induction motors
4. Relate the applications of electrical machines to their respective fields of study and industrial applications.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Introduction to Electrical Machines:** Overview of electrical machines and their significance, Classification of electrical machines, Fundamental principles: Faraday's Law, Lenz's Law, and Electromagnetic Induction. **DC Machines** Working principle of DC machine as a generator and a motor; Types and constructional features; EMF equation of generator, DC motor working principle; Back EMF and its significance, torque equation; Types of D.C. motors, characteristics, Necessity of a starter for DC motor, Speed control methods of DC shunt and DC series motor and industrial applications.	8
II	**Three phase induction motor** – constructional features, working principle, Rotating magnetic field, slip ring and cage types. slip, phasor diagram, expression for mechanical power and torque, torque-slip characteristics, starting torque, full load and pull-out torque, equivalent circuit. Industrial applications.	7
III	**Single phase induction motors:** Construction of single-phase induction motor, double field revolving theory. Types of single-phase induction motors: Split phase and shaded pole type induction motors, applications. Specifications of induction motors (KW rating, rated voltage, current rating, frequency, speed, class of insulation)	8
IV	**Special Purpose Motors:** Construction, principle of working, characteristics ratings and applications of Brush less D.C. motors, Stepper motors (permanent magnet and variable reluctance type only), Permanent Magnet motor (A.C. & D.C.), SRM Switch reluctance motor.	7

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Total	**30**

Text Books:

1. V. N. Mittal and Arvind Mittal,"Basic Electrical Engineering" , 2nd Edition. (McGraw-Hill),2010
2. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010

Reference Books:

1. J.B. Gupta, "Theory and Performance of Electrical Machines," S.K. Kataria & Sons.
2. A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, "Electric Machinery," McGraw-Hill Education.
3. D. C. Kulshreshtha, "Basic Electrical Engineering" , 1st Edition (Tata McGraw hill),2009
4. B. L. Theraja and A. K. Theraja S. Chand & Co. Pvt. Ltd. New Delhi, "A textbook of Electrical Technology Vol II",2020

Online Sources:

1. Electrical Machines – I-https://onlinecourses.nptel.ac.in/noc20_ee60/preview
2. Electrical Machines – I-https://archive.nptel.ac.in/courses/108/105/108105017/

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Program :	B. Tech. (Computer Engineering)					Semester: III	
Course :	Introduction to Signals and Systems (OE – Engineering Sciences) (Offered by E&TC))					Code : BET23OE02	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of Linear Algebra & Differential Calculus **is essential.**

Course Objectives:

This course aims at enabling students,

1. To develop an understanding of students related to signal representation, classification, and operations.
2. To build the understanding of analyzing and classifying the systems and their applications
3. To apply the basic concept of Fourier transform and Laplace transform to the systems

Course Outcomes:

After learning the course, the students should be able to:

1. Represent, classify, and perform the operation on signals
2. Classify the system and utilize convolution for system analysis
3. Apply the basics of Fourier transform to analyze the signal in frequency domain
4. Apply the basics of the Laplace transform to analyze the signal in a complex frequency domain.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Introduction to Signals**: Representation of Standard signals, Classification of signals: Continuous-time and discrete-time signals, Periodic Signals and non-periodic, Operations on signals: Time shifting, Time reversal, Time scaling, Amplitude scaling, Signal addition, Subtraction, Signal multiplication.	07
II	**Introduction to System**: System Definition and Application, Classification of Systems: Continuous-time and Discrete-time systems, Linear and Non-Linear systems, Time variant and Time-invariant systems, Stable and Unstable systems, Causal systems, and non-causal systems. Convolution sum using graphical method.	07
III	**Fourier Transform**: Fourier Transform (FT) representation of aperiodic continuous time (CT) signals, Evaluation of magnitude and phase response, FT of standard CT signals, Application of Fourier transform	08
IV	**Laplace Transform and Z Transform**: Definition of Laplace Transform (LT), ROC, Laplace transform of standard periodic and aperiodic functions, Inverse Laplace transform, Application of Laplace transforms.	08
	Total	**30**

Text Books:

1. A.V. Oppenheim, A.S. Willsky —Signals and systemsl, Prentice-Hall signal processing series. 2nd Edition, 2015
2. A. Nagoor Kanni —Signals and Systemsl, McGraw Hill, 2nd Edition, 2017

Reference Books:

1. B P Lathi —Linear Systems and Signals‖, Oxford University Press, Third Edition, 2017
2. Simon Haykins and Barry Van Veen —Signals and Systems‖, Wiley India, 2nd Edition, 2017
3. M.J. Roberts —Signal and Systems‖, Tata McGraw Hill, Third Edition ,2019.
4. Charles Phillips —Signals, Systems and Transforms‖, Pearson Education, 4th Edition, 2013
5. R. J. Beerends, H. G. ter Morsche —Fourier and Laplace Transforms‖ Cambridge University Press, 2003.
6. Shaila Dinkar Apte, Signals and System, Cambridge University Press, Edition 1, 2018

Online Sources:

1. https://onlinecourses.nptel.ac.in/noc23_ee14/preview
2. https://www.classcentral.com/course/engineering-iitbombay-signals-and-systems-part-1-2679

"Knowledge Brings Freedom"

Program :	B. Tech. (Computer Engineering)					Semester: III	
Course :	Material Science (OE – Engineering Sciences) (Offered by Mechanical Engineering)					Code : BME23OE01	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prerequisite : Nil

Course Objectives:

This course aims at enabling students,

1. To Aquitaine students about materials, their properties, and structure property relationship.
2. To create awareness about the importance of materials information in engineering.

Course Outcomes:

After learning the course, the students should be able to:

1. Compare different materials based on their structures.
2. Relate the structure of materials with their properties.
3. Suggest suitable material for given application based on its structure and properties.
4. Explore advanced materials in engineering applications.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	Introduction to materials: Classification of materials, structure of materials :Atomic structure, crystal structure and microstructure, material properties: Physical, Mechanical, Electrical, Magnetic etc.	8
II	Metals: Ferrous, non ferrous, alloys, structure and properties of commonly used metals, applications of metals in engineering.	7
III	Polymers: Structure of polymers and their properties, Thermoplastic and thermosetting plastics, advanced polymers such as temperature resistant polymers, shape change polymers, conducting polymers Ceramics: Structure of ceramics and their thermal, electrical and magnetic properties, applications of ceramics in engineering.	8
IV	Composites: Classification of composite materials and their applications. Processing of advanced materials such as semiconductors.	7
	Total	**30**

Text Books:

1. Material Science and Engineering An Introduction, William D. Callister, Wiley Publication, 10th Edition 2009.
2. Material Science and Metallurgy, Dr. V. D. Kodgire, Everest publishing house, 5th Edition, 2021.

Reference Books:

1. Materials for Engineering, John Martin, Woodhead Publishing Limited, CRC Press, 3rd Edition, 2006.

Online Sources:

1. NPTEL Course : Nature and properties of materials (https://onlinecourses.nptel.ac.in/noc20_me13/course)
2. NPTEL Course : Properties of materials (https://onlinecourses.nptel.ac.in/noc20_mm13/course)

Program:	B. Tech. (Computer Engineering)					Semester : III	
Course :	Drawing for Engineers (OE – Engineering Sciences) (Offered by Mechanical Engineering)					Code : BME23OE02	
Credit	Teaching Scheme			Evaluation Scheme			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prerequisite: Nil

Course Objectives:

1. Develop imagination of physical objects for communication of Engineering Drawing.
2. Develop the interpretation and manual drawing skills.
3. Develop the physical realization of the dimension of the objects.

Course Outcomes*:

After learning the course, students will be able to

1. **Understand** the basics of Engineering Graphics and **apply** the concepts in real life applications
2. **Analyze** 3D engineering objects and draw orthographic projections
3. **Analyze** 2D views of engineering objects and draw isometric views
4. **Analyze** 3D objects and draw development of lateral surfaces of solid

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Part A: Introduction to engineering drawing** **Importance of engineering drawing to Civil, Electrical, Electronics, IT and Computer Engineers**, introduction to drawing instrument and their uses, drawing sheet layout and its sizes, types of lines and their applications, dimensioning terminology and methods **Part B: Projection of Points, Lines and Planes** Projection: Introduction to projection and different methods of projections, Projection of Point: Introduction, Point situated in all the quadrants. Projection of lines: Introduction, Projection of lines. Projection of Planes: Introduction, Types of planes, Projection of planes. **CPU circuit diagram, Electrical/Electronic board circuit diagram, Building floor plan**	8
II	**Orthographic projections** Orthographic projection of given real life components by first angle method of projection, types of sections.	7
III	**Isometric view** Isometric axes, scale, difference between isometric projection and isometric view, isometric view of simple solids and its dimensioning.	8
IV	**Development of lateral surface of solids** Development of lateral surfaces of prism, pyramid, cylinder and cone. 3D and 2D drawing of branch specific industrial products and its lateral surface development.	7
	Total	**30**

Text Books:

1. Engineering Drawing with an introduction to AutoCAD- Dhananjay A. Jolhe, Revised Edition 2017, Tata McGraw Hill publishing company Ltd. New Delhi, India
2. Engineering Drawing, Plane and solid geometry- N. D.Bhatt, 54th edition 2023, Charotor publication house.

Reference Books:

1. Engineering Drawing- M.B Shah and B.C Rana, 2nd edition 2009, Pearson Publications.
2. Engineering Graphics- P.J. Shah, Revised edition 2019, S Chand Publications.
3. Fundamentals of Engineering Drawing- Warren J. Luzzader, 11th edition 2015, Prentice Hall of India New Delhi.
4. A text book of Engineering Drawing- R.K. Dhawan, Revised Edition 2019, S. Chand and company ltd. New Delhi, India

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Program :	B. Tech. (Computer Engineering)					Semester: III	
Course :	Fundamentals of Mechanical Components and Systems (OE – Engineering Sciences) (Offered by Mechanical Engineering)					Code :BME23OE03	
Credit	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prerequisites: Nil

Course Objectives:

This course aims at enabling students,

1. Impart knowledge of mechanical engineering and describe the scope of mechanical engineering with multidisciplinary industries.
2. Impart knowledge of basic concepts of thermodynamics and heat transfer applied to industrial applications.
3. Understand, identify and get exposure to latest trends in manufacturing processes and materials.
4. Describe the fundamentals of automobile systems and the emerging trends of electric vehicles, hybrid electric vehicles and solar vehicles..

Course Outcomes:

After learning the course, the students should be able to:

1. **Identify** different materials and manufacturing processes for different applications.
2. **Apply** the fundamentals of thermodynamics and heat transfer to real life applications.
3. **Identify** the basic mechanical elements and the power transmission drives based on their applications.
4. **Comprehend** automotive system for the combustion vehicle, EV's, HEV's and solar vehicles..

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Materials and Manufacturing Engineering** Classification of materials, their properties and applications, phase change material (PCM), composite material. Introduction to manufacturing processes: classification and applications, sheet metal working and forging. Introduction to industry 4.0.	8
II	**Thermal Engineering** Introduction to thermodynamics: concept of a system, types of systems, energy interactions: heat and work, laws of thermodynamics, entropy, and modes of heat transfer, thermal resistance, insulation. Applications of hydraulic turbines, centrifugal pumps, compressor, household refrigerator, window and split air conditioner.	7
III	**Fundamentals of Design Engineering** Introduction to mechanical engineering: use of mechanical engineering in day to day life and its interdisciplinary use, Introduction to design thinking. Machine elements, power transmission drives and mechanisms.	8
IV	**Automotive Engineering** Classification of automobile, specifications of two wheeler, four wheeler and multi axle vehicles, types of chassis layout and drives, working of I.C. Engine, gear boxes, clutch, brakes, drive train system. Emission standards. Concept and environmental importance of electric vehicles (EV), construction and working of EV, hybrid electric vehicles (HEV) and solar vehicles, challenges and future scope of EV's and HEV's.	7
	Total	**30**

Text Books:

1. Basic Mechanical Engineering- Basant Agarwal and C. M. Agarwal, Wiley publication, First edition, (2008).
2. Engineering Thermodynamics- P. K. Nag, Tata McGraw-Hill publishing Co. Ltd., Sixth edition, (2017).
3. Heat and mass transfer- R. K. Rajput, S Chand publication, Revised edition, (2007).
4. A Textbook of Automobile Engineering- Khalil U Siddiqui, New Age International Publishers, Fifth edition, (2012).

Reference Books:

1. Design of Machine Elements- V. B. Bhandari, Tata McGraw-Hill publishing Co. Ltd., Fourth edition, (2017).
2. Theory of Machine- S. S. Ratan, Tata McGraw-Hill publishing Co. Ltd., Fifth edition, (2019).
3. Thermal Engineering- Arora and Domkunwar, Dhanpat Rai and Sons, Sixth edition, (2013).
4. Elements of Workshop Technology- Hajra, Chaudhari Volume I, Media Promoters and Publishers, Mumbai, Fourteenth edition, (2008).
5. Elements of Workshop Technology- Hajra, Chaudhari Volume II, Media Promoters and Publishers, Mumbai, Twelfth edition, (2007).
6. Handbook of Industry 4.0 and SMART Systems- Diego Galar Pascual, Pasquale Daponte, Uday Kumar, CRC Press, First edition, (2019).
7. Industry 4.0 - Dr. Bhushan Kelkar, Neuflex Publication, First edition, (2019).
8. Automobile Engineering Volume I- Dr. Kripal Singh, Standard Publishers Distributors, Eleventh edition, (2008).
9. Automation, production systems computer integrated manufacturing- Mikell Groover, Pearson Publication, Fourth edition, (2014).
10. Automotive Electrical Equipment- P. L. Kohli, McGraw Hill Education (India) Pvt Ltd., First edition, (2001).

"Knowledge Brings Freedom"

Program:	B. Tech. (Computer Engineering)					Semester: III	
Course:	E-waste Management (OE – Engineering Sciences) (Offered by Civil Engineering))					Code: BCI23OE01/ BCI24OE01	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA 1	FA 2		
2	2	-	-	10	10	30	50

Prior Knowledge of

1. Fundamentals of environmental science.
2. Fundamentals of sustainable development.

is essential

Course Objectives: This course aims at enabling students.

1. To impart the knowledge of issues and challenges of e-waste management.
2. To create awareness of potential health effects and risk associated with e-waste.
3. To build knowledge of e-waste legislation (policy and guidelines) and circular economy.
4. To get acquainted with recycling, recovering and disposal techniques.

Course Outcomes: After learning the course, the students should be able to:

1. Identify the issues and challenges of e-waste management for a sustainable environment.
2. Analyze potential health effects and risk assessment.
3. Illustrate e-waste laws and guidelines and apply a circular economy road map for an e-waste sustainable future.
4. Identify the e-waste recycling, recovery and disposal techniques and its significance for a sustainable future.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Electronic Waste Management – Issues and Challenges:** Introduction to e-waste, classification and composition, need to manage / recycle, E-waste generation in India and comparison with world scenario; facts & figures, estimation of waste electronic and electrical equipment (WEEE), economic assessment of E-waste (Rare earth minerals, precious metals), effluents (solid, liquid and gas) generated during recycling, quantification of health hazard due to informal recycling of E-Waste,(Case study-based learning)	7
II	**E-Waste-Environmental and Public health issue:** Characteristics of Hazardous Substances, toxicity concerns, potential health effects and symptoms of long-term exposure, case study of heavy metal contamination due to E-Waste recycling, Introduction to risk assessment, epidemiologic data analysis and parameter for determining exposure and disease (numerical), classification of potential carcinogens, dose-response assessment, Potency Factor for Carcinogens (numerical), Hazard Index (HI) and Hazard Quotient (HQ) (numerical)	8
III	**E-waste (Management & Handling) Rules / Guidelines and circular economy:** Regulatory frameworks in India, objectives of e-waste rules 2016,2018,2022 and 2024, hazardous and other wastes (Management and Transboundary Movement) Rules, application of rules to stakeholders, India's stand on liberalizing import rules, UN Sustainable Development Goals (SDGs) and E-Waste, circular economy startup in India with a case study.	7
IV	**Recycling and Recovery of Metals from Electronic Waste and Disposal Techniques:**	8

	E-waste recycling machineries, recycling process of E-Waste, existing E-Waste recycling Techniques, case study/ examples (metal recovery process), mechanism of extraction of precious metal from leaching solution, recovery of precious metals from solutions by solvent extraction, extraction of precious and rare earth metals from End-of- Life (EOL) electronic products, disposal techniques, role and responsibility of extended producers' responsibility (EPR), E-waste economy in the organized and unorganized sector, Case study on recycling and precious metal recovery from E-waste.	
	Total	**30**

Text Books:

1. E-waste management challenges and opportunities in India,Varsha Bhagat Ganguly, Routledge India, 1st edition 2021.
2. E-waste Management and procurement of Environment, Dr. Suresh Kumar and Dr. Jitendra Kumar Pradhan, Authorpress, 2021 edition.
3. E-waste in India: Management, challenges and opportunities (Volume I & II), Dr. Suresh Kumar, Authorspress, September, 2021 edition.

Reference Books:

1. Fowler B, Electronic Waste – 1st Edition (Toxicology and Public Health Issues), 2017 Elsevier
2. Johri R., E-waste: implications, regulations, and management in India and current global best practices, The Energy and Resources Institute (TERI)TERI Press, New Delhi, 2008.
3. The Complete Technology Book on E-Waste Recycling (Printed Circuit Board, LCD, Cell Phone, Battery, Computers), ASIA PACIFIC BUSINESS PRESS Inc., 2015.

Online Sources:

1. https://cpcb.nic.in/e-waste/
2. https://courses.iid.org.in/course/e-waste-recycling-business
3. https://www.suritex.co.in/
4. http://greenscape-eco.com/
5. https://onlinecourses.nptel.ac.in/noc20_ce12/preview
6. https://nielit.gov.in/gangtok/content/paid-course-e-waste-management
7. https://www.semanticscholar.org/paper/Electronic-waste-management-Hester Harrison/bc34471b0f9d94b0656b43df6b322116f2a7175c

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Program:	B. Tech. (Computer Engineering)	Semester: III
Course :	Neural Network and Fuzzy Logic Control (OE – Department Specific) (Offered by AS&H)	Code : BSH23OE06

Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior Knowledge: Nil

Course Objectives:

1. To provide knowledge of Neural Networks and apply them for modelling and controlling real-time dynamic systems.
2. To apply fuzzy logic techniques for solving various engineering and decision-making problems.

Course Outcomes:

After learning the course, the students will be able to:

1. **Describe** learning rules, activation functions and basics of neural networks.
2. **Implement** backpropagation and optimizer algorithms for weight updates of Neural Network.
3. **Apply** fuzzy set concepts for fuzzification and defuzzification.
4. **Perform** Mamdani and Sugeno fuzzy inference system in real world problems.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Architecture of Neural Network:** Introduction; biological neural networks; artificial neural networks; architecture of artificial neural networks—bias, activation functions, learning methods, and learning rules; types of neural networks such as single-layer, multi-layer, feedforward, and recurrent neural networks.	7
II	**Neural Networks for Control:** Loss functions; weight initialization; optimization algorithms; backpropagation algorithm; associative memory networks and their types; discrete-time Hopfield networks.	8
III	**Fundamentals of Fuzzy Logic:** Classical sets; fuzzy sets; membership functions; cardinality of fuzzy sets; fuzzy complement; fuzzy composition; properties and operations on fuzzy sets; fuzzy relations; fuzzification; and defuzzification.	7
IV	**Fuzzy Logic Control:** Fuzzy rules; decision-making logic; linguistic variables; fuzzy inference systems including Mamdani FIS and Sugeno FIS; design of fuzzy controllers; fuzzy optimization; and applications of FIS to real-life problems.	8
	Total	**30**

Text Books:

1. Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", Prentice Hall, NewDelhi, 2004.
2. Ross T. J., "Fuzzy logic with engineering applications (Vol. 2)", New York: Wiley, 2004, ISBN: 9783030375478

Reference Books:

1. Jack M. Zurada, "Introduction to Artificial Neural Systems," PWS Publishing Co., Boston, 2002.
2. Zimmerman H.J., "Fuzzy set theory and its Applications," Kluwer Academic Publishers Dordrecht, 2001.
3. Driankov, Hellendroonb, "Introduction to fuzzy control," Narosa Publishers,2001.
4. G Klir, B Yuan, "Fuzzy sets and fuzzy logic: Theory and application," PHI, ISBN:
5. LauranceFausett, Englewood Cliffs, N.J., "Fundamentals of Neural Networks," PearsonEducation, New Delhi, 2008.
6. B Yegnanarayana: Artificial Neural Networks for pattern recognition, PHI Learning Pvt. Ltd., 14-Jan-2009

Online Sources:

1. Online course "Fuzzy Logic and Neural Network" by Prof. Dilip Kumar Pratihar, IIT Kharagpur. https://nptel.ac.in/courses/127/105/127105006/

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Program:	B. Tech. (Computer Engineering)	Semester: III
Course :	Biology for Engineers (OE – Department Specific) (Offered by E&TC))	Code : BET23OE03

Credit	Teaching Scheme			Evaluation Scheme			
	Theory	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Pre-requisite of Basics of Human Anatomy and physiology, Basics of Electronics Engineering **is essential**

Course Objectives:

1. To introduce biological engineering principles, procedures needed to solve real-world problems.
2. To provide an overview of human anatomy and physiology in order to support biomedical engineering solutions.
3. To introduce biomedical sensors, signal processing and diagnostic systems.
4. To provide a basic knowledge of the applications of biological systems in relevant industries.

Course Outcomes:

After completing the course the students should be able :

1. to understand basics of human physiological system and its cell functioning
2. to understand human immune system and significance of microbiology
3. to map role of biology in designing industrial applications
4. to understand biomedical sensors, its interfacing and related to measurement systems.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**CELL PHYSIOLOGY :** Introduction to the cell biology – Cell size and shape - Chemical composition - Classification of cell and its properties, Cell cycle; Cell signaling, Transport across cell membrane; Introduction to Human physiology – Circulatory system - Respiratory system - Excretory system - Nervous system.	08
II	**IMMUNOLOGICAL SCIENCE:** Immune system and its types; Functional properties of antibodies; Helper T cells and T cell activation; Importance of Microbiology.	07
III	**BIOLOGY AND ITS INDUSTRIAL APPLICATION:** Introduction : Bioreactors, biocontrol, biofilters, biopolymers, bioenergy, biomaterials, biochips, Nano-Biomolecules and its various types: Principles and Application of Biosensor; Basics of Biochips – Bio fertilizer – Bioinformatics – Bio fuel.	07
IV	**INTRODUCTION TO BIOMEDICAL INSTRUMENTATION:** Need and Challenges in measurement of the parameters in living systems, Source of bioelectric potential: Resting and action potential, propagation of action potential, depolarization and re-polarization. Introduction to few important bio-potential such as Electrocardiogram(ECG), Electroencephalogram(EEG) and Electromygram (EMG).	08
	Total	**30**

Text Books:

1. Dr. Sohini Singh and Dr. Tanu Allen, "Biology for Engineers", Vayu Education Of India, New Delhi, 2014.
2. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, 2nd edition,Prentice Hall of India

Reference Books:

1. Arthur T. Johnson, "Biology for Engineers" CRC Press, 2011.
2. Goldsby RA, Kindt TK, Osborne BA and Kuby J (2003) Immunology, 5th Edition, W.H. Freeman and Company, New York.
3. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
4. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012
5. John G. Webster(Editor), Amit J. Nimunkar (Editor), Medical Instrumentation: Application and Design,5th edition Wiley publication
6. Joseph H. Carr, John M. Brown, Introduction to Biomedical equipment Technology, 4edition , Pearson publication

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Program :	S. Y BTech (Open for All Branches offered by E&Tc Department)					Semester: III/IV	
Course :	Human Behavior, Ethics & Wisdom					Code :	BET23OE04
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
02	02	-	-	10	10	30	50

Prior knowledge of is not essential.

Course Objectives:

This course aims at enabling students,

- To develop a clear understanding of success in terms of academic, career, and life dimensions, and help students identify the ultimate human goal.
- To enable students to build harmonious relationships and responsible behavior based on right understanding, values, and priorities.
- To cultivate ethical conduct and holistic thinking for sustainable living, professional competence, and universal harmony.

Course Outcomes:

After learning the course, the students should be able to:

CO1 Differentiate the career success, academic success and life success

CO2 Identify the correct priority order in life and illustrate the human goal

CO3 Understand that the relationships are definite

CO4 Understand the Interconnectedness between all the orders in existence

Detailed Syllabus:

Unit	Description	Duration [Hrs]
1	**Understanding success and Living domain of Human** Academic success (marks), career success (recognition & position), life success (balance & contentment), ultimate goal of human being, Difference between happiness and excitement Continuous happiness vs temporary pleasure, Right Understanding (RU), Relationship (R), Physical Facility (PF) with right priority, how our choices are affected by RU, R, PF. Understand the human being On the basis of needs and activities	07
2	**Human Behavior** Behavior driven by: Desire or Fear or Understanding Relationship as the foundation of life, Understanding the expectations in 7 relationships Mother-Father/Son-Daughter, Husband-Wife, Brother-Sister, Friend-Friend, Teacher-Student, Colleague-Coworker, Societal Nine core human values in relationships (trust, respect, affection, care, etc.), Justice and fairness Marriage as: A foundation for family stability, Purpose of Marriage, Common Problems in Marriage Justice in Family, Ability to build Stable, respectful relationships, Parenting & Values	08
3	**Wisdom & Universal Harmony (Holistic Living)** Sustainable living, Human role in society Human Goal (Resolution, Prosperity, Fearlessness, Coexistence) Five dimensions to fulfill human goal - Education- Sanskar (Inculcation), Justice-Protection, Production-Work, Exchange-Storage, Health-Self regulation Universal order and interconnectedness - The four orders in nature - Interconnectedness and mutual fulfillment	08

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4	**Ethics & Human Conduct** Natural acceptance. Responsibility and duty. Fair roles and responsibilities. Gender equality in dignity Definite Human Conduct -Behavior Work. Participation in relationships Right wealth. Right marital relationship. Right work and behavior Values. Policies. Character Competence in Professional Ethics. Holistic Technologies. Production Systems and Management Models-Typical Case Studies.	07
	Total	30

Text Books: :

- A. Nagaraj. Jeevan Vidya: Ek Parichaya. Amarkantak. India: Jeevan Vidya Prakashan. 1999.
- A. Nagaraj. Manava Vyavahāra Darsana. Amarkantak. India: Jeevan Vidya Prakashan. 2003.
- R. R. Gaur. R. Asthana. and G. P. Bagaria. A Foundation Course in Human Values and Professional Ethics. 2nd rev. ed. New Delhi. India: Excel Books. 2019. ISBN: 978-93-87034-47-1.

Reference Books:

- A. Nagaraj. Vyavahārvādī Samājshāstra. Amarkantak. India: Jeevan Vidya Prakashan. 1999.
- A. Nagaraj. Vyavharatmak Janvad. Amarkantak. India: Jeevan Vidya Prakashan. 2009.
- A. Nagaraj. Abhyas Darshan. Amarkantak. India: Jeevan Vidya Prakashan. 2004.
- M. K. Gandhi. Hind Swaraj or Indian Home Rule. Ahmedabad. India: Navajivan Publishing House. 1909.
- S. R. Covey. The Seven Habits of Highly Effective People. New York. NY. USA: Free Press. 1989.
- Aristotle. The Nicomachean Ethics. Translated by W. D. Ross. Oxford. U.K.: Oxford University Press. 1925.

Online Sources:

http://madhyasth-darshan.info/postulations/knowledge/knowledge-of-humane-conduct/
https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
https://youtu.be/OgdNx0X923I
https://www.edx.org/learn/happiness/university-of-california-berkeley-the-science-of-happiness
https://www.youtube.com/watch?v=11E0ZaoGqEI

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Program:	B. Tech. (Computer Engineering)					Semester: III	
Course:	AI for Financial Modelling (OE – Department Specific) (Offered by CSE(AI&ML)					Code:BCS23OE01	
Credit	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
02	02	-	-	10	10	30	50

Course Objectives:

1. To understand the essentials of financial modeling
2. To learn to build a simple financial model.
3. To perform the analyses of financial models and Apply AI/ML methods for forecasting
4. To use AI enabled platforms for finance tasks
5. To learn feature engineering, EDA and understanding with regards to financial data

Course Outcomes:

After learning the course, the students will be able to:

1. To learn the essentials of financial modeling.
2. To build financial models and perform the analysis .
3. To apply AI/ML methods for financial forecasting.
4. To use AI enabled tools and platforms for finance tasks.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Introduction to Financial Modelling :** Importance and Applications in Finance, Key Financial Statements (Income Statement, Balance Spheet, Cash Flow), Basic Excel Techniques for Financial Modelling, Overview of Financial Ratios and KPIs, Limitations of Traditional Modelling Techniques.	7
II	**Basics of Artificial Intelligence and Machine Learning:** Introduction to AI and Machine Learning, Types of Machine Learning (Supervised, Unsupervised), Common Algorithms in Finance: Linear Regression, Decision Trees, Clustering, Introduction to Python for AI (basics, IDEs, libraries: NumPy, Pandas), Data Preprocessing for Financial Datasets.	8
III	**AI Applications in Financial Modelling:** AI for Forecasting Revenue and Expenses, AI for Credit Risk Assessment across financial applications, AI in Fraud Detection, Portfolio Optimization Basics, Predictive Analytics in Budgeting and Planning.	8
IV	**Tools, Ethics, and Future Trends :** AI Tools for Finance: Power BI/Tableau, AutoML Platforms, Introduction to FinTech and Robo-Advisors, Ethical Considerations: Data Privacy, Bias, Model Interpretability. Case Studies of AI in Financial Services	7

Total	**30**

TextBooks:

1. Yves Hilpisch, "Artificial Intelligence in Finance: A Python-Based Guide", O'Reilly Media Inc., July 2019. ISBN: 9781492055433
2. Jannes Klaas, "Machine Learning for Finance", Packt Publishing, 2019. ISBN: 9781789136364

Reference Books:

1. Edward P.K.Tsang, "AI for Finance", Routledge Taylor and Francis, 1st Edition, 2023, ISBN 9781032384436

Online Sources:

1. https://www.udemy.com/course/python-and-machine-learning-in-financial-analysis/
2. https://www.udemy.com/course/ai-for-finance/

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Program :	B. Tech. (Computer Engineering)					Semester: III	
Course :	Industry 4.0 (OE – Department Specific) (Offered by Mechanical Engineering)					Code : BME23OE04	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of Basic programming skills, Mathematical skills is **essential.**

Course Objectives:

This course aims at enabling students.

1. To introduce revolutions of manufacturing industry
2. To introduce technological advancement in modern manufacturing industries
3. To Introduce concepts of smart manufacturing, emphasizing Industry 4.0 in manufacturing industries

Course Outcomes:

After learning the course, the students should be able to:

1. Correlate the recent manufacturing trends and technological pillars of Industry 4.0.
2. Apply pillars of Industry 4.0 to the manufacturing industry.
3. Adapt the changes in existing manufacturing practices and relate the role of industrial robotics and sensors.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Industrial revolution and current state of industry:** Overview of industrial revolution, Introduction to Automation, hard automation, soft automation, classification of production system, adaptive control, overview of terminologies like CAD, CAM, CAE, CAPP etc.	06
II	**Introduction to Industry 4.0:** Introduction to industry 4.0, need for Industry 4.0, Framework for Industry 4.0, technological pillars in industrial 4.0, applications, challenges and scope for industry 4.0	08
III	**Technological developments in Industry 4.0:** Introduction to Smart Manufacturing, overview of big data and analytic techniques, cyber security, Internet of things (IoT), Industrial Internet of things (IIoT), Cloud computing, artificial intelligence.	08
IV	**Robotics and Sensors:** Introduction to technological components of Robot, classification of sensors and its applications in Manufacturing industry, Role of robots in Industry 4.0, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics	08
	Total	**30**

Text Books:

1. Nine pillars of technologies for Industry 4.0, W. Leong, IET publishers, 2020
2. Industry 4.0, A. Gilchrist, Apress Publication, 2016
3. Industrial Automation: Hands On, Lamb, Frank. , McGraw-Hill Professional, 2013

Reference Books:

1. C. Schröder, The Challenges of Industry 4.0 for Small and Medium-sized Enterprises, 2021.
2. Chua C. K., Leong K. F., Lim C. S., Rapid Prototyping, World Scientific, 2012.
3. A. Nayyar and A. Kumar, A Roadmap to Industry 4.0: Smart Production, Sharp Business and Sustainable Development-Springer International Publishing, 2020. https://doi.org/10.1007/978-3-030-14544-6
4. K. Kumar, D. Zindani, J. P. Davim, Industry 4.0: Developments towards the Fourth Industrial Revolution, Springer Singapore, 2019.

Online Sources:

1. https://nptel.ac.in/courses/108105063

Program :	B. Tech. (Computer Engineering)					Semester: III	
Course :	Energy Storage Management (OE – Department Specific) (Offered by Mechanical Engineering)					Code : BME23OE05	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of Fundamentals of Engineering and basic sciences **is essential.**

Course Objectives:

This course aims at enabling students,

1. To explore energy storage systems' fundamentals, technologies, and applications.
2. To enable students to understand the principles of energy storage systems design.
3. To provide a general awareness of energy storage audit, safety, and management.

Course Outcomes:

After learning the course, the students should be able to:

1. Differentiate and select energy storage systems based on performance and safety.
2. Select material and analyze the energy storage in thermochemical form.
3. Analyze energy storage system with batteries/supercapacitors/fuel cells.
4. Perform audit of Energy storage systems

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Energy storage system:** Introduction, Need, Modes, Energy storage devices, Merits, and Demerits of different types of Storage, utilization, and system applications. **Performance:** Energy capture rate and efficiency, Discharge rate and efficiency, Dispatch ability and load flowing characteristics, Scale flexibility, durability, Cycle lifetime, mass.	8
II	**Thermochemical storage** – Types, Phase Change Materials (PCMs) and classifications, properties of the PCMs for different temperature ranges, Selection criteria of PCMs for heating and cooling in buildings. Application of PCM in energy storage. SHS mediums, Energy analysis of the latent heat storage based on different systems	7
III	**Energy Storage for transportation:** Mechanical Design and Packaging of Battery, Packs for Electric Vehicles, Advanced Battery-Assisted Quick Charger for Electric Vehicles, Charging Optimization Methods for Li-ion Batteries, Thermal run-away for battery systems, State of Charge and Health Estimation Over the Battery Lifespan, Recycling of Batteries from Electric Vehicles **Fuel cell**: Operational principle, types, hybrid fuel cell-battery systems, hybrid fuel cell-supercapacitor systems,	8
IV	**Energy Storage Management** Relationship between economic growth and energy use, Energy demand analysis in different economic sectors, increase energy conversion efficiencies by introducing energy storage, Energy audit of energy storage system, The carbon markets, Safety: Risks of fire, explosion, toxicity, Ease of materials, recycling, and recovery, Environmental consideration, and recycling	7
	Total	**30**

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Text Books:

1. A. R. Pendse, "Energy Storage Science and Technology," SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN – 13:9789380090122), 2011.
2. Jiujun Zhang, Lei Zhang, Hansan Liu, Andy Sun, Ru-Shi Liu, "Electrochemical Technologies for Energy Storage and Conversion," John Wiley and Sons, 2012.
3. Lithium-Ion Batteries Basics and Applications by Reiner Korthauer, Springer.
4. Fuel cells from fundamentals to applications by Supramaniam Srinivasan, Springer.

Reference Books:

1. Frank S. Barnes and Jonah G. Levine, Large Energy Storage Systems Handbook (Mechanical and Aerospace Engineering Series), CRC press (2011)
2. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication. ISBN: 978-1-118-97130-7, Mar 2016.
3. Pistoia, Gianfranco, and Boryann Liaw. The behavior of Lithium-Ion Batteries in Electric Vehicles: Battery Health, Performance, Safety, and Cost. Springer International Publishing AG, 2018.
4. E. Lipman, A. Z. Weber, Fuel Cells and Hydrogen Production, A Volume in the Encyclopedia of Sustainability Science and Technology, Second Edition, Springer reference.
5. Handbook of Energy Audit by Sonal Desai Publisher Tata McGraw Hill.

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Program:	B. Tech. (Computer Engineering)					Semester : III	
Course:	Total Quality Management (OE – Department Specific) (Offered by Civil)					Code: BCI23OE02	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior Knowledge: Basic definitions of Quality and importance of Quality in industry for safety and durability is essential

Course Objectives: After Completing this course, student will have adequate background :

1. To understand the importance of Quality in construction.
2. To understand the need of Total Quality management & it's tools.
3. To understand role of ISO in quality management.

Course Outcomes: After learning the course, the students should be able to:

1. Articulate quality and quality ideas as presented by many gurus and philosophers after learning.
2. Illustrate different quality control tools.
3. Apply ISO concepts and the cost of quality to quality assurance.
4. Analyze various techniques of TQM.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Unit I: Quality in Construction** a) Quality – Various definitions and interpretation. Importance of quality on a project in the context of global challenges, Factors affecting quality, Reasons for poor quality & measures to overcome, Contribution of various Quality Gurus (Juran, Deming, Crossby, Ishikawa). b) Evolution of TQM- QC, TQC, QA, QMS, TQM.	7
II	**Unit II: TQM, Six Sigma and QC tools** a) TQM – Necessity, advantages, Quality Function Deployment (QFD), b) Six sigma – Importance, levels, Application of 6 Sigma, c) Implementation of 7 QC tools through case study.	8
III	**Unit III: Cost of Quality and ISO** a) Categories of cost of Quality, b) Study of ISO 9001 principles., Quality manual – Importance, contents, documentation, Corrective and Preventive actions, Conformity and NC reports.	7
IV	**Unit IV: Techniques in TQM Implementation** a) Benchmarking in TQM, Kaizen in TQM, b) '5-S_techniques, Zero Defects, c) Quality Circle Concept and applications through Quality Circle Formation.	8
	Total	**30**

Text Books:

1. Total Quality Management-- Dr. Gunmala Suri and Dr. Puja Chhabra Sharma—Biztantra.
2. Quality Control and Total Quality Management by P.L.Jain- Tata McGraw Hill Publ.
3. Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar—Biztantra.
4. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.

Reference Books:

1. Juran's Quality Handbook – Juran Publication. (2016 Edition)
2. Management –Principal, process and practices by Bhat – Oxford University Press.(2008)
3. Financial management by Shrivastava- Oxford University Press (6th Edition 2022)
4. Management Information Systems – Gordon B. Davis, Margrethe H. Olson – Tata McGraw Hill Publ. Co. (2022)
5. Total Project Management – The Indian Context - P.K.Joy Macmillan India Ltd.

Program:	B. Tech. (Computer Engineering)					Semester: III	
Course:	Building Services and Maintenance (OE – Department Specific) (Offered by Civil Department)					Code: BCI23OE03	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Course Objectives:

This course aims at enabling students,

1. To impart knowledge about the building services
2. To examine the purpose and type of building maintenance.

Course Outcomes: After learning the course, the students should be able to:

1. Understand different building services provisions.
2. Interpret the fundamental concepts relevant to functional requirement of building.
3. Relate the knowledge of Acoustic and Fire Protection.
4. Choose diverse maintenance methodologies applicable to building and infrastructure services.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Introduction to Building Services:** Definitions, Objective and uses of services, different types of building, Classification of based on Occupancy, FSI, Carpet area, built-up area, Standard of Accommodation, Classification of building services, Types of services and selection of appropriate services for given project, case studies.	7
II	**Escalator and Plumbing-** Classification of different types of escalators, Lift codes and Rules, Design Features of Escalator, Plumbing- Common Sanitary Fixtures, Layout of Sanitary Fixtures, Water Pipe Sizing in Buildings, Building Services Detailing, Rain Water Harvesting, Sanitation in buildings.	8
III	**Acoustics and Ventilation-** Material properties, acoustical design of assembly halls and buildings, noise and its control, measuring equipment, Ventilation- Ventilation systems, health and comfort ventilation, Fire protection and National Building Codes 2016- requirements, equipment and their applications, security systems.	8
IV	**Building Maintenance:** Role of maintenance in durability and serviceability of structures, Economic aspects of maintenance, Different types of maintenance and audits process. **Infrastructures services:** Different types of structures, infrastructure services, case studies.	7
	Total	**30**

Text Books:

1. Building Construction Dr. B. C. Punmia Laxmi Publications (P) Ltd., New Delhi
2. Building Construction P. C. Varghese PHI Learning (P) Ltd., New Delhi
3. Building repair and Maintenance Management P. S. Gahlot CBS Publishers & Distribution(P) Ltd.

Reference Books:

1. Building Science & Planning by S.V. Deodhar, Khanna Publishers.
2. Design and Practical Hand Book on Plumbing by C.R Mohan, VivekAnand, Standard Publishers Distributors.
3. Hand book of Designing and Installation of Services in High Rise Building Complexes, by V.K. Jain, Khanna Publication

Program:	B. Tech. (Computer Engineering)					Semester: III	
Course:	Android App Development with Kotlin (OE – Department Specific) (Offered by Computer Engineering)					Code: BCE23OE03	
Credit	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
02	02	-	-	10	10	30	50

Prior knowledge of Basic programming knowledge
is essential

Course Objectives:

1. To explore Kotlin programming language features.
2. To familiarize with the concepts of Kotlin.
3. To get acquainted with Android features, networks, and data handling techniques.
4. To develop an Android app with testing.

Course Outcomes:

After learning the course, the students will be able to:

1. Explore object-oriented programming with Kotlin.
2. Illustrate the concept of Kotlin fundamentals
3. Apply the network handling and Android UI techniques.
4. Deploy the Android application with testing.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Introduction to Kotlin programming language** Introduction to Kotlin programming language, Setting up Android Studio development environment, Basics of Kotlin syntax and basic programming concepts, Variables, data types, and operators in Kotlin.	6
II	**Kotlin fundamentals** Conditional statements, Loops, Functions, parameters, Kotlin collections, Classes and objects, Properties, fields, and methods, Inheritance, polymorphism, and interfaces, Data classes and sealed classes.	9
III	**Android architecture, Android UI and Networking** Android Architecture, Activities and life cycle, Views, View groups, fragments and lifecycle, Working with RESTful APIs and JSON data, Using Retrofit and OkHttp for network communication, Implementing LiveData and ViewModel, Asynchronous programming.	9
IV	**Android App Development and Testing** Case study: Picture gallery, Developing an App, Unit testing and UI testing with Junit and Espresso, Preparing and publishing app to Google Play store	6
	Total	**30**

Text Books:

1. Laurence PO, Hinchman-Dominguez A, G. Blake Meike, Dunn M. "Programming Android with Kotlin", O'Reilly Media, Inc.; 2021. ISBN:9781492063001
2. Lim G. "Beginning Android Development With Kotlin" Greg Lim; 2020. ISBN:9811477973, 9789811477973

Reference Books:

1. Trivedi Hardik. "Android application development with Kotlin", BPB Publications; 2020.
2. Fazio M. "Kotlin and Android Development featuring Jetpack", Pragmatic Bookshelf; 2021.

Online Sources:

1. https://developer.android.com/

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Program:	B. Tech. (Computer Engineering)					Semester: III	
Course:	Data Exploration and Visualization Laboratory					Code: BCE23VS03	
Credit	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
02	-	04	-	50	-	50	100

Prior knowledge of Linear algebra, Programming Skills **is essential**

Course Objectives:

This course aims at enabling students

1. To learn how to manipulate datasets using Python libraries.
2. To apply data pre-processing techniques and interpret through various graphs.
3. To build a strong statistical and algorithmic foundation to infer insights.

Course Outcomes:

After learning the course, the students will be able to:

1. Demonstrate Data Science tools and Environment.
2. Apply pre-processing techniques and visualize the data using Python libraries.
3. Analyze different types of data modeling algorithms.
4. Summarize the report on the Data Science application.

Guidelines for Students:

1. Laboratory Instructors may design a suitable set of assignments for each topic. All topics should be addressed. For every topic, at least three lab assignments should be framed and approved during the module meeting.
2. For each laboratory assignment, it is essential for students to write the title, aim, topic theory, algorithm, mathematical background, and data set description (as applicable).
3. Laboratory Journal- Program codes with sample output of all performed assignments are to be submitted as softcopy.
4. Term Work –Term work is a continuous assessment that evaluates a student's progress throughout the semester. Laboratory Instructors may design rubrics to assess assignments and mini-projects.
5. Practical Examination should be conducted on a given list of topics.

Detailed Syllabus

Suggested List of Assignments

Assignment No.	Assignment Title
1.	**Data Science Tools and Environment, Python programming basics** • Introduction to the laboratory environment (e.g., Jupyter Notebook, Python IDEs) • Introduction to the Data Science • Python Programming for Data Science • Python Data Structures • Introduction to data manipulation libraries (e.g., Pandas, NumPy, MatPlotlib)
2.	**Data Acquisition and Cleaning** • Data importing from various sources (CSV, JSON, SQL databases) • Data scraping techniques (web scraping, API integration) • Data cleaning and preprocessing (handling missing values, outliers, etc.)
3.	**Data Visualization and Exploratory Data Analysis (EDA)** • Data visualization libraries (e.g., Matplotlib, Seaborn) • Exploratory Data Analysis techniques (summary statistics, data distribution analysis, correlation analysis)

4.	**Statistical / Algorithmic Data Modeling** • Hypothesis testing, probability distributions, etc. • Basics of classification and regression algorithms • Model evaluation techniques (performance metrics) • Hands-on exercises with sci-kit-learn library
5.	**Mini-Project Development and Presentation** • Development of Mini-Project and its presentations diverse examples of case studies in data science for Mini-project Predictive Maintenance in Manufacturing, Churn Prediction in Telecom Industry, Fraud Detection in Financial Transactions, Healthcare Predictive Analytics, etc.

Reference Books:

1. Grus Joel, Data Science from Scratch, O'Reilly Media Inc., ISBN: 9781491901427
2. McKinney Wes, Python for Data Analysis, O' Reilly media, ISBN: 978-1-449-31979-3. 4. Python

Online Sources:

1. https://onlinecourses.nptel.ac.in/noc22_cs32/
2. https://www.coursera.org/specializations/introduction-data-science
3. https://www.linkedin.com/learning/topics/data-science
4. https://www.mygreatlearning.com/academy/learn-for-free/courses/basics-of-data-visualization-for-data-science
5. https://www.simplilearn.com/data-science-free-course-for-beginners-skillup?source=SidebarWidget_SkillUp
6. https://www.scaler.com/topics/course/python-for-data-science/
7. https://www.mygreatlearning.com/data-science/free-courses
8. https://www.mygreatlearning.com/data-visualization/free-courses
9. https://www.microsoft.com/en-us/power-platform/products/power-bi/getting-started-with-power-bi
10. https://www.tableau.com/

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Program:			B. Tech. (Computer Engineering)					Semester: III	
Course:			Design Thinking					Code: BCE23EM01	
Credit			Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
			Lecture	Practical	Tutorial	FA		SA	Total
L	P	T				FA1	FA2		
1		1	1	-	1	25	25	-	50

Prior knowledge of Programming Languages **is essential**

Course Objectives:

This course aims at enabling students:

1. To Identify user needs through empathy, observation and Formulate clear and actionable problem statements
2. To translate ideas into effective visual representations and maintain clear, structured design documentation.
3. In selecting and applying suitable design thinking frameworks and methodologies to develop user-centered and sustainable solutions.
4. To Work in multidisciplinary teams to foster creativity, collaboration, and innovation.

Course Outcomes:

After learning the course, the students will be able to:

1. Framing a problem statement by identifying user needs,
2. Validate problem statements with societal and environmental consciousness
3. Devise visual design and documentation to communicate more effectively
4. Select suitable framework to develop solution

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Unit-1 : Introduction and identifying the need** Understanding the unique needs of the user - empathize - define - ideate - prototype - test. Psychological Principles in Design Thinking **Case Studies -** Develop an appreciation for the design process and its application in specific settings (Guest lectures, Videos, Field visits, Interplay lectures of design-based movies). Self Study: Case Based Discussion	8
II	**Unit-2 : Problem Formulation** Framing a problem statement neutrally using adequate checks from environment, Introduction to Sustainable Development Goals. **Case studies**. Concept Generation: Generate multiple concepts using various creativity tools and thinking styles. Self Study: Brainstorming & Mind mapping, tools like MindMeister, Xmind tools	6
III	**Unit-3 : Design and Analysis** Discover Phases for problems solving, Identifying Stakeholders and Defining User Personas; User Empathisation and Tools; Data collection from users and for users: Surveys, Questionnaires, Statistics, Interactions Need Analysis: Types of Users, Types of Needs; Market Size; Value Proposition to the Users. **Case Studies :** Designing Affinity diagram, mind map Self Study: tools like Point of View(POV) and How Might We (HMW) tools	8

IV	**Unit-4 : Prototyping** Select from ideas and make quick prototypes (mock-ups) using available material. Choose appropriate frameworks, strategies, techniques for prototype development. Self Study: Legal Aspects, IPR	8
	Total	30

Text Books:

1. Design Thinking: A guide to creative problem solving for everyone. Andrew Pressman, Routledge Taylor and Francis group, 2019, 1st Edition
2. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, Tim Brown

Reference Books:

1. Lal, D. M. (2021). Design Thinking- Beyond the Sticky Notes. Sage Publications India Pvt. Ltd.

Online Sources:

1. https://www.coursera.org/learn/designthinkingandinnovation
2. https://www.getapp.com/collaboration-software/a/mindmeister/

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Program:	B. Tech. (Computer Engineering)					Semester: III	
Course:	Universal Human Values (VEC-1) (Offered by AS&H)					Code: BSH23VE01	
Credit	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
02	02	-	-	25	25	-	50

Course Objectives:

This course aims at enabling students,

1. To 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 to lead their personal and professional lives in an ethical 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 learning the course, the students should be able to:

1. **Illustrate** the relevance of Universal Human Values using real-life examples from personal, social, and professional contexts.
2. **Interpret** a human being as the co-existence of 'Self' and 'Body'.
3. **Apply** the concept of harmony in family and society to given scenarios with appropriate value-based actions.
4. **Apply** Universal Human Values to promote coexistence with nature in personal and professional life..

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Introduction to Value Education:** • Understanding Value Education • Self-exploration as the Process for Value Education • Continuous Happiness and Prosperity • Right Understanding • Current Scenario • Method to fulfil the Basic Human Aspirations	4
	Sharing Session: • Sharing about Oneself • Exploring Human Consciousness Exploring Natural Acceptance	3
II	**Harmony in the Human Being:** • Human being: the Co-existence of the Self and the Body • Needs of the Self and the Body • The Body as an Instrument of the Self • Understanding Harmony in the Self	4

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	• Harmony of the Self with the Body • Programme to ensure self-regulation and Health	
	Sharing Session: • Exploring the difference of Needs of Self and Body • Exploring Sources of Imagination in the Self • Exploring Harmony of Self with the Body • AI Integration: Personal Habit Analysis	4
III	**Harmony in the Family and in Society;** • Harmony in the Family • 'Trust'—the Foundational Value in Relationship • 'Respect' – as the Right Evaluation • Other feelings (Values) in Human-to-Human Relationship • Understanding Harmony in Society • Vision for the Universal Human Order • Five Dimensions of Human Order	4
	Sharing Session: • Exploring the Feeling of Trust • Exploring the Feeling of Respect and Exploring Systems to Fulfil Human Goal	3
IV	**Harmony in Nature/Existence:** • Understanding Harmony in Nature, • Realizing Existence as Coexistence at All Levels • The Holistic Perception of Harmony in Existence **Implications of Holistic Understanding: A Look at Professional Ethics:** • Definitiveness of (Ethical) Human Conduct • Humanistic Constitution and Universal Human Order, • Competence in Professional Ethics • Holistic Technologies, Production Systems and Management Models-Typical Case Studies • Strategies for Transition towards Value-based Life and Profession.	4
	Sharing Session: • Exploring the Four Orders of Nature • Exploring Co-existence in Existence • Exploring AI for Holistic Technologies • Exploring Humanistic Models in Education • Exploring Steps of Transition towards Universal Human Order	4
	Total	**30**

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2019, A Foundation Course in HUMAN VALUES and Professional Ethics- Presenting a universal approach to value education through self-exploration, Excel Books

Reference Books:

1. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
2. A. Nagaraj, 1999, Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amarkantak.
3. A. N. Tripathy, 2003, Human Values, New Age International Publishers.
4. E. G. Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
5. M. Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics and Human Values, Eastern Economy Edition, Prentice Hall of India Ltd.
6. P. Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
7. L. Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Online Sources:

1. http://madhyasth-darshan.info/postulations/knowledge/knowledge-of-humane-conduct/
2. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
3. https://youtu.be/OgdNx0X923I

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Course Syllabus
Semester IV

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Program:			B. Tech. (Computer Engineering)					Semester: IV				
Course:			Design and Analysis of Algorithms					Code: BCE24PC07				
Credit			Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks						
			Lecture	Practical	Tutorial	FA		SA	TW	OR	P R	Total
L	P	T				FA1	FA2					
3		-	2	2	-	10	10	30	50			100

Prior knowledge of Data Structure and Algorithms **is essential.**

Course Objectives:

This course aims at enabling students:

1. To learn fundamental mathematical theories and techniques that support problem-solving and algorithm design.
2. To understand the techniques for analyzing the performance of algorithms with respect to time and space complexity.
3. To learn the application of algorithmic strategies and paradigms for solving computational problems effectively.
4. To understand methods for developing algorithms those are optimized for time and space efficiency.

Course Outcomes:

After learning the course, the students will be able to:

1. Analyze efficiency of algorithms using mathematical techniques to evaluate algorithm performance.
2. Analyze computational efficiency of algorithmic problems using Divide and Conquer or Greedy strategy.
3. Apply algorithmic techniques to solve optimization problems using Dynamic programming or Branch and Bound.
4. Apply Backtracking approach to implement solutions for combinatorial problems.

Guidelines for Laboratory/Term Work Assessment:

The laboratory assignments are to be submitted by students in the form of a journal.

1. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, data description, conclusion, and assessor's sign.
2. Program codes with sample output of all performed assignments should be submitted.
3. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.
4. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
5. Suggested parameters for overall assessment as well as each laboratory assignment assessment include timely completion, performance, innovation, efficiency, punctuality and neatness.
6. All assignments are mandatory.
7. Recommended Tools for the implementation of above assignments: Python, Java etc.
   Best Practices: GitHub, Leetcode, Hacker Rank and other similar platforms.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Problem solving and Algorithmic Analysis**: Asymptotic notations, lower bound and upper bound: Best case, worst case, average case analysis, classification of time complexities (linear, logarithmic etc)-Growth of function, Recurrences: Formulation and solving recurrence equations using Master Theorem, Introduction: P,NP, NP hard, NP Complete. **Self Study:**	8

	Solving recurrence equations using substitution method	
II	**Divide and Conquer Strategy:** Principle, control abstraction, Time Analysis of control abstraction, Binary search, Quick sort, Integer Arithmetic- Multiplication. **Greedy strategy:** Knapsack problem, Job scheduling algorithm with deadlines, Single Source Shortest Path Dijkstra's. **Self Study:** Divide and Conquer : Merge Sort, Greedy strategy: Minimum Spanning Tree	7
III	**Dynamic Programming Strategy:** Single Source Shortest Path: Bellman-Ford, All Pair Shortest Path - Floyd-Warshall, Binomial coefficients, 0/1 knapsack. **Branch and Bound Strategy:** Strategies – FIFO, LIFO and LC approaches, 0/1 knapsack problem (FIFO, LIFO, LC), Branch and Bound using TSP **Self Study:** Dynamic Programming Strategy: Optimal Binary Search Tree (OBST), Branch and Bound Strategy: Sum of subset	8
IV	**Backtracking Strategy:** Principle, control abstraction, Time Analysis of control abstraction, N-queen problem, Graph Coloring problem, Knapsack problem, Hamiltonian cycle, Sum of Subset **Self Study:** Knight's Tour	7
	Total	30

Suggested Lab Assignments:

1. You are working as a data analyst for a financial institution that handles high-precision transactions involving large, multi-digit monetary values. Recently, the institution needs to calculate the product of two exceptionally large numbers (each over 15 digits) representing aggregated transaction amounts for quarterly reports. Due to the size of these values, traditional multiplication methods are computationally inefficient. Implement the algorithm to perform high-precision multiplication of these large integers accurately and efficiently. Test your implementation with multiple large-number pairs to ensure reliability and precision in financial reporting.

2. Consider the scheduling problem. n tasks to be scheduled on a single processor. Let d1, ...,dn be the deadline and p1,....pn be the profit of each task to execute on a single processor. The tasks can be executed in any order but one task at a time and each task takes 1 unit of time to execute. Design a greedy algorithm for this problem and find a schedule or sequence of jobs that gives maximum profit.

3. You find yourself in a labyrinthine dungeon with multiple rooms and connecting passageways. Each passage has a specific time to travel, and some passages are blocked due to cave-ins. Starting from the main entrance, you must find the shortest escape routes to every other room in the dungeon. Use Dijkstra's algorithm to determine the quickest time required to reach each room from the entrance. If any room is isolated and unreachable, mark it as -1. Test this with a dungeon of at least 15 rooms and random travel times for each accessible passage.

4. You have a business with several offices; you want to lease phone lines to connect them up with each other; and the phone company charges different amounts of money to connect different pairs of cities. You want a set of lines that connects all your offices with a minimum total cost. Solve the problem by Floyd-Warshall algorithm.

5. You are given a set of items, each with a weight and profit, and a maximum weight capacity. Using the Branch and Bound approach, find the optimal subset of items that maximizes total profit while staying

within the weight limit. Implement and compare FIFO, LIFO, and Least Cost (LC) approaches (any 2) for this problem.

6. A classic problem that can be solved by backtracking is called the Knight's tour Problem. It is a problem in which we are provided with a NxN chessboard and a knight. For a person who is not familiar with chess, the knight moves two squares horizontally and one square vertically, or two squares vertically and one square horizontally. In this problem, there is an empty chess board, and a knight starting from any location on the board, task is to check whether the knight can visit all of the squares on the board or not. When it can visit all of the squares, then place the number of jumps needed to reach that location from the starting point.

7. A traveler wants to visit every city exactly once in a network of connected cities. The goal is to determine whether such a path exists starting from a given city. Use backtracking to explore all possible routes while ensuring no city is revisited. If a route becomes invalid, backtrack and try alternative paths. Extend the solution to detect Hamiltonian cycles.

Text Books:

- Horowitz, Sahani, "Fundamentals of computer Algorithms", Galgotia. 2Nd Edition, 2008.ISBN 13. 978 8173716126
- Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", PHI, ISBN 978-81-203-1131-2

Reference Books:

1. Thomas H Cormen and Charles E.L Leiserson, "Introduction to Algorithms", The MIT Press; 4th edition, April 5, 2022, ISBN-13: 978-0262046305
2. Michael T. Goodrich, Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", Wiley, ISBN 978-81-265-0986-7
3. Parag Himanshu Dave, Himanshu Bhalchandra Dave, " Design And Analysis of Algorithms",Pearson Education, ISBN 81-7758-595-9

Online Sources:

1. https://onlinecourses.nptel.ac.in/noc19_cs47/preview

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Program:			B. Tech. (Computer Engineering)					Semester: IV				
Course:			Database Management System					Code: BCE24PC08				
Credit			Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks						
						FA		SA	TW	OR	PR	Total
L	P	T	Lecture	Practical	Tutorial	FA1	FA2					
5			3	4	-	20	20	60	50	-	50	200

Prior knowledge of Computer Organization, Data Structures, basics of Linux commands, and programming **is essential**

Course Objectives:

This course aims at enabling students:

1. To make students understand the fundamental concepts of database management.
2. To make students familiar with building database design.
3. To make students familiar with the basic issues of transaction processing and concurrency control.
4. To make students understand different SQL queries and concepts.
5. To make students understand different NOSQL and MongoDB concepts.

Course Outcomes:

After learning the course, the learner will be able to:

1. Design E-R Model for given requirements and convert the same into database tables
2. Use SQL to write queries for given requirements
3. Implement normalization techniques, to construct optimized relational database designs
4. Analyze and implement transaction management strategies
5. Apply principles of NoSQL and MongoDB databases to perform the operations on databases

Guidelines to Instructor for laboratory Conduction:

1. Instructor must frame assignments on all concepts covered in Group A and Group B.
2. Instructor will design the queries which demonstrate the use of concepts specified in the assignment.
3. Operating System recommended: - 64-bit Open-source Linux or its derivative.
4. Programming tools recommended: - MYSQL, MongoDB, ERD plus, ER Win etc.

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Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student.
2. Each Laboratory assignment submitted by students will be assessed and marks will be assigned by the instructor based on parameters mentioned in predefined rubrics. Average of marks obtained by students for each assignment will be considered to assign final TW marks.
3. Practical examination will be on assignments given in Group A and Group B

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Introduction to Database System and ER Modeling:** Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Structure, Data Models, Database Design and ER Model: Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity Relationship Model, ER Diagram, Design Issues, Extended E-R Features, converting E-R & EER diagram into tables.	9

	Self Study: Case Study of Edgar F. Codd (Turing Award 1981) "A Relational Model of Data for Large Shared Data Banks"	
II	**SQL:** SQL: Characteristics and advantages. SQL Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators, Tables: Creating, Modifying, Deleting, Updating, SQL DML Queries: SELECT Query and clauses, Views: Creating, Dropping, Updating using Indexes, Set Operations, Predicates and Joins, Set membership, Tuple Variables, Set comparison, Ordering of Tuples, Aggregate Functions, SQL Functions, Nested Queries, **Self Study** :Online Shopping Platform (Amazon / Flipkart), Why SQL survived for 40+ years?	9
III	**Relational Database Design:** Relational Model: Basic concepts, Attributes and Domains, CODD's Rules, Relational Integrity: Domain, Referential Integrities, Enterprise Constraints, Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, 2NF, 3NF, BCNF **Self Study** :Aadhaar Database Design	9
IV	**Database Transaction Management:** Transaction concept, Transaction states, ACID properties, Concept of Schedule, Serial Schedule, Serializability: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules, Concurrency Control: Lock-based, Time-stamp based Deadlock handling, Recovery methods: Shadow- Paging and Log-Based Recovery **Self Study** : Case study of **Jim Gray (Turing Award 1998)** Father of transaction processing, Why banks trust databases more than humans?	9
V	**NoSQL Databases:** Introduction to Distributed Database System- Advantages, disadvantages, CAP Theorem. Types of Data: Structured, Unstructured data & Semi-Structured Data; NoSQL Database: Introduction, need, Features, Types of NoSQL Databases: Key-value store, document store, graph, wide column stores; BASE Properties, Data Consistency model ACID Vs BASE, Comparative study of RDBMS and NoSQL, MongoDB (with syntax and usage): CRUD Operations, Aggregation, MapReduce, **Self Study** :WhatsApp / Instagram and **Aadhaar Project Case Study:** India's largest biometric database with 1.2+ billion records, demonstrating MongoDB, MySQL	9
	Total	**45**

Suggested List of Lab assignments:

1. Decide a real time application and formulate a problem statement for the application to be developed. Propose a Conceptual Design using ER features using tools like ERD plus, ER Win etc. (Identifying entities, relationships between entities, attributes, keys, cardinalities, generalization, specialization etc.)Convert the ER diagram into tables on paper and propose an optimal database design using different normalization concepts.
2. **MySQL Database Operations** Implement SQL queries to familiarize students with essential SQL commands in MySQL - to create a new user, create a table considering different data types, Insert, Select, Update, Delete, Drop, Alter, distinct, describe, Truncate command
3. **Implementing Data Constraints in MySQL** Implement sql queries to provide students with hands-on experience in implementing various data constraints using SQL commands in MySQL. (NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, and DEFAULT)
4. **Exploring SQL Computations done on Table Data and Built-in Functions in MySQL** Implement sql queries for different SQL concepts for SQL computation (arithmetic operators, logical operators, pattern matching, IN and NOT IN predicates, and MySQL built-in functions).
5. **Exploring SQL Grouping, Database Views** Implement SQL queries for different SQL concepts such as

grouping data, using the GROUP BY clause, employing the HAVING clause, applying the EXISTS/NOT EXISTS operators, Creating and using Database Views.

6. **Subqueries, Join Operations and Set Operations** Write SQL queries to demonstrate the different SQL concepts like subqueries, performing various join operations, and using set operators in MySQL.
7. **Nested Queries** Implement SQL queries to demonstrate the nested queries in SQL using MySql.
8. **MongoDB Queries:** Design and Develop MongoDB Queries using CRUD operations. (Use CRUD operations, SAVE method, logical operators etc)
9. **MongoDB - Aggregation and Indexing:** Design and Develop MongoDB Queries using aggregation and indexing with suitable examples using MongoDB
10. **MongoDB - Map reduce operations:** Implement Map reduces operation with a suitable example using MongoDB.

Text Books:

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, 7th Edition, 2020 ISBN 978-0-07-802215-9.
2. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB Publications, 2014 ISBN: 9788176569644.
3. Connally T, Begg C., "Database Systems- A Practical Approach to Design, Implementation and Management", Pearson Education, 5th Edition, 2010, ISBN 81-7808-861-4.
4. Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled", Addison Wesley, ISBN 10: 0321826620, 2013, ISBN 13: 978-0321826626.

Reference Books:

1. C. J. Date, "An Introduction to Database Systems", Addison-Wesley, 8th Edition, 2004, ISBN 0321189566. S. K. Singh, "Database Systems: Concepts, Design and Application", Pearson Education, 2009,ISBN 9788177585674.Kristina Chodorow, Michael Dierolf, "MongoDB: The Definitive Guide", O''Reilly Publications, 3rd Edition, 2019 ISBN 9781491954461.
2. Kevin Roebuck, "Storing and Managing Big Data - NoSQL, HADOOP and More", Emereo Pty Limited, 2011, ISBN 1743045743, 9781743045749.

Online Sources:

1. http://w3schools.org/

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Program :	B. Tech. (Computer Engineering)					Semester: IV	
Course :	Applied Mathematics (OE – Applied Mathematics) (Suggested for Mechanical branch) (offered by AS&H)					Code : BSH23OE01	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of Univariate Calculus, Multivariate Calculus **is essential.**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1. Statistical techniques and Probability theory for Data Analysis.
2. Partial differential equations applied to mechanical engineering problems such as mechanical vibrations and heat transfer.
3. Laplace Transform and Inverse Laplace Transform applied to solve linear differential equations.

Course Outcomes:

After learning the course, the students should be able to:

1. **Apply** descriptive statistical techniques to numerical data.
2. **Draw** inferences from data using probability theory and hypothesis testing.
3. **Solve** wave, heat and Laplace equations using separation method.
4. **Find** Laplace and Inverse Laplace Transform for piecewise continuous function and solution of linear differential equations.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	Statistics: Measures of Variability: Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting, Correlation and Regression.	7
II	Probability Distributions: Probability, Theorems on Probability, Mathematical Expectation, Binomial, Poisson, and Normal Distributions. Hypothesis Test: z-test, t-test, Chi-Square test, ANOVA Test.	8
III	Applications of Partial Differential Equations: Solution to One dimensional Wave, Heat and Transport equation, Two-dimensional heat flow equation using Method of separation of variables.	7
IV	Laplace Transform: Introduction, Laplace Transform of some standard and special functions, Region of convergence and Properties, properties and theorems of Laplace Transformation. Inverse Laplace Transform, Application of Laplace Transform to solve LDE.	8
	Total	**30**

Text Books:

1. Peter O'Neil, "Advanced Engineering Mathematics", Thomson Learning ,7 Edition, ISBN 13:9781337274524.
2. B.V. Ramana , "Higher Engineering Mathematics", Tata McGraw-Hill, 34 edition, ISBN 13:9780070634190.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics" Wiley Eastern Ltd.,10 Edition, ISBN 13: 9780470458365
2. B. S. Grewal , "Higher Engineering Mathematics", Khanna Publication, 42 Edition, ISBN 13:9788174091955.
3. N. P. Bali, Manish Goyal, " A textbook of Engineering Mathematics", 9th Edition, ISBN 16:978-8131808320
4. H.K. Das, "Advanced Engineering Mathematics", S Chand & Company Ltd. 22 edition, ISBN 9352533836.

Online Sources:

NPTEL Course lectures links:

1. https://nptel.ac.in/courses/111/105/111105038/ (P.D.E)
2. https://onlinecourses.nptel.ac.in/noc20_ma13/ (Advanced Engineering Mathematics)

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Program :	B. Tech. (Computer Engineering)					Semester: IV	
Course :	Computational Techniques (OE – Applied Mathematics) (Suggested for E&TC branch) (offered by AS&H)					Code : BSH23OE02	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge Univariate Calculus, Multivariate Calculus is essential

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1. Statistical techniques, Probability theory and hypothesis techniques.
2. Numerical techniques to approximate solutions for interpolation, integration and ordinary differential equations.

Course Outcomes:

After learning the course, the students should be able to:

1. **Apply** descriptive statistical techniques to numerical data.
2. **Analyze** random phenomena using probability theory and distributions.
3. **Draw** inferences from data using hypothesis testing.
4. **Find** approximate solutions for interpolation, integration and ordinary differential equations.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Statistics:** Measures of Variability: Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting, Correlation and Regression.	7
II	**Probability Distributions:** Probability, Theorems on Probability, Random Variable, Probability mass function, Mathematical Expectation, Probability distributions: Binomial, Poisson, and Normal..	8
III	**Sampling Distribution:** Introduction and Types, Population vs Sample **Hypothesis Tests:** Level of significance, Confidence interval, p-Test, z-test, t-test, Chi-Square test, ANOVA Test.	7
IV	**Numerical Methods:** **Interpolation:** Finite Differences, Newton's and Lagrange's interpolation formula. **Numerical Integration:** Trapezoidal and Simpson's rule **Ordinary differential equations:** Euler's, Modified Euler's and Runge-Kutta fourth order methods	8
	Total	**30**

Text Books:

1. Peter V. Neil, "Advanced Engineering Mathematics", Thomson Learning ,7 Edition, ISBN 13:9781337274524.
2. B.V. Ramana , "Higher Engineering Mathematics", Tata McGraw-Hill, 34 edition, ISBN 13:9780070634190.

Reference Books:

1. M. D. Greenberg , "Advanced Engineering Mathematics", Pearson Education, 2 Edition, ISBN 13:9780486492797.
2. B. S. Grewal , "Higher Engineering Mathematics", Khanna Publication, 42 Edition, ISBN 13:9788174091955.
3. N. P. Bali, Manish Goyal, " A textbook of Engineering Mathematics", 9th Edition, ISBN 16:978-8131808320
4. H.K. Das, "Advanced Engineering Mathematics", S Chand & Company Ltd. 22 edition, ISBN 9352533836.

Online Sources:

NPTEL Course lectures links:

1. Probability Theory for Data Science - Course (nptel.ac.in) (Statistics, Probability and Hypothesis testing)
2. Numerical methods - Course (nptel.ac.in) (Numerical Methods)

"Knowledge Brings Freedom"

Program :	B. Tech. (Computer Engineering)					Semester: IV	
Course :	Applied Mathematics (OE – Applied Mathematics) (Suggested for Civil branch) (offered by AS&H)					Code : BSH23OE03	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of Univariate Calculus, Multivariate Calculus **is essential**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1. Statistical techniques, Probability theory, and hypothesis techniques.
2. Higher level mathematics and their applications in Civil Engineering.

Course Outcomes:

After learning the course, the students should be able to:

1. Apply descriptive statistical techniques to numerical data.
2. Draw inferences from data using probability theory and hypothesis testing.
3. Find approximate solutions for interpolation, integration and ordinary differential equations.
4. Examine the vector fields using concepts of vector differentiation and Integration.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Statistics:** Measures of Variability: Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting, Correlation and Regression.	7
II	**Probability Distributions:** Probability, Theorems on Probability, Mathematical Expectation, Binomial, Poisson and Normal Distribution **Hypothesis Test:** z-test, t-test, Chi-Square test, ANOVA Test.	8
III	**Numerical Methods:** **Interpolation:** Finite Differences, Newton's and Lagrange's interpolation formula **Numerical Integration:** Trapezoidal and Simpson's rule **Ordinary differential equations:** Euler's, Modified Euler's and Runge-Kutta fourth order methods	7
IV	**Vector Differentiation:** Introduction, Vector differential operators, Gradient, Divergent, Curl, Directional Derivatives, Solenoidal and Irrotational fields, Scalar Potential. **Vector Integration and Applications:** Introduction to Line, Surface and Volume Integration of vectors, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem	8
	Total	**30**

Text Books:

1. B.V. Ramana , "Higher Engineering Mathematics", Tata McGraw-Hill, 34 edition, ISBN 13:9780070634190
2. Peter O'Neil, "Advanced Engineering Mathematics", Thomson Learning ,7 Edition, ISBN 13: 9781337274524

Reference Books:

1. M. D. Greenberg , "Advanced Engineering Mathematics", Pearson Education, 2 Edition, ISBN 13: 9780486492797
2. S.R.K. Iyengar, Rajendra K. Jain, "Advanced Engineering Mathematics", Alpha Science International, Ltd.4
3. Edition, ISBN 13: 9781842658468
4. B. S. Grewal , "Higher Engineering Mathematics", Khanna Publication, 42 Edition, ISBN 13: .9788174091955
5. N. P. Bali, Manish Goyal, " A textbook of Engineering Mathematics", 9th Edition, ISBN 16:978-8131808320

Online Sources:

1. NPTEL Course lectures links:
   https://nptel.ac.in/courses/111/105/111105090/ (Probability)
   https://onlinecourses.nptel.ac.in/noc20_ma13/ (Advanced Engineering Mathematics)
2. V-lab (IIT-Bombay) link: http://vlabs.iitb.ac.in/vlabs-dev/labs/numerical_lab/labs/explist.php

"Knowledge Brings Freedom"

Program :	B. Tech. (Computer Engineering)					Semester: IV	
Course :	Computational Techniques (OE – Applied Mathematics) (Suggested for Comp/Comp R/ IT branch) (offered by AS&H)					Code : BSH24OE07	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of Univariate Calculus, Multivariate Calculus **is essential.**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1. Statistical techniques, Probability theory, and hypothesis techniques.
2. Different mathematical approaches for optimization.

Course Outcomes:

After learning the course, the students should be able to:

1. **Apply** descriptive statistical techniques to numerical data.
2. **Analyze** random phenomena using probability theory and distributions.
3. **Draw** inferences from data using hypothesis testing.
4. **Apply** optimization techniques in transportation and assignment problems.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Statistics:** Measures of Variability: Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting (line, parabola & exponential curves), Correlation and Linear Regression.	7
II	**Probability Distributions:** Probability, Theorems on Probability, Random Variable, Probability mass function, Mathematical Expectation, Probability distributions: Binomial, Poisson, and Normal.	8
III	**Sampling Distribution:** Introduction and Types, Population vs Sample **Hypothesis Tests:** Level of significance, Confidence interval, p-Test, z-test, t-test, Chi-Square test, ANOVA Test.	7
IV	**Transportation Problems:** Introduction, Mathematical model of transportation problem, Methods of finding initial solutions: North-west Corner rule, Least cost method, VOGEL"s approximation method, Optimality of initial solution using MODI Method. **Assignment Problems:** Introduction, Mathematical model of Assignment problem, solutions to Assignment problems using Hungarian method.	8
	Total	**30**

Text Books:

1. Peter O'Neil, "Advanced Engineering Mathematics", Thomson Learning ,7 Edition, ISBN 13:9781337274524.
2. B.V. Ramana , "Higher Engineering Mathematics", Tata McGraw-Hill, 34 edition, ISBN 13:9780070634190.

Reference Books:

1. M. D. Greenberg , "Advanced Engineering Mathematics", Pearson Education, 2 Edition, ISBN 13:9780486492797.
2. B. S. Grewal , "Higher Engineering Mathematics", Khanna Publication, 42 Edition, ISBN 13:9788174091955.
3. N. P. Bali, Manish Goyal. " A textbook of Engineering Mathematics", 9th Edition, ISBN 16:978-8131808320
4. H.K. Das, "Advanced Engineering Mathematics", S Chand & Company Ltd, 22 edition, ISBN 9352533836.

Online Sources:

NPTEL Course lectures links:

1. Probability Theory for Data Science - Course (nptel.ac.in) (Statistics, Probability and Hypothesis testing)
2. https://nptel.ac.in/courses/110/106/110106059/(Transportation&AssignmentsProblems)

"Knowledge Brings Freedom"

Program :	B. Tech. (Computer Engineering)					Semester: IV	
Course :	Mathematical Optimization (OE – Applied Mathematics) (Suggested for AI & ML branch) (offered by AS&H)					Code : BSH24OE08	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of Univariate Calculus, Multivariate Calculus **is essential**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1. Different mathematical approaches for optimization.
2. Commonly used tools and techniques in network analysis.

Course Outcomes:

After learning the course, the students should be able to:

1. **Solve** Linear Programming Problems using graphical and simplex methods.
2. **Apply** optimization techniques in transportation and assignment problems.
3. **Analyze** project networks using Critical Path Method and Project Evaluation & Review Techniques.
4. **Apply** numerical methods for optimal solutions of constrained, unconstrained linear and nonlinear programming problems.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Linear Programming (LP):** Introduction, formulation of Linear Programming problems, Graphical solution method, multiple optimal solutions, Unbounded solutions, Infeasible solutions, Simplex Method.	8
II	**Transportation Problems:** Introduction, Mathematical model of transportation problem, methods of finding initial solutions: North-west Corner rule, Least cost method, VOGEL"s approximation method, Optimality of initial solution using MODI Method. **Assignment Problems:** Introduction, Mathematical model of Assignment problem, solutions to Assignment problems using Hungarian method.	7
III	**Network Analysis:** Network Diagram, Project Management: PERT and CPM, Critical path analysis, Project scheduling with uncertain activity time, and Project time-cost	8
IV	**Unconstrained optimization:** One-dimensional search methods, Gradient-based methods, Conjugate direction and quasi-Newton methods. **Constrained Optimization:** Lagrange theorem	7
	Total	**30**

Text Books:

1. Rao S. S., Engineering Optimization Theory and Practice, Willy Eastern Ltd.4th Edition, ISBN: 978-0-470- 18352-6
2. Taha Hamdy, Operation Research: An Introduction, Pearson Education,9th Edition, ISBN:0134444019

Reference Books:

1. Sharma S.D.Operation Research, Kedarnath Ramnath & Co.Edition, ISBN: 9380803389
2. Peter. O'Neil, "Advanced Engineering Mathematics," Thomson Learning,7 Edition, ISBN 13: 9781337274524
3. Hira Gupta, "Operation Research," S.Chand Publication, ISBN(13): 9788121909686.
4. Sharma J.K."Operations Research-Theory and Applications," Trinity Press,6 Edition, ISBN:9789385935145

Online Sources:

NPTELCourselectureslinks:

1. https://nptel.ac.in/courses/111/102/111102012/(LPP)
2. https://nptel.ac.in/courses/110/106/110106059/(Transportation&AssignmentsProblems)

"Knowledge Brings Freedom"

Program:	B. Tech (Computer Engineering)				Semester: IV		
Course:	Community Engagement Project (CEP)/ Field Project (FP)				Code: BCE24EL01		
Credit	Teaching Scheme			Evaluation Scheme			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	4	-	100	-	-	100

Prior knowledge of basic programming knowledge **is essential**

Course Objectives:

This course aims at enabling students:

1. To identify and analyze environmental issues faced by local communities.
2. To identify the use of technology for societal needs.
3. To design and implement innovative solutions using computer engineering principles to address identified problems.
4. To work in a team with individual contributions to the project development.

Course Outcomes:

After learning the course, the students will be able to:

1. Apply their computer engineering knowledge to analyze communities' real-world environmental problems.
2. Design real-world applications by considering suitable requirements.
3. Implement real-world applications using suitable tools and technology.
4. Work in a team with individual contributions to the development of the project.
5. Communicate and demonstrate technical information effectively through project reports, presentations, and interactions with community members and mentors.

Guidelines:

The purpose of this course is to empower students with the knowledge, skills, and mindset needed to leverage technology for addressing environmental and societal needs. Through a hands-on approach, students will learn to identify, analyze, and solve environmental issues faced by local communities using computer engineering principles. By designing and implementing innovative solutions, students will not only gain technical proficiency but also develop teamwork, collaboration, and communication skills essential for making a positive impact on communities and the environment.

Team Formation, Guide Allocation, and Project Identification:

1. 2-4 students can form a team within the same or different disciplines.
2. Students are expected to explore and understand environmental challenges that communities face, such as pollution, waste management, water scarcity, resource depletion, climate change, energy transition, natural disasters, biodiversity loss, land degradation, etc.
3. The project coordinator, in consultation with a panel of experts, assigns project guides from the same program to provide guidance and support to the teams throughout the project.
4. The identified problem statement addressing environmental challenges must be registered with the project coordinator by the team after consulting with their respective project guide.
5. Field visits are encouraged to identify the problem statements.

Collaborative Work and Progress Reporting:

1. Each student on the team must work collaboratively and contribute significantly to the design and development of solutions for registered problem statements, focusing on environmental challenges faced by the community.
2. Students should work at least 4 hours per week and shall meet their assigned project guide regularly (at least twice a week) and report the progress of the project work, emphasizing the application of community engineering principles.
3. Students are expected to Incorporate suggestions from the earlier review.

Documentation and Reporting:

1. Students shall maintain a record of all meetings, remarks given by the guide/reviewers, and progress of the work in the project diary, presented during each review presentation.
2. For the final assessment, students shall complete the project report in all aspects, including formatting, duly signed by the project guide, Head of the Department.

Data Submission and Additional Outputs:

1. Students shall submit all data related to project work in soft copy to their guides, including the project report, A3 size poster, presentation, paper, etc., focusing on community engineering solutions.

Mode of Evaluation:

Review-I - Problem Identification: (Within the first month of Semester VI) (Weightage: 50%)

1. Students must identify a specific problem statement related to community engineering projects.
2. The problem statement should be relevant to environmental science/study-related societal needs and address a real-world issue.
3. A brief presentation outlining the identified problem and its significance should be submitted. The presentation should include the background of the problem, literature review, proposed solution approach, and initial findings or developments.
4. Students should be prepared to present their progress to a review committee.

Review-II – (Weightage: 50%) (at the end of semester IV)

Solution Development:

1. Projects will be evaluated based on the effectiveness of the solution designed and developed using fabrication, coding, modeling, product design, process design, or other relevant processes for identified problem statement.

Outcome Evaluation:

2. The project outcome will be assessed regarding its technical feasibility, economic viability, societal impact, and environmental sustainability.
3. A detailed report covering the problem identification, literature review, methodology, progress made, challenges faced, and future plan should be submitted.
4. Teams must prepare an e-document, uploaded along with a plagiarism check report, detailing their project work and findings.
5. Each team member must submit their report, highlighting their individual contributions with a brief abstract of the total work in the initial part of the document. Reports must be unique, and the review will be based on individual contributions.

Program:			B. Tech. (Computer Engineering)					Semester: III				
Course:			Management Information System					Code: BCE24EM01				
Credit			Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks						
						FA		SA	TW	OR	PR	Total
L	P	T	Lecture	Practical	Tutorial	FA1	FA2					
2	-	-	2	-	-	10	10	30	-	-	-	50

Prior knowledge of software engineering
is essential

Course Objectives:

This course aims to enable students:

1. To understand the fundamentals of Management Information System (MIS).
2. To identify types of Information Systems.
3. To study concepts of data resource management for MIS
4. To use MIS in business and decision-making.
5. To comprehend CRM, SCM, and ERP components.

Course Outcomes:

After learning the course, the students will be able to:

1. Comprehend the fundamentals of MIS.
2. Apply concepts of data resource management for MIS
3. Use MIS in Supporting Decision Making
4. Demonstrate the significance of MIS in Business Applications and enterprise systems.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Foundations of Information Systems:** Systems concepts: A foundation, Components of Information Systems, Information System Resources, Information System Activities, The Role of e-Business in Business, Trends in Information Systems, types of Information Systems, Managerial challenges of Information Technology. **Self Study:** Case study for each type of Information system	7
II	**MIS in Data Resource Management:** Fundamentals of Database Concepts, Types of Databases, The Database Management Approach, Implementing Data Resource Management, challenges of Data Resource Management, Accessing Databases, Database Development, Data planning and Databases Design, Data Warehouses and Data Mining **Self Study:** Database system tool	7
III	**MIS in Supporting Decision Making:** Business and Decision Support, Decision Support Trends, Decision Support Systems, Executive Information Systems, Enterprise Portals and Decision Support, an overview of Artificial Intelligence Technologies in Business **Self Study:** Data Analytical tool	8
IV	**MIS in Business Applications:** Introduction to e-Business Systems, Functional Business Systems, IT in Business, Marketing systems, Manufacturing systems, Human Resource Systems, Accounting systems, Financial Management Systems Enterprise e-Business Systems: Customer Relationship Management (CRM), Enterprise Resource Planning (ERP), Supply Chain Management (SCM), e-Commerce processes, Electronic Payment Processes. Real World Case Study **Self Study:** Any one MIS Tool	8

Total	30

Text Books:

- James A. O'Brien Management Information Systems. McGraw-Hill/Irwin. *Sixth Edition.* ISBN: 978-0-07-337681-3, 2006.
- W.S. Jawadekar, Management Information Systems, Tata McGraw Hill, 4th Edition, ISBN: 9780070146624, 0070146624, 2011.

Reference Books:

1. Kenneth C. Laudon & Jane P. Laudon, Management Information Systems Managing the Digital Firm, Pearson Education Limited, 13TH Edition, ISBN: 978-0-13-305069-1, 2014
2. Stephen Haagand Maeve Cummings, Management Information Systems for the Information Age, McGraw-Hill Companies, ISBN: 007337678, 2010.

Online Sources:

1. https://www.odoo.com/documentation/16.0/fr/applications/inventory_and_mrp/inventory/warehouses_storage/inventory_management.html
2. https://trailhead.salesforce.com/users/digitalbhardwaj/trailmixes/for-absolute-beginners
3. https://trailhead.salesforce.com/users/natbattista78/trailmixes/beginner-admin
4. https://trailhead.salesforce.com/users/jurn/trailmixes/beginner-trails

"Knowledge Brings Freedom"

Program :	S.Y.B. Tech.				Semester: IV				
Course :	Professional Development Training				Code : BSH24AE05				
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks				
	Lecture	Practical	Tutorial	Others	Practical			SA	Total
					FA1	FA2	TW		
2	-	4	-	-	-	-	100	-	100

Prior knowledge of Basic Mathematics & English **is essential**

Course Objectives:

This course aims at enabling the students

1. To enhance the logical reasoning skills of the students and improve the problem-solving abilities.
2. To improve the overall professional development of students.

Course Outcomes:

After learning the course, the students will be able to:

1. Apply mathematical concepts to solve diverse numerical problems encountered in engineering, spanning arithmetic, algebra, geometry, and statistics.
2. Employ deductive reasoning, interpret data, and discern patterns to navigate complex logical puzzles and analytical challenges typical of engineering aptitude tests and professional scenarios.
3. Identify grammatical nuances, enhancing their verbal and written communication prowess essential for effective engineering discourse.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Numerical Ability-I** HCF & LCM and Number System, Geometry, Ages, Allegations and Mixtures, Averages, Clocks and Calendars, Equations, Percentages, Profit and Loss, Ratios and Proportion, Series and Progressions, Time, Speed and Distance, Time and Work.	18
II	**Numerical Ability-II** Permutations and Combinations, Probability, Mean, Median, Mode, Standard Deviation, and Variance, Data Interpretation, Graphical Data Interpretation, Pie Charts, Tabular Data Interpretation, Simple Arithmetic Operations, Interest and Compound Interest, Linear equations, Quadratic equations, Triplets, Trigonometry	12
III	**Logical Reasoning** Clocks and Calendar, Direction sense, Family tree, Syllogism, Seating arrangement, Team formation, Coding and Decoding, Number Series and Letter Series, Ranking and Arrangements, Game-Based Aptitude.	12
IV	**Verbal Ability & Reading Comprehension** Subject-Verb Agreement, Articles and Other Determiners, Prepositions, Tenses, Parts of Speech, Active and Passive Voice, Direct and Indirect Speech, Conjunctions, Sentence Selection, Contextual Vocabulary, Error Spotting and Sentence Correction, Sentence Completion, Synonyms and Antonyms, Reading Comprehension, Jumble words & sentences. SMART Goal Setting & Career Road-map, Resume Writing & Linked-in Profile Building, Mock Interviews. Programming Language: Problem-solving & coding practice, Mock coding interviews	18
	Total	60

Text Books:

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.
2. ETHNUS, Aptimithra, 2013, 1stEdition, McGraw-Hill Education Pvt.Ltd.

Reference Books:

1. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.
2. M. Tyra, Quicker Maths, 2018, 5th edition, 2018, BSC publishing company Pvt. Ltd.

"Knowledge Brings Freedom"

Program:	B. Tech (Computer Engineering)					Semester: IV	
Course:	Constitution of India (VEC-2)					BSH24VE02	
Credit	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
02	02	-	-	25	25	-	50

Prior knowledge of: Nil

Course Objectives:

1. To introduce students to the fundamental principles, philosophy, and key features of the Indian Constitution.
2. To familiarize students with the structure and functioning of government and key constitutional provisions.
3. To enable students to apply constitutional values, rights, and duties in understanding contemporary issues and responsible citizenship.

Course Outcomes:

After learning the course, the students will be able to

1. **Explain** the fundamental principles and key features of the Indian Constitution, including Preamble, Rights, Duties, and DPSP.
2. **Describe** the structure and functioning of the Executive, Legislature, and Judiciary, including the law-making process.
3. **Illustrate** constitutional provisions such as amendments, writs, and citizen mechanisms to address rights and governance issues.
4. **Apply** constitutional values to evaluate contemporary issues and challenges in civic and professional contexts.

Detailed Syllabus

Unit	Description	Duration [Hrs]
I	**Foundations of the Indian Constitution** • Introduction to the Indian Constitution: brief historical background, making of the Constitution, and its significance • The Preamble: ideals, philosophy, and interpretation • Salient features of the Indian Constitution: sovereignty, secularism, democracy, federalism, and rule of law • Fundamental Rights and Fundamental Duties: concepts and relevance in contemporary society • Directive Principles of State Policy (DPSP): objectives and role in governance • Relationship between Fundamental Rights, Duties, and DPSP	7
II	**Structure and Functioning of Government** • Union Executive: President, Vice-President, Prime Minister, and Council of Ministers—roles and functions • Parliament: composition and functioning of Lok Sabha and Rajya Sabha • Legislative process: stages of law-making (bill to act) • Judiciary: structure, independence, and concept of judicial review • Federalism: Centre–State relations and distribution of powers • State Government: role of Governor and State Legislature (overview)	8

III	**Constitutional Mechanisms and Citizen Interface** • Amendment process of the Constitution and basic structure doctrine • Constitutional bodies: Election Commission of India and Comptroller and Auditor General—roles and functions • Emergency provisions: national, state, and financial emergencies • Constitutional remedies: writs and judicial remedies for protection of rights • Public Interest Litigation (PIL): concept and significance • Introduction to citizen-centric mechanisms: Right to Information (RTI)	7
IV	**Constitution in Contemporary Context** • Judicial activism and its role in safeguarding constitutional values • Contemporary constitutional issues: freedom of speech, right to privacy, gender justice, and environmental protection • Challenges to constitutional governance: secularism, federalism, and social justice • Recent constitutional developments and amendments • Basic comparative perspective: Indian Constitution and selected global practices • Case Studies with help of artificial intelligence	8
	Total	**30**

Text Books:

1. E 1. Durga Das Basu, —Introduction to the Constitution of India —, Prentice Hall of India, New Delhi,24th edition, 2020, ISBN-109388548868
2. Clarendon Press, Subhash C, Kashyap, — Our Constitution: An Introduction to India's Constitution and constitutional Lawl, NBT, 5th edition, 2014, ISBN-9781107034624

Reference Books:

1. Maciver and Page, —Society: An Introduction Analysis —, Laxmi Publications, 4th edition, 2007, ISBN- 100333916166
2. PM Bhakshi, —The constitution of Indial, Universal Law Publishing - An imprint of Lexis Nexis, 14th edition, 2017, ISBN-108131262375
3. Indian Constitution by Subhash C. Kashyap, National Book Trust, New Delhi.
4. Constitution of India and Professional Ethics, Dr. G. B. Reddy & Mohd. Suhaib, Dreamtech Press.

Online Sources:

1. https://www.legislative.gov.in/constitution-of-india
2. **https://legalaffairs.nalsar.ac.in/**

Vision and Mission of Computer Department

Department Vision

To be a premier Computer Engineering Department by achieving excellence in Academics and Research for creating globally competent and ethical professionals.

Department Mission

- M1: To develop technologically competent and self-sustained professionals through contemporary curriculum.
- M2: To nurture innovative thinking and collaborative research, making a positive impact on society.
- M3: To provide state-of-the art computing environment and learning opportunities through Center of Excellence.
- M4: To foster leadership skills and ethics with holistic development.