VIT Vidyalankar Institute of Technology
Accredited A+ by NAAC

Vidyalankar Institute of Technology

An Autonomous Institute affiliated to University of Mumbai

Bachelor of Technology

in

Information Technology

with Multidisciplinary Minor

Second Year Scheme & Syllabus

(R-2024)

(As per NEP 2020, with effect from the Academic Year 2025-26)

Preamble

The National Education Policy (NEP) framework aims to break the mould from teacher centric to student centric educational practices. It empowers the students with flexibility in terms of choosing courses across different faculties and mode of learning.

This multidisciplinary approach will encourage learners to follow their passion and inherent interests. The learner is free to learn at a pace that he is comfortable with, and this enables lifelong learning. It also enhances the scope for holistic personality development.

This premise is truly reflected in preamble of the NEP document, "The future of nation is decided in the classrooms of the schools and colleges today".

Details of implementation:

NEP curriculum framework enables us to accelerate change, redesign systems with equity in mind, respond to feedback, encourage collaboration, catch and pollinate ideas and create a culture of research and development. It will allow us to offer the required academic flexibility which will focus on improving competency level of students with diverse strengths.

The curriculum planned by VIT has vertical Program Courses consisting of core courses (PCC) of branch of engineering positioned and sequenced to achieve sequential and integral learning of the entire breadth of the specific branch. This vertical also includes Professional elective courses (PEC) which offer flexibility and diversity to learners to choose specialization from a basket of recent developments in their field of technology. The selection of unique professional elective courses based on industrial requirements and organizing them into tracks is a special feature of this curricula ensuring employability.

The vertical Multidisciplinary Courses consists of Open Elective (OE) courses and multidisciplinary minor (MD M) courses. Special vocational and skill development courses are included as a part of Skill courses vertical that make student capable to work in industrial environment.

The student is expected to demonstrate their ability through course in Experiential Learning Courses vertical like internships/On Job Training, Community Engagement Project, Real Industry Project/ research problem. Our curriculum also introduces Social Service Internship and Internship with institutes abroad along with courses like Design Thinking. This will lead to creation of products and/ or patents through this program.

For holistic development of students, apart from technical courses, Ability Enhancement Courses, Entrepreneurship/Economics/Management Courses, Indian Knowledge System and Value Education courses from vertical Humanities and Social Science and Management develop the required soft-skills and attitude amongst learners.

In Liberal Learning vertical. courses like Various Dance Forms, Global citizenship Education, Facets of Astronomy etc. aims to create balance in brain hemispheres and hence improve learners' clarity in thoughts and responses.

In addition to core courses, professional and open electives; our framework offers honor degree in each programme of engineering. It includes specialized courses along with field/ domain study that make student capable of working on industry relevant problems.

Chairman, Board of Studies
Department of Information Technology
Vidyalankar Institute of Technology

Chairman, Academic Council
Vidyalankar Institute of Technology

Second Year B. Tech. Information Technology **Preferred Semester: III**

Course Structure and Assessment Guidelines

Vertical_ Subvertical	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
BSES_BSC	BSC05	Engineering Mathematics-III	Theory	3	20	30	50	100
PC_PCC	PCIT17T	Microprocessor	Theory	2	15	20	40	075
PC_PCC	PCIT17P	Microprocessor Lab	Practical	1	25	-	25	050
PC_PCC	PCIT02T	Advanced Java	Theory	2	15	20	40	075
PC_PCC	PCIT02P	Advanced Java Lab	Practical	1	25	-	25	050
PC_PCC	PCIT01T	Data Structure & Analysis	Theory	2	15	20	40	075
PC_PCC	PCIT01P	Data Structure & Analysis Lab	Practical	1	25	-	25	050
ELC_CEP	CEP01*	Social Service Internship/ Project	Practical	2	25	-	50	075
MDC_MDM	MDMXX#	MDM Course1 of chosen Title	As per course	4	45	30	50	125
HSSM_EEMC	EEMC01	Design Thinking	Theory + Practical	3	-	-	125	125
HSSM_AEC	AEC03	Presentation Skills	Practical	1	50	-	-	050
MDC_OE	OECXX*	Any Open Elective-1 course	Theory	2	15	20	40	075
Total Credits				**24**				

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESE= End Semester Examination

*Selection based on the subset of courses made available by the Institute for the semester.

***For CEP01- Social Service Internship/ Project:** 1 hour / week slot will be provided during the semester (in regular timetable). Additional work of 45 hours needs to be completed during the semester (besides regular timetable) or after the semester (during inter-semester break).

NOTE: As per Institute guidelines, the results of courses completed in inter-semester break will appear in the marksheet of the next semester.

#Selection based on the MDM Title chosen by the student.

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

List of Open Elective Courses (OECXX)

Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
OEC02	Cyber Law	Theory	2	15	20	40	075
OEC03	Project Management	Theory	2	15	20	40	075
OEC04	Product Lifecycle Management	Theory	2	15	20	40	075
OEC05	Sustainability Management	Theory	2	15	20	40	075
OEC06	Renewable Energy Management	Theory	2	15	20	40	075
OEC07	Biology	Theory	2	15	20	40	075
OEC08	Chemistry	Theory	2	15	20	40	075
OEC13	Principles of Communication	Theory	2	15	20	40	075

Guidelines for Multidisciplinary Elective Courses and Minor Degree – Refer Appendix-B

Learners are required to go through the Appendix-B carefully before selecting the Multidisciplinary Elective courses. Detailed guidelines regarding Multidisciplinary Elective courses, Minor Degree Titles and courses relevant to each MD M Title are given in Appendix-B.

Multidisciplinary Elective Course1 (MDMXX)

MDM Title	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40 % of total marks)
	Code	Name			ISA	MSE	ESE	
Bioinformatics	MDMBI01	Introduction to Bioinformatics	Theory+ Tutorial	4	45	30	50	125
Innovation, Entrepreneurial and Venture Development	MDMIE01	Foundations of Innovation and Entrepreneurship	Theory+ Tutorial	4	45	30	50	125
Business Development, Marketing and Finance	MDMBD01	Introduction to Business Development and Marketing Principles	Theory+ Tutorial	4	45	30	50	125
Robotics	MDMRB01	Fundamentals of Robotics and Control	Theory+ Practical	4	45	30	50	125

Second Year B. Tech. Information Technology **Preferred Semester: IV**

Course Structure and Assessment Guidelines

Vertical_ Subvertical	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
BSES_BSC	BSC07	Engineering Mathematics-IV	Theory	3	20	30	50	100
PC_PCC	PCIT05T	Operating Systems	Theory	2	15	20	40	075
PC_PCC	PCIT05P	Operating Systems Lab	Practical	1	25	-	25	050
PC_PCC	PCIT06T	Computer Networks	Theory	2	15	20	40	075
PC_PCC	PCIT06P	Computer Networks Lab	Practical	1	25	-	25	050
PC_PCC	PCIT09	Automata Theory	Theory+ Tutorial	3	40	20	40	100
PC_PCC	PCIT07T	Database Management Systems	Theory	2	15	20	40	075
PC_PCC	PCIT07P	Database Management Systems Lab	Practical	1	25	-	25	050
SC_VSEC	VSEC03	Python Programming	Practical	2	50	-	25	075
MDC_MDM	MDMXX#	MDM Course2 of chosen Title	As per course	4	45	30	50	125
MDC_OE	OEC11	Psychology	Theory+ Tutorial	3	100	-	-	100
Total Credits				**24**				
Course credits completed during the previous inter-semester break will appear in this semester's marksheet								
ELC_CEP	CEP01*	Social Service Internship/ Project	Practical	2	25	-	50	075

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESE= End Semester Examination

***For CEP01- Social Service Internship/ Project:** 1 hour / week slot will be provided during the semester (in regular timetable). Additional work of 45 hours needs to be completed during the semester (besides regular timetable) or after the semester (during inter-semester break).

NOTE: As per Institute guidelines, the results of courses completed in inter-semester break will appear in the marksheet of the next semester.

[#]Selection based on the MDM Title chosen by the student.

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Multidisciplinary Elective Course2 (MDMXX)

MDM Title	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40 % of total marks)
	Code	Name			ISA	MSE	ESE	
Bioinformatics	MDMBI02	Algorithms and Data Structures in Bioinformatics	Theory+ Tutorial	4	45	30	50	125
Innovation, Entrepreneurial and Venture Development	MDMIE02	Startup Planning and Development	Theory+ Tutorial	4	45	30	50	125
Business Development, Marketing and Finance	MDMBD02	Financial Basics for Engineers and Technopreneurs	Theory+ Tutorial	4	45	30	50	125
Robotics	MDMRB02	Machine Vision and Robotic Perception	Theory+ Practical	4	45	30	50	125

Second Year B. Tech. Information Technology - Summer Break

Vertical_ Subvertical	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
MDC_OE	OEC01[*]	Collaborative Inter-Institute Studies	As per course	4	125	-	-	125
Total Credits				**04**				

[*]**For OEC01- Collaborative Inter-Institute Studies:** Internship with other reputed institutes equivalent to 4 credits is recommended to be done by learner during second year inter semester break (i.e. summer break between semester 4 and semester 5).
NOTE: As per Institute guidelines, the results of courses completed in inter-semester break will appear in the marksheet of the next semester.

Detailed Syllabus of Second Year Semester-III

Course Name: Engineering Mathematics-III

Course Code: BS_BSC05

Vertical/ Sub-Vertical: BS_BSC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: BS01 & BS03 (Engineering Mathematics-I & II)

Pre-requisite for: BS42 (Engineering Mathematics-IV), and DBMS, Computer Graphics, Cryptography, Coding & encoding in data transmission, Data science & higher-level mathematical courses.

Recommended Semester: 3

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
BS_BSC05	3	-	3	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (BS_BSC05)	20 (~20%)	30 (~30%)	50 (~50%)	100 (100%)

Preamble: -

Engineering Mathematics-III course provides a comprehensive introduction to the fundamental concepts of discrete mathematics, including set theory, relations, graph theory, algebraic structures, coding theory, and number theory. These concepts form the mathematical foundation for computer science, information theory, cryptography, and algorithmic thinking. The course aims to develop logical reasoning, mathematical maturity, and problem-solving skills necessary for further studies and real-world applications in computing and data analysis.

Course Objectives

- To understand the fundamental concepts of set theory and apply counting techniques in problem-solving skill.
- To understand & analyse the represent relations and functions along with their properties.
- To explore the basics of graph theory and apply it to practical problems in computer science.
- To study algebraic structures and their use in abstract mathematical modelling.
- To understand the principles of coding & decoding theory for reliable data transmission and error correction.
- To delve into number theory and modular arithmetic, emphasizing cryptographic and algorithmic applications.

Course Outcomes: -
Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall key formulas, types and definitions related to set theory, counting principles, mathematical induction, Properties of Relation, POSET, Graph theory, Algebraic structures, coding function & Euler's theorem.	Remembering (BL-1)
CO2	Understand & explain the concepts from all six modules including Hamiltonian Graphs, abelian & cyclic group and Group codes, with Composition Table & congruences in Number Theory & Fermat's Little Theorem.	Understanding (BL-2)
CO3	Apply learned techniques like Mathematical Induction, Inverse Function, abelian & cyclic group, Parity Check Matrix to Encoding Function, & Fermat's Little Theorems to solve engineering problems.	Applying (BL-3)
CO4	Analyse the structure of graphs, groups, Hamming Distance & prime numbers to interpret data's behaviours and patterns.	Analysing (BL-4)
CO5	Evaluate the coding theory concepts for error detection & correction, and Maximum Like hood Decoding technique to Decode encoded string.	Evaluating (BL-5)
CO6	Design real-world mathematical solutions involving all six topics to support IT and engineering applications.	Creating (BL-6)

Module No.	Module Name	Content	No of Hours
1	**Set Theory and Counting Techniques**	• Definition and Representation of Sets • Types of Sets • Operations on Sets • Laws of Set • Principle of Inclusion & Exclusion (for 2 & 3 sets) • Partition of Set • Counting Principle • Pigeonhole Principle • Mathematical Induction	06
2	**Relations and Functions**	• Definition of Relation • Representation of Relation & Properties of Relation • Closure properties of Relation (Reflexive, Symmetric and Transitive)	08

		• Partial Order and Equivalence Relation. • Composite and Circular Relation. • Definition of Function • Types of Function: Inverse Function & Composite Function.	
3	**Graph Theory**	• Definition of Graph • Types of Graphs, Graph Representation Techniques • Sub Graphs, Operations on Graphs • Walk, Path and Circuit • Connected and Disconnected Graph • Homomorphism and Isomorphism of Graphs • Euler and Hamiltonian Graphs • Planar Graph, Cut Set, Cut Vertex	08
4	**Algebraic structures**	• Algebraic structures with one binary operation • Groupoid- Closure Axiom property, • Semigroup- Groupoid with Associative Property • Monoid- Semigroup with identity element property • Group- Monoid with Inverse Element Property • Abelian Group- Commutative Group • Cyclic groups- Group with Generator Element • Order and subgroup • Group Homomorphism, Isomorphism and Automorphism.	08
5	**Coding and Decoding theory**	• Coding theory: Definition of encoding function, weight, Hamming Distance, Error Detection and Correction • Group codes, with Composition Table • Minimum distance, error detection and correction • Parity Check Matrix to Encoding Function Generation, Maximum Like hood Decoding Technique to Decode give codeword using Encoding Function	06
6	**Number Theory**	• Modular Arithmetic, Divisibility Arithmetic • Euclid Algorithm • Prime Number Theorem • Euler's Theorem • Fermat's Little Theorems • Congruences in Number Theory • Computing Inverse in Congruences • Chinese Remainder Theorem	09
		Total	**45**

Course Name: Microprocessor

Course Code: PCIT17T & PCIT17P

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: Computer Organization and Architecture (ESC08)

Pre-requisite for: Operating system (PCIT05T)

Recommended Semester: 3

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT04T	2	--	2	--
IT04P	--	2	--	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT04T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (ITE04P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall decide her/his assessment methodology based on the course's nature. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Preamble:

This course is an introductory course to understand the working of the microprocessor. To introduce students to assembly language programming and to explain how the peripherals are connected to the processor. This will serve as a foundation for advanced studies in Hardware design and Embedded System Design.

Course Objectives:

- To develop background knowledge and core expertise in microprocessors
- To study the concepts and basic architecture of 8086 microprocessor
- To know the importance of different peripheral devices and their interfacing with 8086
- To appreciate the architecture of advanced microprocessors

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall the basics of RISC and CISC Architecture microprocessors.	Remembering
CO2	Understand operating modes of 8086 microprocessor and its pipelining.	Understanding
CO3	Apply concept of assembly language programming to develop simple application programs.	Applying
CO4	Analyse and understand the necessity of the peripheral chips.	Applying
CO5	Design simple microprocessor-based system with memory & I/O devices.	Applying
CO6	Appreciate and understand the advantages of advanced microprocessors in creating supercomputing machines.	Analysing

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Introduction to Microprocessors	Evolution of INTEL microprocessors, Basic concept of 8085 architecture. ***Self-Learning Topics***: Registers as binary storage elements and their different uses.in microprocessors organization.	4
2	8086 Architecture and PIN configuration	8086 - Bus Interface Unit, Execution unit, Pipelined Architecture of 8086., Concept of Segmentation, Physical Address, Logical Address, 8086 – Pin description, Minimum and Maximum Mode system diagram, 8284 clock generator, 8288 bus controller.	6
3	8086 Addressing Modes & Instruction set	8086 – Addressing Modes, Instruction Set, Assembler directives and assembly language programming with 8086.	6
4	Peripheral chips	Concept of parallel peripheral interface and study of 8255 (PPI), Interrupt structure of 8086 and study of 8259 (PIC), Concept of DMA and study of 8257 (DMAC).	6
5	8086 Based System Design	Address decoders for memory interfacing, Interfacing of RAM, EPROM, and I/O chips with 8086.	4

6	Introduction of Advanced Pentium Processor Architecture	Introduction to the architecture of Pentium Processor and concept of Superscalar Architecture Comparative study of salient features of 8086, 80186,80286, 80386, 80486 and Pentium processor.	4
Total			**30**

Sr. No.	**List of experiments**
1	Introduction of various assembler directives used in TASM
2	ALP to solve given arithmetic expressions.
3	ALP for different data conversions (Like BCD to ASCII and vice versa)
4	Implementation of memory block transfer with and without use of string instruction.
5	Implementation of memory block exchange with and without use of string instruction.
6	Implementation of ALP to find smallest and largest element in given array.
7	Implementation of ALP to sort an array in ascending and descending order.
8	Implementation of ALP to check if user entered string, is PALINDROME.
9	Introduction of various assembler directives used in TASM

Course Name Advanced Java

Course Code: PCIT02T & PCIT02P

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: Object Oriented Programming (VSEC02)

Pre-requisite for: Nil

Recommended Semester: 3

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT02T	2	-	2	-
IT02P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (CE01T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (CE01P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

The aim of this course is to enable students to attain industry-identified competency of developing web-based and standalone applications using advanced Java concepts. Through a variety of teaching and learning experiences, students will acquire in-depth knowledge and practical skills in core and advanced features of Java. By the end of the course, they will be equipped to apply this knowledge to analyze and solve complex real-world problems in software development.

Course Objectives:

- To develop front end applications using Java Swing and AWT
- To access database through JDBC
- To create a simple client server application using network protocols.
- To implement server-side programming using Java Servlets and JSP
- Full application development using Java Enterprise Beans

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Understand the role of Java Swing components and layout managers in creating interactive GUI applications.	Understand
CO2	Use the JDBC to perform various CRUD operations	Apply
CO3	Develop client-server-based applications using Java networking APIs.	Apply
CO4	Create server-side applications using Java Servlets to handle client requests and server responses.	Create
CO5	Design dynamic web pages using Java Server Pages and integrate with backend logic.	Create
CO6	Create simple web applications using basic features of the Spring Boot framework	Create

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Swings	Introduction to Swings, JFC, Swings vs AWT, Swing Components, Event Handling in Swings ***Self-Learning Topics:*** *MVC Architecture in Swing*	4
2	Java Database Connectivity	Introduction to JDBC, JDBC Architecture and API Overview, JDBC Drivers and Their Types, Steps to Connect Java Application with Database, Executing SQL Queries (Statement and PreparedStatement), ResultSet and Its Methods, Handling Exceptions in JDBC ***Self-Learning Topics:*** *SQL, Metadata, Transaction Management*	4

3	Networking	Networking basics, TCP IP client sockets, URL, TCP IP Seversockets, Datagrams, Remote Method Invocation(RMI) ***Self-Learning Topics:*** • *Difference between TCP and UDP sockets*	5
4	Servlets	Introduction to Servlets, Servlet Life Cycle, Types of Servlet, servlet API, servletConfig interface, ServletRequest and ServletResponse Interfaces, GenericServlet Class. HttpServletRequest and HttpServletResponse Interfaces, HttpSession Interface, Servlet Lifecycle. Session Handling in Servlets **Working with servlets:** organization of a web application, creating a web application (using netbeans), creating a servlet, compiling and building the web application ***Self-Learning Topics:*** *HTTP methods and headers*	7
5	Java Server Pages (JSP)	Introduction to JSP, Comparison with Servlet, JSP Architecture, JSP: Life Cycle, Scripting Elements, Directives, Action Tags, Implicit Objects, JSP Standard Tag libraries (JSTL) ***Self-Learning Topics****: JSP directives and built-in objects*	5
6	Introduction to Spring Boot	Introduction, Spring Architecture, Life Cycle of bean, Create Spring bean in different ways, Bean Scope, Writing Springboot programs. ***Self-Learning Topics:*** *MVC*	2
Total			**30**

Course Name: Data Structure & Analysis

Course Code: PCIT01T & PCIT01P

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: VSEC01T (Structured Programming)

Pre-requisite for: PCIT07T (Database Management System), PCIT05T (Operating Systems), PCIT06T (Computer Networks)

Recommended Semester: 3

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT01T	2	-	2	-
IT01P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT01T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (IT01P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

Data Structures deals with the organization, management, and manipulation of data. This course covers basic data structures and their algorithms, design and analysis principles, and real-world applications. By the end, students will be able to apply their knowledge to solve complex problems.

Course Objectives:

- To introduce the fundamental concepts of data structures and Abstract Data Types (ADTs) for organizing and processing data efficiently.
- To develop the ability to apply linear and non-linear data structures in problem-solving.
- To analyse and implement algorithms for data structure operations and assess their performance.

Course Outcomes:

Learner will be able to:

Course Outcomes	Course Outcome Statement	Bloom's Level
CO1	Recall fundamental concepts of data structures and their classifications.	Remembering
CO2	Explain the working principles of linear and non-linear data structures.	Understanding
CO3	Apply data structures to solve computational problems like stack applications and graph traversals.	Applying
CO4	Analyse algorithms for operations like tree traversals and graph search techniques.	Analysing
CO5	Evaluate the performance of data structure algorithms in terms of time and space complexity.	Evaluating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Data Structures	Introduction to Data Structures, Concept of ADT, Types of Data Structures-Linear and Nonlinear, Operations on Data Structures. ***Self-Learning Topics***: *Array Data Structure, Elementary Data Structure Organization.*	2
2	Stack and Queue	Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack-Correctness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation, Recursion. Introduction, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, Double Ended Queue.	7
3	Linked List	Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List, Circular Linked List, Doubly Linked List, Operations on	7

		Singly Linked List and Doubly Linked List, Stack and Queue using Singly Linked List.	
4	Trees	Introduction, Tree Terminologies, Binary Tree, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree, Applications of Binary Tree-Expression Tree, Huffman Encoding, Search Trees-AVL, rotations in AVL Tree, Introduction of B Tree, B+ Tree.	7
5	Graphs	Introduction, Graph Terminologies, Representation of Graph, Graph Traversals-Depth First Search (DFS) and Breadth First Search (BFS), MST using Kruskal's and Prims Algorithm.	5
6	Hashing	Hashing, Hash Functions, Collision resolution Techniques.	2
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Implementation of stack using array.
2.	Stack Applications (Correctness of parenthesis, Infix to postfix conversion and Evaluation of postfix expression)
3.	Implementation of different types of queues using array (Linear queue, Circular queue, Priority queue, Double Ended queue)
4.	Implementation of different types of linked list (Singly linked list, Doubly linked list and Circular linked list)
5.	Implementation of stack and queue using linked list.
6.	Implementation of binary search tree
7.	Implementation of graph traversal techniques (DFS and BFS)

Course Name: Social Service Internship/ Project

Course Code: CEP01*

Category: General Education (GE)

Preamble:

The Social Service Internship encourages students to identify real-world social problems, formulate clear problem statements, and propose feasible technical or non-technical solutions. Through active community engagement, students enhance empathy, problem-solving, and innovation skills while contributing meaningfully to society and preparing for responsible professional roles.

Pre-requisites:

NIL

Course Objectives:

Student will be able to:

- To develop empathy and social awareness through community engagement.
- To enable students to identify and analyze real-world social problems.
- To guide students in formulating clear, structured problem statements.
- To encourage innovative thinking for proposing appropriate technical or practical solutions.
- To enhance communication, teamwork, and project documentation skills through fieldwork.

Course Outcomes:

Student will be able to:

CO1: Identify and analyze real-world social problems through community interaction.

CO2: Formulate clear and structured problem statements reflecting societal needs.

CO3: Propose practical or technical solutions that are feasible, ethical, and sustainable.

CO4: Demonstrate ethical behavior and sensitivity to community values and responsibilities.

CO5: Communicate internship activities and outcomes effectively through reports and presentations and work effectively in teams.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
-	2	-	3

2 hours / week slots will be provided during the semester (in regular timetable). Additional work of 60 hours needs to be completed during the semester (besides regular timetable) or after the semester (during inter- semester break).

NOTE: As per Institute guidelines, results of courses completed in the inter- semester break will appear in the marksheet of the next semester.

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	-	-	100	100

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Multidisciplinary Elective Course 1

Track: Bioinformatics

Course Name: Introduction to Bioinformatics

Course Code: MDMBI01

Vertical/ Sub-Vertical: MDM

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: - NIL

Pre-requisite for: - MDMBI02 (Algorithms and Data Structures in Bioinformatics**)**

Recommended Semester: 3

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMBI01	3	1	3	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory + Tutorial (MDMBI01)	45	30	50	125

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

This course is designed with the objective of equipping students with a robust understanding of the integration between biology and computational science, key bioinformatics concepts, methodologies, and applications. Through a combination of theoretical knowledge and practical applications, students will develop a holistic understanding of how computational methods can enhance the comprehension of biological processes. It also emphasizes on real-world biological questions and research challenges, empowering them to make meaningful contributions to the rapidly evolving field of bioinformatics

Course Objectives:

- To enable learners to understand the basic principles of bioinformatics.
- Build a foundational understanding of biology, types of biological data, and the role of computing in biology.

Course Outcomes:

Learner will be able to:

Course Outcomes	Course Outcome Statement	Bloom's Level
CO1	Explain foundational molecular biology concepts and their relevance to bioinformatics, including DNA, RNA, proteins, and gene functions.	Understanding
CO2	Access, compare, and utilize various biological databases and sequence file formats to retrieve and analyze genomic and proteomic data effectively.	Applying
CO3	Apply key sequence alignment algorithms and computational techniques to analyze biological sequences and construct phylogenetic relationships.	Applying
CO4	Implement bioinformatics algorithms and data structures to solve problems in genomics, proteomics, and systems biology, including gene prediction and motif discovery.	Applying
CO5	Evaluate current applications and emerging trends in bioinformatics, including personalized medicine, big data analytics, ethical issues, and the integration of AI/ML technologies in biological research.	Analyse

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Basics of Molecular Biology	• Structure and function of DNA, RNA, and proteins • Central Dogma of Molecular Biology (Replication, Transcription, Translation) • Codons and genetic code • Types of genes (structural, regulatory) • Mutations and their biological effects.	6

		Self-Learning Topics: *Overview of transcription factors, epigenetics, and recent genetic editing technologies (CRISPR).*	
2	Biological Databases	Types: Primary, Secondary, Specialized databases GenBank, EMBL, DDBJ – comparative study UniProt, PDB, RefSeq, Ensembl Sequence file formats (FASTA, GenBank, GFF, SAM/BAM) Querying biological databases (using NCBI Entrez, EBI search tools) ***Self-Learning Topics***: *Meta-databases and integrative resources (e.g., UniProt, INSD)*	6
3	Sequence Analysis	Types of biological sequences: DNA, RNA, Protein,Pairwise and Multiple Sequence Alignment (MSA),Scoring matrices (PAM, BLOSUM),Tools: BLAST, FASTA, ClustalW, Applications: gene finding, phylogeny, structure prediction ***Self-Learning Topics***: Evolutionary models used in sequence analysis	6
4	Genomics & Human Genome Project	Genome organization and structure, Sequencing techniques: Sanger, Next Generation Sequencing (NGS), Nanopore, Applications: disease gene identification, forensic genomics, Human Genome Project: goals, achievements, ethical issues, Comparative genomics ***Self-Learning Topics***: *Public repository of genomic data*	6
5	Applications of Bioinformatics	Bioinformatics in personalized medicine, Drug discovery and vaccine design, Agriculture and animal genomics Role of AI/ML in bioinformatics	6
Total			**30**

Books and Resources:

1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004

2. Bioinformatics— a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009

3. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education, 1999

Course Title: Foundations of Innovation and Entrepreneurship

Course Code: MDMIE01

NEP Vertical_Basket: MDC_MDM

Preamble:

This course provides a foundational understanding of how innovation emerges, how entrepreneurs identify and act on opportunities, and how new ventures can be developed to address real-world challenges. It explores the intersection of creativity, strategic thinking, and risk-taking, emphasizing both individual initiative and collaborative problem-solving.

Pre-requisites: NIL

Course Objectives:

- To introduce the foundational concepts of innovation and entrepreneurship.
- To build awareness of opportunity recognition, creativity, and idea validation.
- To expose students to business modelling and startup ecosystems.

Course Outcomes:

Students will be able to:

CO1: Understand key entrepreneurial trends and innovation drivers
CO2: Apply ideation tools to enhance entrepreneurial ideas.
CO3: Create basic business models using modern tools.
CO4: Evaluate entrepreneurial case studies and pitch early-stage ideas and take critical feedback.

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMBI01	3	1	3	1

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory	45	30	50	125

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Introduction to Entrepreneurship	• Definition, importance, and scope • Types of entrepreneurs • Entrepreneurial mindset and characteristics	8
2	Innovation Basics	• Types of innovation (product, process, business model) • Disruptive vs. incremental innovation Design Thinking fundamentals	8
3	Idea Identification & Evaluation	• Creativity and ideation tools (brainstorming, SCAMPER, mind-mapping) • Problem-solving frameworks • Validating ideas	10
4	Business Case presentation	• Business Model Canvas • Value Proposition Design • Customer Segments and Customer Discovery	6
5	Leveraging the Entrepreneurial Ecosystem	• Role of incubators, accelerators, and funding bodies • Startup India, Atal Innovation Mission, etc	7
		Total	**45**

Tutorials (1 Credit):

- Case studies on startups
- Group exercises on ideation
- Hands-on practice with the Business Case presentation
- Ideation workshops
- Business culture studies exercises
- Group discussion and presentations

Reference books:

- Steve Blank, The Startup Owner's Manual, K&S Ranch Publishing Inc
- Alexander Osterwalder, Business Model Generation, John Wiley and Sons
- Peter F. Drucker, Innovation and Entrepreneurship, HarperCollins Publishers Inc

Course Name: Introduction to Business Development and Marketing Principles

Course Code: MDMBD01

Category: Minor Degree Course (MDM)

Preamble:

The objective of this course is to introduce engineering students to the fundamentals of business development and marketing using a customer-centric lens. Students will learn how to conceptualize a basic business idea, understand market needs, and align engineering innovations with customer demand.

Pre-requisites: None

Course Objectives:

- Understand basic business structures and concepts.
- Identify customer needs and conduct basic market research.
- Learn fundamentals of marketing strategy in a technology-driven world.
- Appreciate the role of engineering in business innovation.

Course Outcomes:

Student will be able to:

CO1: Explain key concepts in business development and marketing relevant to engineers.
CO2: Conduct simple market research and competitor analysis for a tech-based idea.
CO3: Draft a basic value proposition and elevator pitch.
CO4: Identify business opportunities through innovation in telecom and electronics domains.

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMBD01	3	1	3	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory + Tutorial (MDMBD01)	45	30	50	125

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Foundations of Business	Types of businesses, vision-mission-goals, legal forms of business, introduction to entrepreneurship.	8
2	Marketing Essentials	Needs vs wants, Segmentation, targeting, positioning, Marketing mix (4Ps), digital vs traditional marketing.	8
3	Customer Focus	Basics of customer journey, personas	7
4	Technology Product Planning	Basics of product lifecycle, innovation funnel, idea screening.	10
5	Market Research Basics	Research Types, Research steps, Sampling, Surveys, interviews, SWOT, competitor analysis.	6
6	Business Idea Pitch	Business idea pitch, value proposition canvas, storytelling.	6
		Total	**45**

Textbooks:

1. Marketing Management by Kotler

Reference Books:

1. Marketing Basics PDF by MIT OpenCourseWare

Course Name: Fundamentals of Robotics and Control

Course Code: BMMDM1T

Category: Multidisciplinary Minor (MDM)

Preamble:

This course introduces the foundational principles of robotics, including kinematics, dynamics, and control systems. The course explores real-world robotic applications and the growing role of automation in modern industries. Students will gain hands-on experience with robotic systems and process automation tools. The course integrates Robotic Process Automation (RPA) to bridge physical and digital automation domains.

Course Objectives:

- Understand the foundational principles of robotics, including kinematics, dynamics, and control of robotic systems.
- Apply basic control strategies such as PID to robotic manipulators and mobile robots
- Explore the role of Robotic Process Automation (RPA) as a complementary software-based automation technique and build simple RPA workflows.

Pre-requisites:

1. Engineering Mathematics-I
2. Engineering Mathematics-II
3. Structured Programming
4. Object Oriented Programming

Course Outcome:

The students will be able to:

CO1: Explain the components and types of robotic systems and their applications.
CO2: Derive and apply forward and inverse kinematics for simple manipulators.
CO3: Analyze and implement feedback control systems, including PID controllers
CO4: Simulate basic robotic arm motion and trajectory control using software tools.
CO5: Describe the fundamentals of Robotic Process Automation (RPA) and its uses in industry.
CO6: Develop a basic RPA workflow to automate a simple rule-based software task.

Course Scheme:

Contact Hours		**Credits Assigned**
Theory	Practical	Total
3	2	4

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory+ Practical	45	30	50	125

The assessment/evaluation guidelines for the courses of different credits are mentioned in the table above. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose a revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Module Contents	No. of Hours
01	Introduction to Robotics	Types of robots: manipulators, mobile robots, humanoids Robot anatomy: joints, links, actuators, sensors Applications in manufacturing, healthcare, and services	06
02	Kinematics of Robotic Manipulators	Coordinate systems and transformations, Denavit–Hartenberg (D-H) parameters, Forward and inverse kinematics for 2-DOF and 3-DOF arms	09
03	Dynamics and Trajectory Planning	Basic concepts in robot dynamics (torque, inertia – overview), Joint and Cartesian trajectory planning, Linear and cubic interpolation	06
04	Control of Robotic Systems	Introduction to control systems, PID control: tuning, implementation, and real-time control, Stability and feedback concepts	08
05	Introduction to Robotic Process Automation	What is RPA, Difference from physical robotics, Components of an RPA system: bots, orchestrators, recorders, Overview of popular RPA tools (e.g., UiPath)	06
06	RPA Workflow Design and Integration	Creating simple bots to automate tasks (e.g., Excel, web forms), Control structures, data handling, and triggers in RPA, Conceptual integration: using RPA to initiate physical robot actions	10
Total			**45**

Suggested List of Value-Added Home Assignments:

1. Research a real-life robotic system (e.g., Da Vinci surgical robot, warehouse AGVs, Boston Dynamics' Spot). Analyze its components, sensing and actuation methods, and control logic. Propose a reconfiguration or redesign for a different application.
2. Design a 2-DOF or 3-DOF manipulator in MATLAB or Python. Simulate a simple pick-and-place routine.
3. Design a time-optimized trajectory considering joint velocity and acceleration limits for trajectory planning for a Robotic Painter
4. Implement a PID controller to stabilize an inverted pendulum model. Simulate using MATLAB/Python
5. Identify a repetitive digital task in your daily academic/work life. Automate them using tools
6. Create an RPA bot that responds to an email, form submission, or file upload.

Reference Books / Articles

1. Robert Shilling, Fundamentals of Robotics-Analysis and control, Prentice Hall of India, 2003.
2. John J. Craig, Introduction to Robotics–Mechanics &Control Pearson Education, India, Third Edition, ,2009.
3. Katsuhiko Ogata, Modern Control Engineering
4. Alok Mani Tripathi, Learning Robotic Process Automation
5. Fu, Gonzales and Lee, Robotics, Robotics, McGraw Hill, SecondEdition,2011.
6. Staughard, Robotics and AI, Prentice Hall of India.
7. Grover, Wiess, Nagel, Oderey Industrial Robotics,, McGraw Hill.
8. Walfram Stdder, Robotics and Mechatronics, Mc Graw Hill, New York 2008.
9. Saeed B Niku, Introduction to Robotics, Pearson Education.
10. Mittal, Nagrath, Robotics and Control, Tata McGraw Hill publications

Course Name: Design Thinking

Course Code: EEMC01

Category: General Education

Preamble:

Design thinking is a powerful tool for rethinking and revitalizing strategy—and for driving organizational performance. By placing customers' needs at the center of a product, service, process, or business model, you can reframe strategic challenges and develop more effective solutions. Drawing on right-brained creativity and left-brained analytics, the course on design thinking enables you to broaden your strategic perspective, find novel opportunities for innovation, and keep your business moving forward.

Course Objectives:

- To impart knowledge on the concepts of Design Thinking
- To impart knowledge on the phases of Design Thinking
- To apply Design Thinking concepts

Course Outcomes:

Learner will be able to:

CO1: Understand the concepts of design thinking approaches
CO2: Create design thinking teams and conduct design thinking sessions
CO3: Apply both critical thinking and design thinking in parallel to solve problems
CO4: Apply design concept to their daily work

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment guidelines:

Head of Learning	**ISA**	**MSE**	**ESE**	**Total**
Theory & Tutorial	15	20	40	75

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be

approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content
1	Design Thinking Overview	What is different about design thinking, Design thinking skills, Design thinking mindset, Principles of Design thinking
2	General Approaches to Design Thinking	The basics of Design thinking, Design thinking frameworks, Design thinking team, Design thinking workshops and meeting – Characteristics and types
3	Design Thinking approach in stages	Apply design thinking framework, empathize with customers/users, Define the problem, Ideate, Prototype, Test solution.
4	Design Thinking Techniques	Listening and emphasizing techniques – Engagement, Observation, showing empathy, Define and ideation techniques – Unpacking, Personas, Pattern recognition and connecting the dots, Prototype, and testing techniques – Types of prototypes, forms of testing in design thinking,
5	General Design Thinking Practices	Use of diagrams and maps in design thinking – empathy map, affinity diagram, mind map, journey map. Story telling techniques – Improvisation, scenarios, K-scripts
6	Adopt and Adapt Design thinking	Cautions and pitfalls – assumptions, pitfalls and cautions in design thinking workgroups, best practices
Total:		**30 Hours**

Reference Books:

1. Tim Brown, "Change by Design - How Design Thinking Transforms Organizations and Inspires Innovations"
2. Larry J.Leifer, Michael Lewerick, and Patrick, "The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods"

Course Name: Presentation Skills

Course Code: AEC03

Category: Humanities and Social Sciences (HSS)

Preamble:

The course, Presentation Skills, is intended to equip students with the necessary skill set to help them bridge the gap from the campus to the corporate world. It will help them to be industry ready in sync with the requirements of the program they are pursuing.

Pre-requisites:

Nil

Course Objectives:

- To familiarize students about constructing a personal brand effectively.
- To create engaging and deliver effective business presentation skills by utilizing digital tools.
- To apply communication and strategic planning in business plan pitches and presentations.
- To develop an appreciation for cultural diversity and enhance intercultural communication skills.
- To understand the nuances of storyboarding and storytelling
- To present oneself professionally in interviews, group discussions and various corporate situations.

Course Outcomes:

Student will be able to:

CO1	Understand the significance of brand-building and apply strategies to construct an effective personal brand.
CO2	Demonstrate proficiency in delivering impactful presentations by utilizing digital tools and applying structured communication principles.
CO3	Proficient in crafting comprehensive business plans by employing persuasive marketing and financial strategies, and implementation plans.
CO4	Craft engaging visual stories through storyboarding and storytelling, creating compelling video presentations.
CO5	Demonstrate readiness for placements by gaining practice in aptitude tests, HR interviews and GDs, and crafting professional resumes.
CO6	Understand intercultural communication, global citizenship, and respect for cultural diversity.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Examination Scheme:

ISA	MSE	ESE	Total
50	-	-	50

ISA: 50 Marks (30 Marks for assignments + 20 Marks for Presentations)

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Personal Branding	Introduction to Personal Branding –Purpose, Significance, Benefits and Techniques to build a personal brand	06
		Corporate/Organisational Branding	
		Online identity of Brand on social media	
		Maintenance and Improvement of your Brand	
		Factors affecting your Brand	
2	Corporate Presentations	Business Presentation Tips	04
		Digital Presentations	
		PAIBOC Model and Minto Pyramid Principles	
3	Business Plan Presentations	Introduction to Business Plans	06
		Company Overview & Industry Analysis	
		Persuasive Communication in Marketing Strategy	
		Operations Strategy in Financial Management	
		Implementation Plan	

4	Storyboarding and Storytelling	Visual Story Telling	04
		Video Presentations	
		Story Structure with images	
		Film and Animation	
5	Placement Readiness	Mock HR Interviews	06
		Mock GDs	
		Aptitude Tests	
		Placement ready resume	
6	Global Communication	An introduction to inter-cultural communication	04
		Introduction to languages and cultures	
		Global media in mass communication	
		Tips to become a global citizen	
		Respecting cultural diversity	
Total			**30**

Guidelines to conduct practical sessions:

- Personal Branding
- Personal Branding
- Personal Branding
- Corporate Presentations
- Corporate Presentations
- Business Plan Presentations
- Business Plan Presentations
- Business Plan Presentations
- Storyboarding and Storytelling
- Storyboarding and Storytelling
- Placement Readiness
- Placement Readiness
- Placement Readiness
- Global Communication
- Global Communication

List of Assignments:

- Personal Branding (Individual)

- Corporate Presentations (Group)
- Business Plan Presentations (Group)
- Storyboarding and Storytelling (Group)
- Global Communication (Individual)

Skill Set:

- Placement readiness and Personal branding techniques (H)
- Corporate presentation and Business Plan techniques (M)
- Inter-cultural communication to handle industry clients (H)

Tool Set:

- Software for visual storytelling, film and animation
- Software for digital presentations

Module Mapping:

Module	Skill Set	Tool Set
1	1	
2	2	2
3	2	
4	2	1
5	1	
6	3	

Recommended Online Courses:

- Introduction to Personal Branding - https://www.coursera.org/learn/personal-branding
- Strategic Self-Marketing and Personal Branding - https://www.coursera.org/learn/self-marketing
- Learn to Storyboard for Film or Animation - https://www.udemy.com/course/storyboard-for-film-or-animation/
- Powerful Tools for Teaching and Learning: Digital Storytelling - https://www.coursera.org/learn/digital-storytelling
- Presentation Skills: Speechwriting, Slides and Delivery Specialization - https://www.coursera.org/specializations/presentation-skills
- Business English for Cross-Cultural Communication - https://www.coursera.org/learn/cross-cultural-communication-business

Reference Books:

- Personal Development for Life and Work, Wallace and Masters, Thomson Learning
- Organizational Behaviour, Robbins Stephens, Pearson Education

- Me 2.0: 4 Steps to Building Your Future, Dan Schawbel, Diversion Books
- Branding Pays: The Five-Step System to Reinvent Your Personal Brand, Karen Kang, Branding Pays Media
- The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience, Carmine Gallo, McGraw Hill Education
- Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds, Carmine Gallo, St. Martin's Press
- The Storytelling Animal: How Stories Make Us Human, Jonathan Gottschall, Mariner Books
- Made to Stick: Why Some Ideas Survive and Others Die, Chip Heath and Dan Heath, Random House

Open Elective Courses

Course Name: Cyber Law

Course Code: OEC02

Category: Open Elective

Preamble:
This course explores the evolving landscape of cyber law and security, equipping students with legal frameworks and technology insights necessary to navigate the challenges posed by digital crimes. It emphasizes both technical and legal aspects of cybersecurity, with a focus on Information Technology Act, 2000 (ITA 2000) and the amendments in the Information Technology Amendment Act, 2008 (ITAA 2008).

Pre-requisites: Nil

Course Objectives:

- To introduce students to the legal framework governing cyber activities, with a focus on ITA 2000 and ITAA 2008.
- To understand the technical foundations of cybersecurity and the role of various security mechanisms in preventing cyber threats.
- To explore different types of cybercrimes and the processes involved in investigating and addressing them.
- To examine the legal aspects of e-commerce, e-governance, and the use of electronic signatures in Indian law.
- To analyze the importance of privacy, data protection, and how international laws influence Indian regulations.
- To provide a global perspective on cyber law and international conventions, addressing challenges like intellectual property and cyber warfare.

Course Outcomes:

Student will be able to:
CO1: Explain the key provisions of ITA 2000 and ITAA 2008 and their impact on various legal domains.
CO2: Gain practical knowledge of cybersecurity tools and techniques such as encryption, firewalls, and digital signatures.
CO3: Identify different types of cybercrimes and apply forensic techniques to investigate digital crimes.
CO4: Assess the legal implications of e-commerce, e-governance, and electronic contracts in India.
CO5: Analyze privacy and data protection laws in India and evaluate them from an international perspective.
CO6: Understand global cyber law frameworks and how international treaties impact the regulation of cyberspace in India.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment Guidelines:

Head	ISA	MSA	ESA	Total
Theory	20	30	50	100

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module no	Module name	Content	No of Hours
1	Introduction to Cyber Law and IT Act	Evolution and necessity of ITA 2000 Overview of ITA 2000 and ITAA 2008: Key provisions, authorities, and penalties Amendments to Indian Penal Code, Evidence Act, and other laws ,Case studies on jurisdiction under cyber law	6
2	Cyber Security Framework	Definition and importance of cybersecurity Overview of threats: hacking, malware, phishing, and cyberterrorism. Basic security mechanisms: firewalls, encryption, PKI, and digital signatures. Role of CERT-IN and other agencies in India	7
3	Cyber Crimes and Investigation	Types of cybercrimes: data theft, identity theft, cyberstalking, cyberbullying, and online fraud Investigation procedures for cybercrimes Seizure of digital evidence and forensic procedures Digital forensics: tools and anti-forensics measures	8
4	E-Commerce, E-Governance, and Cyber Law	E-commerce regulations under ITA 2000 and ITAA 2008 Validity of electronic signatures and contracts in Indian law E-Governance and issues in e-taxation, Cyber Tribunal and appellate processes	8

5	Privacy, Data Protection, and Emerging Trends	Sensitive Personal Data or Information (SPDI) under Indian law International perspectives on data protection and privacy (GDPR, HIPAA) Impact of cloud computing and data localization Case studies on privacy violations and legal recourse	8
6	International Cyber Law and Legal Framework	UNCITRAL model law and international conventions on cybercrime Intellectual property rights in cyberspace: trademarks, patents, and copyright Cyber warfare, digital sovereignty, and human rights Cyber law practices in other jurisdictions (US, EU, China)	8
Total			**45**

Textbooks:

1. "Cyber Law & Cyber Crimes" by Advocate Prashant Mali, Snow White Publications, Mumbai.
2. "Information Technology Law and Practice" by Vakul Sharma, Universal Law Publishing Co. Pvt. Ltd.
3. "The Indian Cyber Law" by Suresh T. Vishwanathan, Bharat Law House, New Delhi.

Reference Books:

1. "Digital Evidence and Computer Crime" by Eoghan Casey, Academic Press.
2. "Cyber Law in India" by Farooq Ahmad, Pioneer Books.
3. "Computer Forensics: Principles and Practices" by Linda Volonino et al., Pearson Prentice-Hall, 2007.

Course Scheme

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
OEC03	Project Management	03	--	--	03	--	--	03

Evaluation Scheme:

	ISE	MSE (Mid Semester)	ES (End Semester)	Total
TH	20	30	50	100

Objectives:

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

Outcomes: Learner will be able to…

1. Apply selection criteria and select an appropriate project from different options.
2. Write work breakdown structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide on an approach to deal with them strategically.
4. Use Earned value technique and determine & predict the status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute(PMI).	5
02	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6

03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM,GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	**Planning Projects:**	6
	Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and riskregister. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	
05	**Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engagingwith all stakeholders of the projects. Team management, communication and project meetings. **Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Usingmilestones for measurement; change requests and scope creep. Project audit. **Project Contracting** Project procurement management, contracting and outsourcing,	8
06	**Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6
Total		39

REFERENCES:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India,7th Ed.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Course Name: Product Life Cycle Management

Course Code: OEC04
Category: Open

Elective

Preamble:

This course aims to give students an overview of product Life Cycle Management (PLM) which is a strategic approach to managing the entire lifecycle of a product, from its inception through design, manufacturing, deployment, and disposal. This course gives student insigts on various aspects such as PLM Strategies, Product design, Product Data Management, Virtual Product Development Tools, Integration of Environmental Aspects in Product Design, Life Cycle Assessment and Life Cycle Cost Analysis

Pre-requisites:

Course Objectives:

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

Course Outcomes:

Students will be able to:

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	20	30	50	100

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Product Lifecycle Management and PLM Strategies	**Introduction to Product Lifecycle Management (PLM):** Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
2	Product Design	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering. and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	10

3	Product Data Management (PDM)	**Product Data Management (PDM):** Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	06
4	Virtual Product Development Tools	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case Studies	07
5	Integration of Environmental Aspects in Product Design	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of- Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	06
6	Life Cycle Assessment and Life Cycle Cost Analysis	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	06
Total			**45**

Textbooks:

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

Reference Books:

1. SaaksvuoriAntti, ImmonenAnselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
2. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course Name: Sustainability Management

Course Code: OEC05

Category: Open Elective

Preamble:

To provide learners with a comprehensive understanding of sustainability principles, strategies, and management practices that enable organizations to operate responsibly while achieving long-term success.

Pre-requisites:

NIL

Course Objectives:

- To provide a comprehensive understanding of sustainability concepts and their importance in global and organizational contexts.
- To equip participants with the tools and frameworks to develop and implement effective sustainability strategies.
- To foster the ability to analyze environmental, social, and economic impacts and propose practical solutions.
- To empower learners to lead and manage sustainable practices through innovation, technology, and ethical decision-making.

Course Outcomes:

Learner will be able to:

CO1: Understand the Core Principles of Sustainability: Comprehend the key environmental, social, and economic dimensions of sustainability

CO2: Analyze Environmental Impacts: Evaluate organizational and societal environmental footprints and recommend sustainable practices.

CO3: Develop Strategies for Social and Economic Sustainability: Formulate strategies that address social equity, community engagement, and economic resilience.

CO4: Implement Sustainability Practices: Design and implement sustainability strategies within an organizational context, including reporting and stakeholder management.

CO5: Leverage Technology and Innovation: Utilize emerging technologies to enhance sustainability outcomes.

CO6: Lead and Manage Change: Apply leadership and change management principles to foster a sustainability-focused culture.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	20	30	50	100

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Sustainability	Overview of Sustainability: Definition, history, and importance. Sustainable Development Goals (SDGs): UN's 2030 Agenda and its impact on global development. Three Pillars of Sustainability: Environmental, social, and economic dimensions. Current Challenges: Climate change, resource depletion, inequality, and global initiatives.	5
2	Environmental Sustainability	Understanding Environmental Impact: Carbon footprint, waste management, and biodiversity. Energy Management: Renewable energy sources, energy efficiency, and innovations in energy systems. Circular Economy: Concepts, examples, and transitioning to closed-loop systems.	8

		Sustainable Resource Management: Water, minerals, and sustainable agriculture.	
3	Social Sustainability	Social Equity and Inclusion: Addressing diversity, equity, and inclusion in organizations. Community Engagement: Building partnerships and contributing to societal development. Labor Practices: Ethical employment practices, health, and safety. Corporate Social Responsibility (CSR): Importance, frameworks, and success stories.	7
4	Economic Sustainability	Sustainable Business Practices: Triple bottom line approach. Green Finance: ESG investing, green bonds, and carbon pricing. Sustainable Innovation: Developing products and services that align with sustainability goals. Regulatory Frameworks: Policies and standards for sustainable business operations.	5
5	Sustainability Strategy & Implementation	Developing a Sustainability Strategy: Key steps and tools. Stakeholder Engagement: Identifying and collaborating with key stakeholders. Sustainability Reporting: Standards (GRI, SASB), metrics, and case studies. Measuring Impact: Life cycle assessment (LCA), carbon accounting, and sustainability indicators.	8
6	Technology and Innovation for Sustainability	Digital Transformation: Role of AI, IoT, and big data in achieving sustainability. Green Technologies: Innovations in clean energy, transportation, and waste management. Smart Cities: Integration of sustainable technologies in urban planning. Role of Blockchain: Transparency and traceability in sustainability practices.	6

7	Leadership and Change Management in Sustainability	Sustainability Leadership: Characteristics and examples of successful leaders. Driving Organizational Change: Overcoming resistance and fostering a sustainability culture. Ethical Decision Making: Frameworks for responsible leadership. Global Case Studies: Examining successful implementations of sustainability initiatives.	6
Total			**45**

Textbooks:

1. "Sustainability Principles and Practice" by Margaret Robertson.
2. "The Triple Bottom Line" by Andrew Savitz.
3. "The Business Guide to Sustainability" by Darcy Hitchcock and Marsha Willard.

Reference Books:

1. "Cradle to Cradle: Remaking the Way We Make Things" by William McDonough and Michael Braungart.
2. "Sustainability: A Systems Approach" by Tony Clayton and Nicholas Radcliffe.

Course: Renewable Energy Management

Category: Open Elective

Course Code: OEC06

Preamble:

Renewable Energy Management focuses on the development, implementation, and management of renewable energy projects. This course aims to equip students with the knowledge and skills required to effectively manage renewable energy resources, assess their impact, and implement sustainable energy solutions. The curriculum covers various renewable energy technologies, their applications, and the economic, environmental, and policy aspects of renewable energy systems.

Pre-requisites:

Nil

Course Outcomes:

1. **CO1:** Understand the principles and technologies of various renewable energy sources.
2. **CO2:** Analyse the economic, environmental, and social impacts of renewable energy projects.
3. **CO3:** Evaluate and design renewable energy systems for specific applications.
4. **CO4:** Develop strategies for the integration and management of renewable energy in the energy mix.
5. **CO5:** Understand the policies, regulations, and incentives related to renewable energy.
6. **CO6:** Gain practical skills in renewable energy project planning, implementation, and management.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment Guidelines:

Head of Learning	ISA	MSE	Project	Total
Theory	20	30	50	100

Detailed Syllabus:

Mod No.	**Module Name**	**Content**	**No. of hrs.**
1	Introduction to Renewable Energy	• Overview of global and national energy scenarios • Importance and benefits of renewable energy • Types of renewable energy sources: solar, wind, biomass, hydro and geothermal • Comparison between renewable and non-renewable energy • Current trends and prospects in renewable energy	7
2	Solar Thermal Energy	• Principles of solar thermal energy conversion	6

		• Solar collectors: flat plate, evacuated tube, and concentrating collectors • Solar thermal applications: water heating, space heating, and industrial processes • Solar thermal power plants: parabolic troughs, solar towers, an dish Stirling systems • Economic and environmental aspects of solar thermal energy	
3	Solar Photovoltaics	• Principles of photovoltaic energy conversion • Types of photovoltaic cells: monocrystalline, polycrystalline, an thin film • Design and components of photovoltaic systems: modules, inverters, and batteries • Performance analysis of PV systems: efficiency, shading, and temperature effects • Grid integration and energy storage for PV systems	6
4	Wind Energy	• Fundamentals of wind energy conversion • Wind turbine types, components, and operation • Wind farm design and site selection • Environmental and social impacts of wind energy projects • Economic analysis and policy considerations for wind energy	6
5	Biomass, Hydro and Geothermal Energy	**Biomass & Bio Energy** • Biomass resources and conversion technologies • Bioenergy production: biogas, biofuels, and biomass power generation • Waste-to-energy systems • Environmental and economic aspects of bioenergy • Policies and incentives for bioenergy development **Hydro Energy** • Principles of hydro power generation • Small-scale and large-scale hydro power plants **Geothermal Energy** • Geothermal energy resources and extraction methods • Applications and challenges of geothermal energy • Environmental and economic considerations for hydro and geothermal energy	9
6	Renewable Energy and Management Policy	• Energy management principles and practices • Renewable energy project planning and management • Integration of renewable energy into the grid • Policies, regulations, and incentives for renewable energy • Case studies of successful renewable energy projects	12

Textbooks:

1. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
2. "Renewable Energy Systems: The Earthscan Expert Guide to Renewable Energy Technologies for Home and Business" by David Thorpe
3. "Energy Management Handbook" by Wayne C. Turner and Steve Doty

Reference Books:

1. "Solar Engineering of Thermal Processes" by John A. Duffie and William A. Beckman
2. "Wind Energy Explained: Theory, Design and Application" by James F. Manwell, Jon G. McGowan, and Anthony L. Rogers

3. "Biomass to Renewable Energy Processes" by Jay Cheng
4. "Hydropower: Renewable Energy for a Sustainable Future" by Dirk Aschenbach
5. "Geothermal Energy: Renewable Energy and the Environment" by William E. Glassley
6. "Renewable Energy Policy and Politics: A Handbook for Decision-Making" by Volker M. Quaschning

Course Name: Biology

Code: OEC07

Preamble:

This course introduces students to virology and its related terms and concepts. It also introduces basic concepts of the nervous system, biological immune system, and computational neuroscience. This course will help the learners understand the mathematical models that are inspired from the corresponding biological models/processes and are extensively used in machine learning, deep learning, artificial immune system, computer security, artificial intelligence, etc.

Pre-requisites:
Nil

Course Objectives:

- Enable the learner to understand the concepts of virology.
- Enable the learner to understand the structure and functioning of the nervous system.
- Enable the learner to understand basics of natural immune systems.
- Enable the learner to understand basics of computational neuroscience.
- Enable the learner to understand the derivation of mathematical models from their biological counterparts.

Course Outcomes:

Learner will be able:

CO1: To develop an understanding of virology.

CO2: To understand the structure and functioning of the biological nervous system. CO3: To understand Principles of the natural immune system.

CO4: To understand working principles of the biological neural system.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment

methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Virology	Virus structure and morphology. Viruses of veterinary importance. Important virus families, their replication strategies, pathogenicity and transmission of viruses. Plant viruses, plant virus propagation. Bacteriophages, bacteriophage propagation viroids	5
2	Nervous System	Neuron structure, anatomy in vertebrates: central & peripheral Nervous systems, Functions of the Nervous system: Neurons & Synapses, Neural circuits and systems, Reflexes & other stimulus response circuits, Intrinsic pattern generation	5
3	Immunology	Introduction and history; Components of Immune system: Innate & Adaptive. Primary and secondary organs of the immune system, Cells of the immune system	5
4	Computational Neuroscience-I Single Neuron Modeling	Ion flux in membranes, Nernst Planck Equation, Ion-Channels, Excitable membranes, Spiking, Hodgkin Huxley models, Integrate and Fire Neurons	5
5	Computational Neuroscience-II Neural Encoding and Decoding	Spike train statistics, Receptive fields, Linear and Nonlinear models of Receptive fields, Applications of Information Theory in neural coding and decoding	5

6	Computational Neuroscience-III Plasticity: Adaptation and Learning	Synapses: structure and function, plasticity, Spike Timing Dependent Plasticity (STDP), Learning rules, Supervised and Unsupervised Learning, Classical conditioning, Reinforcement Learning.	5
Total			**30**

Textbooks:

1. Fields Virology Vol 1 and 2. B.N. Fields, D.M. Knipe, P.M. Howley, R.M. Chanock, J.L. Melnick, T.P. Monath, B. Roizman, and S.E. Straus, eds.), 3rd Edition. Lippincott-Raven, Philadelphia, PA.
2. Principles of anatomy & physiology, Tortora & G.J.Derricson, J. Willey publication (15th edition)
3. Dayan, Peter, and L. F. Abbott.Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems. Cambridge, MA: MIT Press, 2001. ISBN: 9780262041997.

Reference Books:

1. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. S. J. Flint, V.
2. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka. Latest edition / Pub. Date: December 2003 Publisher: American Society Microbiology--- Chapters 3-13.
3. Nervous system, Columbia Encyclopedia. Columbia University Press

Course Name: Chemistry

Course Code: OEC08

Preamble:

This course of Chemistry imparts the students sound knowledge on the principles of chemistry involving different application-oriented topics required in technology & engineering.

Pre-requisites:

Basic Chemistry

Course Objectives:

The contents of this course will aid in quantification and understand the applications of several concepts in Chemistry.

- To appreciate the need for and importance of engineering chemistry for industrial and domestic use.
- To gain the knowledge on existing and future upcoming materials used in device fabrication.
- To impart knowledge of green chemical technology and its applications.
- To enhance the thinking capabilities in line with the modern trends in engineering and technology.

Course Outcome:

Student will be able to:

CO1	Interpret properties, synthesis, and uses of important materials in various engineering applications.
CO2	Apply the fundamentals of electrochemistry in prevention & control measures related to corrosion of structures and devices.
CO3	Associate Green Chemistry principles in product development knowledge.
CO4	Students will be able to perform standard computational chemistry tasks.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
2	--	2	--

Examination Scheme:

	ISA (Term Work)	MSA (Mid Semester)	ESA (End Semester)	Total
Theory	15	20	40	75

Detailed Syllabus:

Module no	Module name	Content	No of Hours
1	Engineering Materials- Nanomaterials & Composite Materials	**Advanced polymeric materials:** Advanced polymeric materials: Conducting polymers- Polypyrrole, Polyaniline, polythiophene, (properties & applications), Light Emitting polymers (LEPs), Liquid crystal properties. In computers- electronics engineering materials used in computers **Nanomaterials:** Introduction, Fullerenes, Carbon nanotubes, Nanowires, Electronic and mechanical properties, Applications of nanomaterials - Catalysis, Electronics & Telecommunication, Medicines, Energy sciences. **Composite Materials:** Basics of composites, Types of Composites: Particle, Fibre, Reinforced, Structural, Real-life applications **Smart materials:** Shape Memory Alloys, piezo-electric, chromo-active, photo active materials, etc. required in computer field Packaging materials, Package substrates, Board fabrication. Solder material- lead-free fabrication, Cooling- best liquid coolant, Magnets in the laptop speakers-neodymium magnets, rare earth alloys	8
2	Electrochemistry, Corrosion and Corrosion Control	Electrochemistry- types of electrochemical cells, Electrochemical series and Galvanic series, Numerical problems on Nernst equation Definition of corrosion, Direct chemical corrosion- Oxidation corrosion, Electrochemical corrosion and its mechanisms, Types of electrochemical corrosion- differential aeration, galvanic, stress, Intergranular,	3+ 6

		Microbial (soil) corrosion. Factors affecting corrosion (general factors), Protection of corrosion- anodic & cathodic protection, Coatings- Organic & Metallic, Applications with few practical problems of corrosion. Numerical problems based on Faraday's law Case studies like- Corrosion in electronic gadgets	
3	Chemistry of Semiconductors	Silicon & Germanium - Physical and atomic properties, Isotopes, Chemistry and compounds, applications in industry. Study of compounds- GaAs, GaP, InP. Problems in Semiconductor industry- Shortage of semiconductors, the degradation due to corrosion, the alternative materials, reusability of the semiconductors Strengthening of semiconductors using chemical methods	6
4	Green Chemistry	Introduction to Green Chemistry, 12 Principles of Green Chemistry	3
5	Introduction to Computational chemistry	The students are expected to write and execute at least six of the following computer programs in BASIC/Fortran/C 1. Linear regression. 2. Quadratic equation. 3. Simultaneous pH titration. 4. Michaelis Menten based enzyme kinetics. 5. Analysis of amino acid sequencing. 6. Analysis of DNA sequences. Complementary sequences, repeat frequencies, etc. 7. Handling of atomic coordinates files and distance statistics on large molecules. 8. Determination of number of covalent and weak bonds in each coordinate data for protein molecule. (any 2)	4

Textbooks:

Shashi Chawla, "A Textbook of Engineering Chemistry", Dhanpat Rai & Co. (PVT.) LTD., New Delhi (2004).
S. S. Dara, "Engineering Chemistry", Chand & Co, New Delhi (2006)
Jain and Jain, "Engineering Chemistry", Dhanpat Rai & Co (PVT.) LTD, New Delhi (2006).

Reference Books:

1. B.R. Puri and L.R. Sharma, "Principles of Physical Chemistry", 45th Edition, Vishal Publishing Co. 2012.
2. Peter Atkins, "Physical Chemistry", XI th ed, Oxford, United Kingdom, Oxford University Press, 2017
3. V. K. Ahluwalia, "Green Chemistry: A textbook", Alpha Science International
4. J. D. Lee, "Concise Inorganic Chemistry"
5. V.R.Gowariker, "Polymer Science", New Age International Publication
6. S.K.Kulkarni, "Introduction to Nanotechnology"
7. C. N. Banwell, Elaine M. McCash, "Fundamentals of Molecular Spectroscopy", (4th edition), Tata McGraw Hill.
8. Y.R. Sharma, "Elementary Organic Spectroscopy", S. Chand and Co.
9. William D. Callister, "Materials Science and Engineering: An Introduction", Wiley
10. Mel Schwartz, "Smart Materials", CRC Press New York, 2009
11. Dimitris C. Lagoudas, "Shape Memory Alloys", Springer, New York, 2008
12. Micky Rakotondrabe, "Smart Materials- Based Actuators at Micro/Nano-Scale", Springer Science + Business Media, New York, 2013
13. Computer and Chemistry: introduction to programming and numerical methods T. R. Dickson, Freeman (1968)
14. Computer programs for chemistry D. F. Detar W. A. Benjamin Inc, New York Vol. 1-3 (1968-69)

Course Name: Psychology

Course Code: OEC11
Category: OE

Preamble:

Psychology is a science that seeks to understand behavior and mental processes and a profession that applies empirical knowledge to improve the lives of people. It is a broad discipline. Psychologists study the intersection of two critical relationships: one between brain function and behavior, and one between the environment and behavior. Because it is a scientific discipline, psychologists follow scientific methods, using careful observation, experimentation, and analysis.

This course allows students to apply knowledge about the psychological principles to understand how psychology can address and solve complex, real-world situations of the human experience, including the personal and interpersonal challenges, workplace, health, product design, law and more.

Pre-requisites: NIL

Course Objectives:

The objective of this course is to facilitate the learners with the understanding of concepts of psychology and the cognitive processes that affect behavior, such as, motivation, emotion, problem solving, creativity, concept formation, judgement and decision making.
It also focuses on the application of psychological principles in the effective interpersonal and group functioning, such as, communication, conflict and negotiation, leadership.
It aims at understanding how people interact with machines and technology. Using psychological science to guide the design of products, systems and devices we use every day.

Course Outcomes:

Learner will be able to:
CO1: Increase the understanding of self and others
CO2: Overcome biases and become more empathic and understanding of others and ourselves.
CO3: Improve goal setting behavior, communication, leadership, and group functioning.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Tutorial	Theory	Tutorial
2	1	2	1

Assessment guidelines:

Head of Learning	ISA	Total
Theory	100	100

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Foundations of Psychology	Introduction to psychology, historical evolution, schools of thought (behaviorism, cognitive psychology, and humanism), and research methods.	5
2	Cognitive Processes	Perception, attention, memory, problem-solving, decision-making, and the role of emotions in cognition.	6
3	Emotional Intelligence and Motivation	Theories of motivation (Maslow's hierarchy, self-determination theory) & Emotional intelligence in daily life.	4
4	Social Psychology and Relationships	Interpersonal relationships, and conflict resolution strategies.	6
5	Psychology in Modern Contexts	Workplace psychology, human-computer interaction, psychological aspects of social media, and mental health awareness in the digital age.	5
6	Case Study Analysis	Application of psychological theories to real-world scenarios: interpersonal conflicts, mental health challenges, workplace dynamics, and teamwork.	4
Total			**30**

Reference Books:

1. 1.Baron, R. A., & Kalsher, M. J. (2008). Psychology: From Science to Practice (2nd ed.). Pearson Education. 2.Schultz, D., & Schultz, S. E. (2010). Psychology and Work Today (10th ed.). Pearson Prentice Hall.
2. Matlin, M. W. (2009). Cognition (7th ed.). Wiley.
3. Eysenck, M. W., & Keane, M. T. (2015). Cognitive Psychology: A Student's Handbook (7th ed.). Psychology Press.
4. Goleman, D. (1995). Emotional Intelligence: Why It Can Matter More Than IQ. Bantam Books.
5. Ryan, R. M., & Deci, E. L. (2017). Self-Determination Theory: Basic Psychological Needs in
6. Motivation, Development, and Wellness. Guilford Publications.
7. Sternberg, R. J. (2009). Applied Cognitive Psychology: Perceiving, Learning, and Remembering. New Delhi: Cengage Learning India.
8. Myers, D. G. (2013). Social Psychology (11th ed.). McGraw-Hill.
9. Aronson, E. (2011). The Social Animal. Worth Publishers.
10. Capuzzi, D., & Gross, D. R. (2007). Counseling and Psychotherapy: Theories and Interventions (4th ed.). Pearson Prentice Hall.
11. Khosrow-Pour, M. (2018). Social Media Marketing: Breakthroughs in Research and Practice. IGI Global.
12. Galotti, K.M. (2007). Cognitive Psychology in and out of the Lab. (4th ed.). Thomson Learning.
13. Goldstein, E. B. (2005). Cognitive Psychology: Connecting Mind, Research, and Everyday Experience. Wadsworth/ Thomson Learning.
14. Jones, G.R., & Mathew, M. (2009). Organisational theory, design, and change. 5th ed., Pearson Education,
15. Dorling Kindersley India, New Delhi.
16. Landy, F. J., & Conte, J. M. (2009). Work In The 21st Century: An Introduction to Industrial and Organizational Psychology, 3rd Edition Wiley-Blackwell.
17. Luthans, F. (2005). Organizational Behavior. (10th ed.). McGraw Hill.
18. Matthewman, L., Rose, A., & Hetherington, A. (2009). Work Psychology: An introduction to Human Behaviour in workplace. Oxford university press.
19. Schultz, D., & Schultz, S. E. (2010). Psychology and Work Today (10th ed.). Pearson Prentice Hall.
20. Singh, D. (2006). Emotional intelligence at work: A professional guide. 3rd ed., New Delhi, Sage publications.
21. Sternberg, R.J. (2009). Applied Cognitive Psychology: Perceivnig, Learning, and Remembering. New Delhi: Cengage learning India, Indian reprint 2009.
22. Robbin, Judge and Vohra (2012): Organizational Behaviour, ed.xiv, Pearson-Education, New Delhi.
23. Sakaran, U. (2008), Organizational Behaviour, TMH, N. Delhi.
24. Newstrom J W and K Davis (2010): Organizational Behaviour: Human Behaviour at Work, ed. v., New Delhi: TATA McGraw.
25. F. Luthans (2011): Organizational Behaviour, ed. vii, PHI, New Delhi.
26. Prasad L.M. (2010): Organization Theory and Behaviour, HPH, New Delhi.
27. Mullins L.J. (2009): Management and Organizational Behaviour, Pearson-Education, N. Delhi.
28. Khanna Sushama (2011): "Udai Pareek's Understanding Organizational Behaviour", revised and updated,

29. Oxford University Press, New Delhi.
30. McShane, Glinow, Sharma: (2008): Organizational Behaviour 4th Edition, TATA McGraw Hill, New Delhi.
31. Academy of Management Executive, 16, 67–79.
32. Academy of Management Journal, 44, 1251–1262.
33. Journal of Applied Psychology, 90, 497–508.
34. Journal of Applied Psychology, 92, 885–892.
35. Personnel Psychology, 53, 625–642; Langfred, C. W. (2007).
36. Personnel Psychology, 46, 823–850; Magjuka, R. J., & Baldwin, T. T. (1991).
37. Personnel Psychology, 44, 793–812; Vinokur-Kaplan, D. (1995).
38. Journal of Applied Behavioral Science, 31, 303–327.
39. Journal of Applied Psychology, 92, 1189–1199.
40. Surowiecki, J. (2005). The wisdom of crowds. New York: Anchor Books.
41. Science Quarterly, 4, 84–110; Shin, S. J., & Zhou, J. (2007).
42. Journal of Applied Psychology, 92, 1709–1721.

Course Name: Principle of Communication

Course Code: OE13

Vertical/ Sub-Vertical: Multidisciplinary Courses

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: BS14P-Physics

Pre-requisite for: IT06T (Computer Network)

Recommended Semester: 3

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
OE13	2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (OE13)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:
This course introduces to basic working of Analog and Digital communication system. It is used to understand different analog as well as digital modulation techniques we use for transmission of signals in different applications. It helps to determine impact of noise on communication system.

Course Objectives:

- To introduce the fundamentals of communication systems including the basic structure, types of communication channels, and the distinctions between analog and digital communication methods.
- To develop a strong understanding of noise and its impact on communication systems by exploring various noise types, key parameters, and mathematical models such as the Friis formula and equivalent noise temperature.
- To impart knowledge of modulation techniques, covering both amplitude and angle modulation, along with their generation, detection, performance metrics (such as bandwidth and power), and practical receiver architectures like TRF and superheterodyne receivers.
- To familiarize students with pulse and digital modulation techniques, including sampling theory, PAM, PWM, PPM, PCM, and delta modulation, and to introduce digital line coding methods relevant to modern communication systems.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Define and identify the basic components and types of communication systems, including analog and digital channels.	Remembering
CO2	Explain various types of noise, their parameters such as SNR, noise factor, and noise figure, and their impact on communication systems.	Understanding
CO3	Apply amplitude and angle modulation techniques in the analysis of communication signals, including power and bandwidth calculations.	Applying
CO4	Analyze the performance and characteristics of AM and FM receivers, including TRF and superheterodyne configurations.	Analysing
CO5	Evaluate the performance of pulse analog modulation and digital modulation techniques, including PCM, DM, and ADM, based on signal quality and bandwidth requirements.	Evaluating
CO6	Design a basic communication system using appropriate analog or digital modulation techniques for a given application scenario.	Creating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to communication systems	Basic block diagram of Analog and Digital communication system. Types of communication channel. ***Self-Learning Topics***: *application areas of Analog and Digital communication.*	2
2	Noise in communication system	Basics of signal representation and analyses, Types of Noise, Noise Parameters-Signal to Noise ratio, Noise factor, Noise Figure, Friss formula and equivalent noise temperature. ***Self-Learning Topics***: *Introduction to Fourier Transform and its property.*	4
3	Amplitude and Angle Modulation Technique	Need for modulation, Amplitude modulation techniques, DSBFC-AM, DSBSC-AM, SSB-AM- block diagram, Spectrum, waveform, bandwidth, power calculations. Generation of AM and its different types, TRF receiver and Super heterodyne receiver and its characteristics. Angle Modulation FM: Principle of FM, Waveform, spectrum, bandwidth. FM generation: Direct method (Varactor diode), Indirect method (Armstrong method). FM demodulator-Foster Seeley Discriminator. ***Self-Learning Topics***: *Use of AM and FM in modern communication Technology.*	10
4	Pulse Analog Modulation and Digital Modulation	Sampling Theorem, PAM, PWM and PPM generation and degeneration. Quantization process, Pulse code modulation, delta modulation, Adaptive delta modulation. Introduction to line codes. ***Self-Learning Topics***: *Line coding and ISI.*	7

5	Multiplexing Techniques	Principle of Time Division Multiplexing, Frequency Division Multiplexing, Wavelength Division Multiplexing, Code Division Multiplexing. ***Self-Learning Topics***: *Orthogonal Frequency Division Multiplexing, Space Division Multiplexing.*	3
6	Digital Band Pass Modulation Techniques	Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Q-PSK generation and detection.	4
Total			**30**

Detailed Syllabus for Semester IV

Course Name: Engineering Mathematics-IV

Course Code: BS_BSC07

Vertical/ Sub-Vertical: BS_BSC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: BS01 & BS03 (Engineering Mathematics-I & II)

Pre-requisite for: AI-ML, Data science & Analytics, Cybersecurity & Cryptography, Natural Language Processing (NLP), Finance & Operation Research

Recommended Semester: 4

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
BS_BSC07	3	-	3	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (BS_BSC07)	20 (~20%)	30 (~30%)	50 (~50%)	100 (100%)

Preamble: -

Engineering Mathematics-IV course provides a comprehensive introduction to the Probability, Statistics, and Optimization Techniques course provides a robust mathematical foundation for analyzing data, modeling uncertainty, and optimizing decision-making processes. It includes essential topics such as probability distributions, estimation, hypothesis testing, regression analysis, ANOVA, and chi-square tests, as well as Linear Programming Problems (LPP) and Non-Linear Programming Problems (NLPP). These topics are crucial for solving real-world problems in fields like Artificial Intelligence, Machine Learning, Operations Research, Data Science, Cybersecurity, and Engineering Design. The course emphasizes statistical reasoning, optimization strategies, and computational thinking to enhance problem-solving skills and support data-driven decision-making in various domains.

Course Objectives

- Apply statistical techniques including correlation and regression analysis to interpret data sets.
- Analyze and apply probability distributions in real-world scenarios involving uncertainty.
- Formulate hypotheses and perform statistical inference using t-tests for small samples.
- Apply non-parametric methods like Chi-square and ANOVA tests for decision-making in data analysis.
- Solve linear programming problems using simplex and dual simplex methods.
- Apply optimization techniques in nonlinear programming using Lagrange multipliers and KKT.

Course Outcomes: -
Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall key formulas, definitions, and concepts related to statistical techniques, probability distributions, and hypothesis testing.	Remembering (BL-1)
CO2	Understand and explain the principles of correlation, regression, probability distributions, and hypothesis testing.	Understanding (BL-2)
CO3	Apply statistical techniques, probability distributions, and hypothesis tests to solve engineering and data science problems.	Applying (BL-3)
CO4	Analyze the results of hypothesis tests, ANOVA, and non-parametric tests to interpret data patterns and behaviours.	Analysing (BL-4)
CO5	Evaluate linear and non-linear programming problems using appropriate optimization techniques.	Evaluating (BL-5)
CO6	Design solutions for real-world problems using statistical methods, hypothesis testing, and optimization techniques.	Creating (BL-6)

Module No.	Module Name	Content	No of Hours
1	**Statistical Techniques**	• Karl Pearson's coefficient of correlation (r) • Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks) • Lines of regression: fitting of curves	08
2	**Probability Distribution**	• Random Variable: Probability distribution for discrete and continuous random variable. • Bayes Theorem (without proof) • Expectation, Variance, (without MGF function) • Probability distributions: Poisson and Normal distributions.	08
3	**Testing of Hypothesis**	• Formation of Hypothesis	06

		• Test of significance for Small samples: t- Test for single mean, difference of means	
4	**Non-parametric tests and Anova test**	• χ^2-distribution: - Chi-square test for goodness of fit and independence of attributes. • F- test for ratio of variances. • Analysis of Variance (One Way ANOVA)	07
5	**Linear programming problems (LPP)**	• Simplex method. • Artificial variables & Big-M method (Method of penalty). • Duality, Dual of LPP • Dual Simplex Method.	08
6	**Non-Linear programming problems (NLPP)**	• NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers. • NLPP with two equality constraints. • NLPP with inequality constraint: Karush-Kuhn-Tucker conditions (KKT)	08
		Total	**45**

Course Name: Operating System & Operating System Lab

Course Code: PCIT05T & PCIT05P

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: PCIT01 (Data Structure & Analysis), PCIT17T (Microprocessor)

Pre-requisite for: PCIT13T (Cloud Computing)

Recommended Semester: 4

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
PCIT05T	2	-	2	-
PCIT05P	-	2	-	1

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Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (PCIT05T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (PCIT05P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

The goal of the course is to introduce the students to modern operating systems design. This course covers the design and implementation of operating systems with a focus on modern, concurrent kernels.

Course Objectives:

- To understand the major components of Operating System & its functions.
- To introduce the concept of a process and its management like transition, scheduling, etc.
- To understand basic concepts related to Inter-process Communication (IPC)
- To understand the concepts and implementation of memory management policies and virtual Memory.
- To understand functions of Operating System for storage management and device management.
- To study the need and fundamentals of special-purpose operating system with the advent of new emerging technologies.

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Course Outcomes:
Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall fundamental concepts and structures of operating systems, including process management, memory management, and distributed systems.	Remembering
CO2	Explain the principles of process scheduling, synchronization, deadlock, memory management, and distributed systems.	Understanding
CO3	Apply scheduling algorithms, synchronization techniques, deadlock handling, and memory allocation strategies to solve OS-related problems.	Applying
CO4	Analyze synchronization problems, deadlock situations, memory management techniques, and distributed system behaviors.	Analysing
CO5	Evaluate the effectiveness of disk scheduling methods, deadlock strategies, memory management, and distributed system techniques.	Evaluating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Operating System	Operating System definitions, Processes and Interrupts, Functions of Operating System, Operating System Structures, User mode and kernel mode of a process, Types of Operating System, System Calls, Booting. ***Self-Learning Topics***: *Evolution of Operating Systems (Batch, Multiprogramming, Multitasking, Real-Time), Open-source OS (Linux, Android) architecture*	4
2	Process Management and Synchronization	Process Management: Definition of Process, Process Control Block, Process Scheduling: Types and scheduling algorithms (FCFS, SJF, SRTN, Priority, RR), Threads: Definition and Concept of Multithreading. Process Synchronization: Principles of Concurrency, Inter-process communication, Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Producer and Consumer problem ***Self-Learning Topics:*** *Real-time scheduling, Thread libraries (Pthreads), Modern synchronization primitives (mutexes, spinlocks, condition variables)*	6
3	Deadlock	Principles of Deadlock: Conditions and Resource, Allocation Graphs, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm, Deadlock Detection and Recovery, Dining Philosophers Problem. ***Self-Learning Topics: -*** *Deadlock in multithreaded environment, Resource Allocation Graph (RAG) reduction techniques*	6
4	Memory Management	Memory Management Requirements, Memory Partitioning: Fixed, Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Paging and Segmentation, TLB, Page table design.	6

		Virtual Memory: Demand Paging, Page Replacement Strategies: FIFO, Optimal, LRU, Thrashing, Kernel Memory Allocation. ***Self-Learning Topics:*** *Memory fragmentation and compaction, Inverted page tables, NUMA (Non-Uniform Memory Access), Page coloring and memory caching techniques*	
5	File Systems and I/O Management	Files and File Systems, Directory Systems, File allocation methods: Contiguous allocation, Linked allocation, Indexed allocation, Kernel I/O subsystem, Communication and Data Transfer with I/O Devices, Disk Organization, I/O Management and Disk Scheduling: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK, RAID Structure. ***Self-Learning Topics:*** *SSD vs HDD performance comparison, I/O buffering and spooling*	5
6	Distributed Systems	Distributed operating System: Network based OS, Network Structure and Topology, Communication Structure and Protocols; Distributed File system: Naming and transparency, Remote file access, Stateful Versus Stateless Service, File Replication; Distributed Synchronization: Mutual Exclusion, Concurrency Control and Deadlock Handling. ***Self-Learning Topics:*** *Distributed shared memory (DSM), Real-world examples (Google File System, HDFS), Time synchronization (NTP, Lamport timestamps)*	3
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Explore the usage of basic Linux commands and system calls for managing files, directories, and processes.
2.	Develop shell scripts to perform the following system-related tasks: a. Display the OS name, release number, and kernel version. b. List the top 10 processes in descending order based on CPU usage. c. Display the processes consuming the highest memory. d. Show the currently logged-in user and their login name. e. Display system information including current shell, home directory, OS type, path settings, and working directory.
3.	Implement a program to simulate non-preemptive scheduling algorithms, such as FCFS and SJF, demonstrating their scheduling behavior and turnaround time.
4.	Develop a program to simulate preemptive scheduling algorithms, including Round Robin and Shortest Remaining Time Next (SRTN), and compare their efficiency.
5.	Implement the Producer-Consumer problem using semaphores to handle synchronization between processes.
6.	Implement the Banker's Algorithm to demonstrate deadlock avoidance in resource allocation.
7.	Simulate dynamic partitioning and placement algorithms, such as First Fit, Best Fit, and Worst Fit, for memory management.

8.	Implement page replacement policies like FIFO and LRU to handle page faults in a simulated memory environment.
9.	Simulate various file allocation strategies including contiguous, indexed, and linked file allocation.
10.	Write a program to simulate disk scheduling algorithms, such as FCFS, SCAN, and C-SCAN, and compare their seek time and efficiency.
11.	Mini Project

Textbooks:

1. Operating System Concepts, Abraham Silberschatz, Greg Gagne, Peter Baer Galvin, 8th edition Wiley.
2. Modern Operating System, Tanenbaum, Pearson Education.
3. Operating Systems: Internal and Design Principles: William Stallings, PHI

References:

1. Operating System Design and Implementation, A Tanenbaum, Pearson.
2. Real Time Systems Design and Analysis, Wiley, IEEE Press.
3. Principles of Operating Systems: Naresh Chauhan, Oxford Higher Education

Course Name: Computer Network

Course Code: PCIT06T & PCIT06P

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: ESIT06T (Fundamentals of Computer Hardware and Networking)

Pre-requisite for: PEIT16T (Computer Network Security)

Recommended Semester: 2

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
PCCIT06T	2	-	2	-
PCCIT06P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (PCCIT06T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (PCCIT06P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

This course aims to provide students with a comprehensive understanding of the fundamental concepts and principles of computer networks. It covers key areas including protocol layering, network architectures, switching techniques, routing algorithms, and transport mechanisms. Through this course, students will gain practical insights into the design, operation, and performance analysis of modern network systems. Emphasis is also placed on the OSI and TCP/IP models, along with the application of various protocols to ensure reliable and efficient data communication.

Course Objectives:

- To understand the architecture, functions, and components of computer networks, with a focus on the OSI and TCP/IP reference models.
- To analyze different types of switching techniques, transmission media, and protocols used at various layers of the network.

- To apply error detection and correction methods, IP addressing, and routing algorithms for the design and configuration of reliable networks.
- To explore the functionality of transport, session, presentation, and application layers, including real-world protocols like HTTP, FTP, DNS, and TCP/UDP.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall the functions and components of each layer in the OSI and TCP/IP models.	Remembering
CO2	Explain different types of switching techniques and transmission media used in networks.	Understanding
CO3	Apply error detection and correction techniques to ensure reliable data transmission.	Applying
CO4	Analyze different routing algorithms and their effectiveness in various network scenarios.	Analysing
CO5	Evaluate transport layer protocols and session layer services for connection management.	Evaluating
CO6	Design a basic network architecture using appropriate addressing and routing protocols.	Creating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Computer Network	Introduction to OSI reference model, TCP/IP Model. Self-Study: Introduction to computer network, network application, network software and hardware components, Types of networking devices, Features of computer network, types of network architecture, Computer Network types. ***Self-Learning Topics***: *Components of computer network, network topologies, networking devices.*	2
2	Physical Layer	Switching Techniques: Circuit switching, Message switching, Packet switching. Self-study: Network topologies, Transmission modes, Multiplexing, Transmission medium	7

3	Data Link Layer	Functions of DLL, Framing and Flow Control, Error Detection and correction, ARQ strategies: Stop-and-Wait, Go-Back-N, Selective Repeat. Data Link layer protocols: HDLC and PPP, The channel allocation problem, Multiple access protocols: ALOHA, Slotted ALOHA, CSMA Protocol, CSMA/CD Protocol, CSMA/CA Protocol, Random Access channel, Controlled Access channel, Channelization. Concept of VLAN.	7
4	Network Layer	Functions of Network layer, IPv4 and IPv6 Protocol, IP addressing, Subnetting, Supernetting, Transition from IPV4 to IPV6. NAT and PAT (Network Address Translation and Port Address Translation. Principles of Routing; Types of routing algorithms, Classes of routing algorithms, Properties of routing algorithms, Routing algorithms; Shortest path algorithm, Flooding, Distance vector routing, Hierarchical routing, Link state routing, Congestion control mechanism, Protocols: RIP, OSPF, BGP.	7
5	Transport Layer	Transport Layer Services, Connectionless & Connection-oriented Protocols, User Datagram Protocol: UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, A TCP Connection, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timers, Port Numbers and Sockets.	5
6	Session Layer and Presentation Layer	Session Layer: Functios , Session Layer protocol - Remote Procedure Call (RPC). Compression: Comparison between Lossy Compression and Lossless Compression, Huffman Coding, Speech Compression, LZW, RLE, Image Compression – GIF, JPEG.	2
7	Application Layer	Application layer: Standard Client-Server Protocols: World Wide Web, HTTP, FTP, Electronic Mail, Domain Name System (DNS), SNMP	
		Total	**30**

Suggested List of Practical's:

Sr No.	Suggested Topic(s)
1.	A medium-sized enterprise, ABC Tech Solutions, has been experiencing intermittent network connectivity issues that impact its business operations. Employees report frequent connection timeouts, slow internet speeds, and difficulty accessing internal servers. Additionally, network administrators are struggling to identify the root causes of these problems and verify the health and security of the network. (Study, understand and perform various Basic networking commands: Ping, Tracert, trace route, ipconfig, ifconfig, nslookup, netstat.)
2.	Design and Implement a Fault-Tolerant Office Network Using Different Network Topologies.
3.	Implementing VLAN for Network Segmentation in a University Campus.
4.	Implementing DHCP for Dynamic IP Allocation in a Corporate Office.
5.	A mid-sized enterprise is experiencing intermittent network connectivity issues. Employees report that sometimes they cannot reach certain devices on the network, even though the devices are powered on and properly connected. The IT team suspects that Address Resolution Protocol (ARP) issues, such as stale ARP cache entries, ARP spoofing, or high ARP request traffic, might be causing the problem. To investigate and demonstrate how ARP works, the IT team decides to simulate ARP requests and responses using Cisco Packet Tracer. This will help them understand how ARP resolves IP addresses to MAC addresses and identify potential vulnerabilities in the network. (Understanding ARP Operation in an Enterprise Network.)
6.	Implementing DNS for Domain Name Resolution, DHCP and web server in a Corporate Network. In a small business or home network, it is essential to manage and assign dynamic IP addresses, resolve domain names to IP addresses, and provide web services for clients. *4.2 – Covers IP assignment methods including DHCP. (P.I.-1.3.2 and 1.4.2) (CO6)*
7.	Implementing Dynamic Routing in a Multi-Branch Network Using RIP Protocol. A company named TechCorp has recently expanded to three new office branches located in different cities: Head Office (HO), Branch A, and Branch B. Each office has its own local area network (LAN) and is connected via routers. The company wants seamless communication between these offices using dynamic routing.
8.	Implement Boarder gateway protocol.
9.	Secure Remote Access for Network Devices Using Telnet and SSH in a Corporate Environment. You are working as a network engineer for a medium-sized enterprise, SecureNet Solutions, which manages a central office and a remote branch. The company's IT policy requires network administrators to manage routers and switches remotely without physically accessing them. For initial configuration, Telnet will be used; however, for secure and encrypted communication, SSH must be implemented for ongoing remote management.
10	Enabling Interdepartmental Communication Using Inter-VLAN Routing on a Multilayer Switch.
11	Mini Project

Course Name: Automata Theory (Theory + Tutorial)

Course Code: PCIT09 & PCIT07T

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: BSC05 (Engineering Mathematics-III)

Pre-requisite for: NIL

Recommended Semester: 4

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
IT09	2	1	2	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT38T)	40	20	40	100

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall decide her/his assessment methodology based on the course's nature. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Preamble:

Automata theory (also known as Theory of Computation) is a theoretical branch of Computer Science and Mathematics, which mainly deals with the logic of computation with respect to simple machines, referred to as automata.

Course Objectives:

- To formalize mathematical models of computation: basic machines, deterministic and non-deterministic machines and pushdown machines and Turing Machines.
- To learn fundamentals of formal grammars and languages.
- Develop understanding of different types of Turing machines, their use, capabilities & limitations.
- Understand the concept of Undecidability

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Identify the central concepts in theory of computation and differentiate between deterministic and nondeterministic automata, also obtain equivalence of NFA and DFA.	Understanding
CO2	Infer the equivalence of languages described by finite automata and regular expressions.	Applying
CO3	Devise regular, context free grammars while recognizing the strings and tokens.	Applying
CO4	Design pushdown automata to recognize the language.	Applying
CO5	Develop an understanding of computation through Turing Machine.	Applying

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Introduction to Language and Automata	Concepts: Symbol, Alphabet, Language and Grammar. Types of Grammar and Automata.	2
2	Finite Automata	Deterministic: 5-tuple representation of DFA. Designing DFA for Regular Language. Minimization of DFA. Non-Deterministic: 5-tuple representation of NFA with epsilon moves and NFA without epsilon moves. Equivalence of language recognized by NFA and DFA	6
3	Regular Language and Grammar	Regular Expression and Regular Grammar. Equivalence of FA and Regular Expression. Properties of Regular Sets/ Languages. Classifying language as Regular and Nonregular.	6
4	Context Free and Sensitive Languages	Concepts: CFG, CFL, Derivations and Ambiguity. CFL as a superset of Regular. Normal Forms (CNF and GNF). Properties of CFL.	6
5	Push Down Automata (PDA)	7-tuple Deterministic PDA. Deterministic and Non Deterministic PDA. Equivalence of NPDA and CFL	4
6	Turing Machine(TM)	Basic 7-tuple Turing Machine (TM). Variants of TM. TM as acceptor of Recursively Enumerable (RE) Languages. Halting Problem. Recursive and RE Languages. Undecidability	6
Total			**30**

Course Name: Database Management Systems & Database Management Systems Lab

Course Code: PCIT07T & PCIT07P

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: PCIT01T (Data Structure & Analysis)

Pre-requisite for: PEIT22T (Advanced Database System)

Recommended Semester: 4

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT07T	2	-	2	-
IT07P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT07T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (IT07P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

The Database Management Systems (DBMS) course provides a comprehensive introduction to the principles, design, and implementation of database systems. It emphasizes the importance of data modeling, relational algebra, structured query language (SQL), normalization techniques, transaction management, and database security. Through this course, learners will gain a deep understanding of how data is organized, stored, accessed, and managed efficiently in modern applications. It also prepares students to apply database concepts to real-world problems and equips them with the skills necessary for developing robust and scalable database applications in various domains.

Course Objectives:

- To introduce the fundamental concepts of database systems, including data models, database architecture, and the relational model, enabling learners to understand the role of databases in modern software systems.

- To develop the ability to design and implement relational databases using techniques such as entity-relationship (ER) modeling, normalization, and Structured Query Language (SQL) for efficient data organization and retrieval.
- To understand and apply concepts related to transaction management, concurrency control, and database security, preparing learners to design robust, reliable, and secure database applications.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall fundamental database concepts, data models, and relational terminology.	Remembering
CO2	Explain relational database architecture, ER models, and normalization techniques.	Understanding
CO3	Apply SQL queries to create, manipulate, and retrieve data from relational databases.	Applying
CO4	Analyze database design alternatives using normalization and ER-to-relational mapping.	Analysing
CO5	Evaluate concurrency control methods, transaction protocols, and indexing strategies.	Evaluating
CO 6	Design and implement a real-world relational database application with integrity constraints.	Creating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Databases and Data Models	• Difference between file systems and DBMS • Database characteristics and architecture • Data models: Hierarchical, Network, Relational • Database users and DBMS software components ***Self-Learning Topics***: *History of databases, NoSQL overview*	2
2	Entity-Relationship Modelling	• Entities, attributes, relationships • ER diagram symbols and conventions • Generalization, Aggregation, Specialization • ER to Relational schema mapping.	5
3	Relational Model and Relational Algebra	• Relational schema, attributes, tuples, domains • Keys and constraints • Basic relational algebra: select, project, join, union, set difference	5

		Self-Learning Topics : *Division and assignment in relational algebra*	
4	SQL and Advanced Querying	• SQL: DDL, DML, DCL, TCL • Nested queries, joins, group by, having • Views and indexes, constraints.	6
5	Database Design and Normalization	• Introduction to schema refinement • Functional dependencies and inference rules • Normal forms: 1NF, 2NF, 3NF, BCNF • Lossless join and dependency preservation	5
6	Transactions, Concurrency & Security	• Transaction concepts and ACID properties • Concurrency control techniques: locking, timestamp • Deadlock detection and prevention • Database security and authorization	2
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Installation and creation of simple database with tables
2.	Execute basic SQL commands: CREATE, INSERT, UPDATE, DELETE, SELECT.
3.	Use of constraints: PRIMARY KEY, FOREIGN KEY, UNIQUE, CHECK, NOT NULL.
4.	Write queries using WHERE, ORDER BY, GROUP BY, HAVING, and DISTINCT.
5.	Implement different types of joins: INNER, LEFT, RIGHT, FULL.
6.	Write subqueries and nested queries.
7.	Create views and indexes for performance optimization.
8.	Design an ER diagram and convert it into relational schema.
9.	Normalize a given relation up to 3NF or BCNF.
10.	Simulate transactions using COMMIT, ROLLBACK and demonstrate concurrency issues.
11.	Implement concurrency control using locking mechanisms.
12.	Develop a mini project using SQL (optionally with frontend).

Course Name: Skill based Lab-Python

Course Code: VSEC03

Vertical/ Sub-Vertical: SC_VSEC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: Object Oriented Programming (VSEC02T) Object Oriented Programming Lab (VSEC02T)

Pre-requisite for: Machine Learning (PCIT15T), Artificial Intelligence (PEIT21T)

Recommended Semester: 4

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT08	-	4	-	2

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical (IT08)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:
Python is next generation multi-purpose programming language, that allows different users to create applications of various domains. Students will be able to learn primary fundamentals of python programming and potential of python is to achieve modern computing requirements.

Course Objectives:
- Acquire basic programming skills in Python.
- Understand various Object-oriented programming concepts in Python
- Understand basic python libraries

Course Outcomes:
Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Demonstrate the basic concepts of python programming with the help of data types, operators and expressions, console input/output	Understand
CO2	Use various decision making statements and functions	Applying
CO3	Demonstrate operations on various builtin types like list,tuple,set and dictionary	Applying

CO4	Identify object-oriented programming constructs for developing large, modular and reusable real-time programs	Understand, Analyze, Create
CO5	To create arrays and manipulate them using numpy library	Applying
CO6	Learn the fundamentals of matplotlib and pandas library	Applying

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Accept student details, marks, calculate percentage & check eligibility
2.	Menu-driven Calculator
3.	Menu-driven program for Factorial, Multiplication Table, Fibonacci series
4.	Write a program in python to accept the continuous assessment of the student according to different rubrics defined for Term Work calculation, calculate the final TW marks and display the grade of the student
5.	Write a python program to create a bank class where deposits and withdrawal can be handled by using instance methods.
6.	Write a python program to print area and perimeter of various geometry by inheriting polygon class.
7.	Write a python program to perform exception handling using try, except, finally, else, assert and raise
8.	Write a python program to create a regular expression:- 1- To extract only name but not number from a given string. 2- To retrive date of birth from the string 3- To retrive all the words starting with "a" in a given string.
9	"Python program to create simple registration form using different widgets and also insert,delete,modify the data in MySQL Database table by using the registration form"
10	Write a python program to show use of various functions of Matplotlib

Multidisciplinary Elective Courses 2

Track: Bioinformatics

Course Name: Algorithms and Data Structures in Bioinformatics

Course Code: MDMBI02

Vertical/ Sub-Vertical: MDM

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: - Introduction to Bioinformatics (MDMBI01)

Pre-requisite for: - Machine Learning Applications in Bioinformatics (MDMBI03)

Recommended Semester: Sem IV(R2024),Sem VI(R2023)

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMBI02	3	1	3	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory + Tutorial (MDMBI02)	45	30	50	125

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

This course is designed with the objective of equipping students with a robust understanding of the integration between biology and computational science, key bioinformatics concepts, methodologies, and applications. Through a combination of theoretical knowledge and practical applications, students will develop a holistic understanding of how various data structures and algorithms can enhance the comprehension of biological processes. It also emphasizes on real-world biological questions and research challenges, empowering them to make meaningful contributions to the rapidly evolving field of bioinformatics

Course Objectives:

- To enable learners to understand the basic data structures for Bioinformatics.

- Build foundational understanding of various algorithms

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Apply fundamental data structures and algorithms (arrays, trees, graphs, hashing, etc.) to solve computational problems in bioinformatics.	Apply
CO2	Analyze and implement sequence alignment algorithms for comparing DNA, RNA, and protein sequences, including global, local, and heuristic approaches.	Analyse
CO3	Construct and interpret phylogenetic trees using distance-based and character-based algorithms for evolutionary analysis.	Applying
CO4	Use algorithmic and statistical models, such as HMMs and motif-finding tools, to predict genes and regulatory elements in genomic sequences.	Applying
CO5	Design and evaluate scalable bioinformatics workflows and pipelines using big data technologies and cloud platforms for handling large-scale genomic datasets.	Evaluate

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Review of Data Structures and Algorithms	Arrays, strings, stacks, queues, Graphs and trees: DFS/BFS with examples from biological data, Suffix trees, suffix arrays, tries, Hashing techniques for genome indexing ***Self-Learning Topics***: *Advanced indexing data structures in genomics*	8
2	Sequence Alignment Algorithms	Needleman-Wunsch algorithm (global alignment) Smith-Waterman algorithm (local alignment) Space optimization (Hirschberg's algorithm) Heuristic alignment methods (BLAST internals) Complexity analysis of sequence alignment algorithms ***Self-Learning Topics***: *Recent advances in sequence alignment techniques*	10

3	Phylogenetic Tree Construction	Multiple Sequence Alignment (MSA) pre-processing Distance-based methods: UPGMA, Neighbor-Joining Character-based methods: Maximum Parsimony, Maximum Likelihood,Tree visualization tools: MEGA, iTOL ***Self-Learning Topics***: Bayesian approaches in phylogenetics	10
4	Gene Prediction and Motif Finding	Regulatory elements in genomes Basics of Hidden Markov Models (HMMs) Motif discovery tools (MEME, FIMO) Promoter and enhancer identification Use of regular expressions in motif searches ***Self-Learning Topics***: *Deep learning methods for gene prediction*	10
5	Big Data in Bioinformatics	Challenges of large-scale genomic and multi-omics data, Hadoop and Spark frameworks for bioinformatics,Bioinformatics pipelines: Snakemake, Nextflow,Cloud platforms for genomics: AWS, Google Genomics,Case studies: 1000 Genomes Project, Cancer Genome Atlas **Self-Learning Topics:** Emerging big data technologies in bioinformatics	7
Total			45

Books and Resources :

1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004

2. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009

3. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999

Course Title: Startup Planning and Development

Course Code: MDMIE02

Credits: 4 (3 Theory + 1 Tutorial)

Course Objectives:

- To develop skills for building, validating, and planning a new venture.
- To understand basic startup finance, legalities, and market strategy.
- To enable students to create business plans and investor pitches.

Course Outcomes:

1. Design MVPs and apply lean startup methods.
2. Conduct market and competitor analysis.
3. Prepare financial models and pitch decks.
4. Understand legal frameworks and intellectual property.

Syllabus:

Unit 1: Lean Startup Methodology

- MVP (Minimum Viable Product)
- Pivoting and iteration
- Build-Measure-Learn loop

Unit 2: Market Research and Strategy

- TAM-SAM-SOM analysis
- Competitive analysis
- Go-to-market strategy

Unit 3: Startup Finance

- Basics of financial modelling
- Unit economics, pricing, and revenue models
- Funding sources: bootstrapping, angels, VCs, crowdfunding

Unit 4: Legal & Regulatory Aspects

- Company formation: types and registration
- IPR basics: patents, trademarks, copyrights
- Compliance and taxation

Unit 5: Business Plan Development

- Writing an effective business plan
- Pitch deck essentials

Tutorials (1 Credit):

- Building a mock startup pitch deck
- Simulated investor pitch
- Budgeting and forecasting exercises

Assessment Methods:

- Class participation & assignments (20%)
- Mid-term exam (20%)

- Business Plan project (30%)
- Final exam (30%)

Recommended Reading:

- Zero to One by Peter Thiel
- The Lean Startup by Eric Ries
- Venture Deals by Brad Feld

Course Name: Financial Basics for Engineers and Technopreneurs

Course Code: MDMBD02

Category: Minor Degree Course (MDM)

Preamble:

The objective of this course is to equip students with basic financial skills needed to evaluate and manage technical projects or business ventures. It covers the principles of cost analysis, budgeting, financial statements, and introduction to funding models.

Pre-requisites:

Introduction to Business Development and Marketing Principles

Course Objectives:

- Learn basic financial terminology and concepts.
- Understand components of a budget and perform break-even analysis.
- Analyse financial viability of a project or startup.
- Gain exposure to funding options.

Course Outcomes:

Student will be able to:

CO1: Interpret and analyze basic financial statements (P&L, balance sheet).
CO2: Prepare a project cost sheet and conduct break-even analysis.
CO3: Explain sources of capital and funding stages for startups.
CO4: Apply budgeting techniques to engineering project proposals

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Tutorial	Theory	Tutorial
3	1	3	1

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory + Tutorial	45	30	50	125

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Introduction to Finance	Financial definitions, roles in business, overview of income, expenses, assets, liabilities, cash flows.	8
2	Costing and Budgeting	Types of costs (fixed/variable), project budgeting, break-even analysis, basic forecasting.	8
3	Financial Statements	Structure and interpretation of P&L, balance sheet, cash flow statements.	10
4	Time Value of Money	Simple vs compound interest, Net Present Value (NPV), Internal Rate of Return (IRR) concepts.	6
5	Funding Sources	Equity, debt, bootstrapping, angel investment, venture capital, crowdfunding.	7
6	Financial Decision Making	Financial ratios (ROI, ROE), pricing basics, cost-benefit analysis, breakeven models.	6
		Total	**45**

Textbooks:

1. Finance for Non-Finance Managers, by: V.G. Narayanan, Publisher: Cengage India, ISBN: 9789353501786
2. Finance for Non-Financial Managers by Gene Siciliano, McGraw Hill, Second Edition, (pdf available online)

Reference Books:

1. Introduction to Finance - Yale Online Course
2. Investopedia - Financial Statements Guide

Course Name: Machine Vision and Robotic Perception

Course Code: MDMRB02

Category: Multidisciplinary Minor (MDM)

Preamble:

This course introduces the fundamentals of computer vision and perceptual systems in robotics. It focuses on enabling robots to sense, interpret, and act upon their environment using visual inputs. Students will explore feature detection, image processing, 3D vision, and sensor fusion techniques. Hands-on activities and simulations bridge theory with real-world robotic perception applications.

Course Objectives:

- To introduce fundamental concepts in machine vision and perception relevant to autonomous robots.
- To equip students with techniques for image processing, object detection, and feature extraction.
- To develop the ability to integrate vision systems into robotic control and decision-making.

Pre-requisites:

Fundamentals of Robotics and Control (BMMDM1T)

Course Outcome:

The students will be able to:

CO1: Explain the principles of image formation and the role of cameras in robotic vision systems.
CO2: Apply basic image processing techniques for feature extraction and noise reduction.
CO3: Detect and match key visual features for use in localization and object recognition.
CO4: Analyze depth and motion using stereo vision and 3D reconstruction techniques.
CO5: Implement object detection and scene understanding in robotic applications.
CO6: Integrate visual data with other sensor modalities for robust robotic perception.

Course Scheme:

Contact Hours		Credits Assigned
Theory	Practical	Total
03	01	04

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory+ Practical	45	30	50	125

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose a revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Module Contents	No. of Hours
01	Introduction to Machine Vision	Role of vision in robotics, camera models, perspective projection, image formation, lens distortions	06
02	Image Processing Basics	Grayscale and color models, filtering, edge detection, noise reduction, histogram equalization	08
03	Feature Extraction and Matching	Interest point detection (Harris, FAST), descriptors (SIFT, SURF, ORB), template matching, homographies	07
04	3D Vision and Depth Estimation	Stereo vision, structure from motion, depth cameras, triangulation, visual odometry	08
05	Object Detection and Scene Understanding	Image segmentation, object classification (traditional and CNN-based), scene interpretation, semantic mapping	08
06	Sensor Fusion and Perception Systems	Integration of vision with other sensors (IMU, LIDAR), Kalman and particle filters, SLAM fundamentals, case studies	08
Total			**45**

Suggested List of Value-Added Home Assignments:

1. Design a vision-based system that can detect traffic violations like red-light running or illegal turns using video footage.
2. Use a stereo camera or simulated stereo images to generate a 3D point cloud and reconstruct a small indoor environment.
3. Create a system that inspects manufactured parts (e.g., PCB boards, bottles, machined components) and flags defects or anomalies using image processing.
4. Develop a mobile robot that can autonomously locate and scan barcodes or QR codes placed in a room to log inventory data.
5. Implement a system that uses AprilTags or ArUco markers to help a robot localize itself within an indoor environment.
6. Build a system that allows a robot to respond to hand gestures (like stop, go, turn) using a webcam and gesture recognition model.

Recommended Online Courses:

1. Computer Vision Specialization (by University of Buffalo)
   https://www.coursera.org/specializations/computer-vision
2. Computer Vision, https://www.udacity.com/course/computer-vision-nanodegree--nd891
3. OpenCVBootcamp,https://opencv.org/university/free-opencv-course/?utm_source=google&utm_medium=cpc&utm_campaign=WW_tut_OBC&utm_term=best%20opencv%20tutorial&gad_source=1&gad_campaignid=21004628838&gbraid=0AAAACbv-xhUM70mKirK31LiktTRipo8G&gclid=Cj0KCQjw9O_BBhCUARIsAHQMjS7VA3JEdz8KONvGanFNC7KAqSt2HModiDtp5hB_PJKX_oKTK80pNxQaAlcVEALw_wcB

Reference Books / Articles

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 1st Edition, 2011.
2. Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer, Second Edition, 2017.
3. Adrian Kaehler and Gary Bradski, Learning OpenCV 4: Computer Vision with Python and OpenCV Library, O'Reilly Media, 1st Edition, 2019.
4. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education, Fourth Edition, 2018.
5. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Cambridge University Press, Second Edition, 2004.
6. Sudeep Sarkar, Computer Vision: A First Course, Cambridge University Press, First Edition, 2022

Open Elective Courses

Course Name: Cyber Law

Course Code: OEC02

Category: Open Elective

Preamble:
This course explores the evolving landscape of cyber law and security, equipping students with legal frameworks and technology insights necessary to navigate the challenges posed by digital crimes. It emphasizes both technical and legal aspects of cybersecurity, with a focus on Information Technology Act, 2000 (ITA 2000) and the amendments in the Information Technology Amendment Act, 2008 (ITAA 2008).

Pre-requisites: Nil

Course Objectives:

- To introduce students to the legal framework governing cyber activities, with a focus on ITA 2000 and ITAA 2008.
- To understand the technical foundations of cybersecurity and the role of various security mechanisms in preventing cyber threats.
- To explore different types of cybercrimes and the processes involved in investigating and addressing them.
- To examine the legal aspects of e-commerce, e-governance, and the use of electronic signatures in Indian law.
- To analyze the importance of privacy, data protection, and how international laws influence Indian regulations.
- To provide a global perspective on cyber law and international conventions, addressing challenges like intellectual property and cyber warfare.

Course Outcomes:

Student will be able to:
CO1: Explain the key provisions of ITA 2000 and ITAA 2008 and their impact on various legal domains.
CO2: Gain practical knowledge of cybersecurity tools and techniques such as encryption, firewalls, and digital signatures.
CO3: Identify different types of cybercrimes and apply forensic techniques to investigate digital crimes.
CO4: Assess the legal implications of e-commerce, e-governance, and electronic contracts in India.
CO5: Analyze privacy and data protection laws in India and evaluate them from an international perspective.
CO6: Understand global cyber law frameworks and how international treaties impact the regulation of cyberspace in India.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment Guidelines:

Head	ISA	MSA	ESA	Total
Theory	20	30	50	100

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module no	Module name	Content	No of Hours
1	Introduction to Cyber Law and IT Act	Evolution and necessity of ITA 2000 Overview of ITA 2000 and ITAA 2008: Key provisions, authorities, and penalties Amendments to Indian Penal Code, Evidence Act, and other laws Case studies on jurisdiction under cyber law	6
2	Cyber Security Framework	Definition and importance of cybersecurity Overview of threats: hacking, malware, phishing, and cyberterrorism Basic security mechanisms: firewalls, encryption, PKI, and digital signatures Role of CERT-IN and other agencies in India	7
3	Cyber Crimes and Investigation	Types of cybercrimes: data theft, identity theft, cyberstalking, cyberbullying, and online fraud Investigation procedures for cybercrimes Seizure of digital evidence and forensic procedures Digital forensics: tools and anti-forensics measures	8
4	E-Commerce, E-Governance, and Cyber Law	E-commerce regulations under ITA 2000 and ITAA 2008 Validity of electronic signatures and contracts in Indian law E-Governance and issues in e-taxation, Cyber Tribunal and appellate processes	8

5	Privacy, Data Protection, and Emerging Trends	Sensitive Personal Data or Information (SPDI) under Indian law International perspectives on data protection and privacy (GDPR, HIPAA) Impact of cloud computing and data localization Case studies on privacy violations and legal recourse	8
6	International Cyber Law and Legal Framework	UNCITRAL model law and international conventions on cybercrime Intellectual property rights in cyberspace: trademarks, patents, and copyright Cyber warfare, digital sovereignty, and human rights Cyber law practices in other jurisdictions (US, EU, China)	8
Total			**45**

Textbooks:

4. "Cyber Law & Cyber Crimes" by Advocate Prashant Mali, Snow White Publications, Mumbai.
5. "Information Technology Law and Practice" by Vakul Sharma, Universal Law Publishing Co. Pvt. Ltd.
6. "The Indian Cyber Law" by Suresh T. Vishwanathan, Bharat Law House, New Delhi.

Reference Books:

4. "Digital Evidence and Computer Crime" by Eoghan Casey, Academic Press.
5. "Cyber Law in India" by Farooq Ahmad, Pioneer Books.
6. "Computer Forensics: Principles and Practices" by Linda Volonino et al., Pearson Prentice-Hall, 2007.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
OEC03	Project Management	03	--	--	03	--	--	03

Evaluation Scheme:

	ISA	MSE (Mid Semester)	ESE (End Semester)	Total
TH	20	30	50	100

Objectives:

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

Course Outcomes: Learner will be able to…

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Detailed Syllabus

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process.Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute(PMI).	5
02	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6

03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM,GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	**Planning Projects:**	6
	Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and riskregister. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	
05	**Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engagingwith all stakeholders of the projects. Team management, communication and project meetings. **Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Usingmilestones for measurement; change requests and scope creep. Project audit. **Project Contracting** Project procurement management, contracting and outsourcing,	8
06	**Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6
	Total	39

REFERENCES:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India,7th Ed.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Course Name: Product Life Cycle Management

Course Code: OEC04
Category: Open

Elective

Preamble:

This course aims to give students an overview of product Life Cycle Management (PLM) which is a strategic approach to managing the entire lifecycle of a product, from its inception through design, manufacturing, deployment, and disposal. This course gives student insigts on various aspects such as PLM Strategies, Product design, Product Data Management, Virtual Product Development Tools, Integration of Environmental Aspects in Product Design, Life Cycle Assessment and Life Cycle Cost Analysis

Pre-requisites:

Course Objectives:

5. To familiarize the students with the need, benefits and components of PLM
6. To acquaint students with Product Data Management & PLM strategies
7. To give insights into new product development program and guidelines for designing and developing a product
8. To familiarize the students with Virtual Product Development

Course Outcomes:

Students will be able to:

5. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
6. Illustrate various approaches and techniques for designing and developing products.
7. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
8. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	20	30	50	100

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Product Lifecycle Management and PLM Strategies	**Introduction to Product Lifecycle Management (PLM):** Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
2	Product Design	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering. and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and	10

		Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	
3	Product Data Management (PDM)	**Product Data Management (PDM):** Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	06
4	Virtual Product Development Tools	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case Studies	07
5	Integration of Environmental Aspects in Product Design	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of- Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	06
6	Life Cycle Assessment and Life Cycle Cost Analysis	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	06
Total			**45**

Textbooks:

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

Reference Books:

3. SaaksvuoriAntti, ImmonenAnselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314

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

Course Name: Sustainability Management

Course Code: OEC05

Category: Open Elective

Preamble:

To provide learners with a comprehensive understanding of sustainability principles, strategies, and management practices that enable organizations to operate responsibly while achieving long-term success.

Pre-requisites:

NIL

Course Objectives:

- To provide a comprehensive understanding of sustainability concepts and their importance in global and organizational contexts.
- To equip participants with the tools and frameworks to develop and implement effective sustainability strategies.
- To foster the ability to analyze environmental, social, and economic impacts and propose practical solutions.
- To empower learners to lead and manage sustainable practices through innovation, technology, and ethical decision-making.

Course Outcomes:

Learner will be able to:

CO1: Understand the Core Principles of Sustainability: Comprehend the key environmental, social, and economic dimensions of sustainability

CO2: Analyze Environmental Impacts: Evaluate organizational and societal environmental footprints and recommend sustainable practices.

CO3: Develop Strategies for Social and Economic Sustainability: Formulate strategies that address social equity, community engagement, and economic resilience.

CO4: Implement Sustainability Practices: Design and implement sustainability strategies within an organizational context, including reporting and stakeholder management.

CO5: Leverage Technology and Innovation: Utilize emerging technologies to enhance sustainability outcomes.

CO6: Lead and Manage Change: Apply leadership and change management principles to foster a sustainability-focused culture.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	20	30	50	100

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Sustainability	Overview of Sustainability: Definition, history, and importance. Sustainable Development Goals (SDGs): UN's 2030 Agenda and its impact on global development. Three Pillars of Sustainability: Environmental, social, and economic dimensions. Current Challenges: Climate change, resource depletion, inequality, and global initiatives.	5
2	Environmental Sustainability	Understanding Environmental Impact: Carbon footprint, waste management, and biodiversity. Energy Management: Renewable energy sources, energy efficiency, and innovations in energy systems. Circular Economy: Concepts, examples, and transitioning to closed-loop systems. Sustainable Resource Management: Water, minerals, and sustainable agriculture.	8

3	Social Sustainability	Social Equity and Inclusion: Addressing diversity, equity, and inclusion in organizations. Community Engagement: Building partnerships and contributing to societal development. Labor Practices: Ethical employment practices, health, and safety. Corporate Social Responsibility (CSR): Importance, frameworks, and success stories.	7
4	Economic Sustainability	Sustainable Business Practices: Triple bottom line approach. Green Finance: ESG investing, green bonds, and carbon pricing. Sustainable Innovation: Developing products and services that align with sustainability goals. Regulatory Frameworks: Policies and standards for sustainable business operations.	5
5	Sustainability Strategy & Implementation	Developing a Sustainability Strategy: Key steps and tools. Stakeholder Engagement: Identifying and collaborating with key stakeholders. Sustainability Reporting: Standards (GRI, SASB), metrics, and case studies. Measuring Impact: Life cycle assessment (LCA), carbon accounting, and sustainability indicators.	8
6	Technology and Innovation for Sustainability	Digital Transformation: Role of AI, IoT, and big data in achieving sustainability. Green Technologies: Innovations in clean energy, transportation, and waste management. Smart Cities: Integration of sustainable technologies in urban planning. Role of Blockchain: Transparency and traceability in sustainability practices.	6
7	Leadership and Change	Sustainability Leadership: Characteristics and examples of successful leaders.	6

	Management in Sustainability	Driving Organizational Change: Overcoming resistance and fostering a sustainability culture. Ethical Decision Making: Frameworks for responsible leadership. Global Case Studies: Examining successful implementations of sustainability initiatives.	
Total			**45**

Textbooks:

4. "Sustainability Principles and Practice" by Margaret Robertson.
5. "The Triple Bottom Line" by Andrew Savitz.
6. "The Business Guide to Sustainability" by Darcy Hitchcock and Marsha Willard.

Reference Books:

3. "Cradle to Cradle: Remaking the Way We Make Things" by William McDonough and Michael Braungart.
4. "Sustainability: A Systems Approach" by Tony Clayton and Nicholas Radcliffe.

Course: Renewable Energy Management

Category: Open Elective

Course Code: OEC06

Preamble:

Renewable Energy Management focuses on the development, implementation, and management of renewable energy projects. This course aims to equip students with the knowledge and skills required to effectively manage renewable energy resources, assess their impact, and implement sustainable energy solutions. The curriculum covers various renewable energy technologies, their applications, and the economic, environmental, and policy aspects of renewable energy systems.

Pre-requisites:

Nil

Course Outcomes:

7. **CO1:** Understand the principles and technologies of various renewable energy sources.
8. **CO2:** Analyse the economic, environmental, and social impacts of renewable energy projects.
9. **CO3:** Evaluate and design renewable energy systems for specific applications.
10. **CO4:** Develop strategies for the integration and management of renewable energy in the energy mix.
11. **CO5:** Understand the policies, regulations, and incentives related to renewable energy.
12. **CO6:** Gain practical skills in renewable energy project planning, implementation, and management.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment Guidelines:

Head of Learning	ISA	MSE	Project	Total
Theory	20	30	50	100

Detailed Syllabus:

Mod No.	**Module Name**	**Content**	**No. of hrs.**
1	Introduction to Renewable Energy	• Overview of global and national energy scenarios • Importance and benefits of renewable energy • Types of renewable energy sources: solar, wind, biomass, hydro and geothermal • Comparison between renewable and non-renewable energy • Current trends and prospects in renewable energy	7
2	Solar Thermal Energy	• Principles of solar thermal energy conversion	6

		• Solar collectors: flat plate, evacuated tube, and concentrating collectors • Solar thermal applications: water heating, space heating, and industrial processes • Solar thermal power plants: parabolic troughs, solar towers, an dish Stirling systems • Economic and environmental aspects of solar thermal energy	
3	Solar Photovoltaics	• Principles of photovoltaic energy conversion • Types of photovoltaic cells: monocrystalline, polycrystalline, an thin film • Design and components of photovoltaic systems: modules, inverters, and batteries • Performance analysis of PV systems: efficiency, shading, and temperature effects • Grid integration and energy storage for PV systems	6
4	Wind Energy	• Fundamentals of wind energy conversion • Wind turbine types, components, and operation • Wind farm design and site selection • Environmental and social impacts of wind energy projects • Economic analysis and policy considerations for wind energy	6
5	Biomass, Hydro and Geothermal Energy	**Biomass & Bio Energy** • Biomass resources and conversion technologies • Bioenergy production: biogas, biofuels, and biomass power generation • Waste-to-energy systems • Environmental and economic aspects of bioenergy • Policies and incentives for bioenergy development **Hydro Energy** • Principles of hydro power generation • Small-scale and large-scale hydro power plants **Geothermal Energy** • Geothermal energy resources and extraction methods • Applications and challenges of geothermal energy • Environmental and economic considerations for hydro and geothermal energy	9
6	Renewable Energy and Management Policy	• Energy management principles and practices • Renewable energy project planning and management • Integration of renewable energy into the grid • Policies, regulations, and incentives for renewable energy • Case studies of successful renewable energy projects	12

Textbooks:

- "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
- "Renewable Energy Systems: The Earthscan Expert Guide to Renewable Energy Technologies for Home and Business" by David Thorpe
- "Energy Management Handbook" by Wayne C. Turner and Steve Doty

Reference Books:

- "Solar Engineering of Thermal Processes" by John A. Duffie and William A. Beckman

- "Wind Energy Explained: Theory, Design and Application" by James F. Manwell, Jon G. McGowan, and Anthony L. Rogers
- "Biomass to Renewable Energy Processes" by Jay Cheng
- "Hydropower: Renewable Energy for a Sustainable Future" by Dirk Aschenbach
- "Geothermal Energy: Renewable Energy and the Environment" by William E. Glassley
- "Renewable Energy Policy and Politics: A Handbook for Decision-Making" by Volker M. Quaschning

Course Name: Biology

Code: OEC07

Preamble:

This course introduces students to virology and its related terms and concepts. It also introduces basic concepts of the nervous system, biological immune system, and computational neuroscience. This course will help the learners understand the mathematical models that are inspired from the corresponding biological models/processes and are extensively used in machine learning, deep learning, artificial immune system, computer security, artificial intelligence, etc.

Pre-requisites:

Nil

Course Objectives:

- Enable the learner to understand the concepts of virology.
- Enable the learner to understand the structure and functioning of the nervous system.
- Enable the learner to understand basics of natural immune systems.
- Enable the learner to understand basics of computational neuroscience.
- Enable the learner to understand the derivation of mathematical models from their biological counterparts.

Course Outcomes:

Learner will be able:

CO1: To develop an understanding of virology.

CO2: To understand the structure and functioning of biological nervous system. CO3: To understand Principles of natural immune system.

CO4: To understand working principles of biological neural system.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment

methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Virology	Virus structure and morphology. Viruses of veterinary importance. Important virus families, their replication strategies, pathogenicity and transmission of viruses. Plant viruses, plant virus propagation. Bacteriophages, bacteriophage propagation viroids	5
2	Nervous System	Neuron structure, anatomy in vertebrates: central & peripheral Nervous systems, Functions of the Nervous system: Neurons & Synapses, Neural circuits and systems, Reflexes & other stimulus response circuits, Intrinsic pattern generation	5
3	Immunology	Introduction and history; Components of Immune system: Innate & Adaptive. Primary and secondary organs of the immune system, Cells of the immune system	5
4	Computational Neuroscience-I Single Neuron Modeling	Ion flux in membranes, Nernst Planck Equation, Ion-Channels, Excitable membranes, Spiking, Hodgkin Huxley models, Integrate and Fire Neurons	5
5	Computational Neuroscience-II Neural Encoding and Decoding	Spike train statistics, Receptive fields, Linear and Nonlinear models of Receptive fields, Applications of Information Theory in neural coding and decoding	5

6	Computational Neuroscience-III Plasticity: Adaptation and Learning	Synapses: structure and function, plasticity, Spike Timing Dependent Plasticity (STDP), Learning rules, Supervised and Unsupervised Learning, Classical conditioning, Reinforcement Learning.	5
Total			**30**

Textbooks:

4. Fields Virology Vol 1 and 2. B.N. Fields, D.M. Knipe, P.M. Howley, R.M. Chanock, J.L. Melnick, T.P. Monath, B. Roizman, and S.E. Straus, eds.), 3rd Edition. Lippincott-Raven, Philadelphia, PA.
5. Principles of anatomy & physiology, Tortora & G.J.Derricson, J. Willey publication (15th edition)
6. Dayan, Peter, and L. F. Abbott.Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems. Cambridge, MA: MIT Press, 2001. ISBN: 9780262041997.

Reference Books:

4. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. S. J. Flint, V.
5. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka. Latest edition / Pub. Date: December 2003 Publisher: American Society Microbiology--- Chapters 3-13.
6. Nervous system, Columbia Encyclopedia. Columbia University Press

Course Name: Chemistry

Course Code: OEC08

Preamble:

This course of Chemistry imparts the students sound knowledge on the principles of chemistry involving different application-oriented topics required in technology & engineering.

Pre-requisites:

Basic Chemistry

Course Objectives:

The contents of this course will aid in quantification and understand the applications of several concepts in Chemistry.

- To appreciate the need for and importance of engineering chemistry for industrial and domestic use.
- To gain the knowledge on existing and future upcoming materials used in device fabrication.
- To impart knowledge of green chemical technology and its applications.
- To enhance the thinking capabilities in line with the modern trends in engineering and technology.

Course Outcome:

Student will be able to:

CO1	Interpret properties, synthesis, and uses of important materials in various engineering applications.
CO2	Apply the fundamentals of electrochemistry in prevention & control measures related to corrosion of structures and devices.
CO3	Associate Green Chemistry principles in product development knowledge.
CO4	Students will be able to perform standard computational chemistry tasks.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
2	--	2	--

Examination Scheme:

	ISA (Term Work)	MSA (Mid Semester)	ESA (End Semester)	Total
Theory	15	20	40	75

Detailed Syllabus:

Module no	Module name	Content	No of Hours
1	Engineering Materials- Nanomaterials & Composite Materials	**Advanced polymeric materials:** Advanced polymeric materials: Conducting polymers- Polypyrrole, Polyaniline, polythiophene, (properties & applications), Light Emitting polymers (LEPs), Liquid crystal properties. In computers- electronics engineering materials used in computers **Nanomaterials:** Introduction, Fullerenes, Carbon nanotubes, Nanowires, Electronic and mechanical properties, Applications of nanomaterials - Catalysis, Electronics & Telecommunication, Medicines, Energy sciences. **Composite Materials:** Basics of composites, Types of Composites: Particle, Fibre, Reinforced, Structural, Real-life applications **Smart materials:** Shape Memory Alloys, piezo-electric, chromo-active, photo active materials, etc. required in computer field Packaging materials, Package substrates, Board fabrication Solder material- lead-free fabrication, Cooling- best liquid coolant, Magnets in the laptop speakers- neodymium magnets, rare earth alloys	8

2	Electrochemistry, Corrosion and Corrosion Control	Electrochemistry- types of electrochemical cells, Electrochemical series and Galvanic series, Numerical problems on Nernst equation Definition of corrosion, Direct chemical corrosion- Oxidation corrosion, Electrochemical corrosion and its mechanisms, Types of electrochemical corrosion- differential aeration, galvanic, stress, Intergranular, Microbial (soil) corrosion. Factors affecting corrosion (general factors), Protection of corrosion- anodic & cathodic protection, Coatings- Organic & Metallic, Applications with few practical problems of corrosion. Numerical problems based on Faraday's law Case studies like- Corrosion in electronic gadgets	3+ 6
3	Chemistry of Semiconductors	Silicon & Germanium - Physical and atomic properties, Isotopes, Chemistry and compounds, applications in industry. Study of compounds- GaAs, GaP, InP. Problems in Semiconductor industry- Shortage of semiconductors, the degradation due to corrosion, the alternative materials, reusability of the semiconductors Strengthening of semiconductors using chemical methods	6
4	Green Chemistry	Introduction to Green Chemistry, 12 Principles of Green Chemistry	3
5	Introduction to Computational chemistry	The students are expected to write and execute at least six of the following computer programs in BASIC/Fortran/C 1. Linear regression. 2. Quadratic equation. 3. Simultaneous pH titration. 4. Michaelis Menten based enzyme kinetics. 5. Analysis of amino acid sequencing. 6. Analysis of DNA sequences. Complementary sequences, repeat frequencies, etc.	4

		7. Handling of atomic coordinates files and distance statistics on large molecules. 8. Determination of number of covalent and weak bonds in each coordinate data for protein molecule. (any 2)	

Textbooks:

Shashi Chawla, "A Textbook of Engineering Chemistry", Dhanpat Rai & Co. (PVT.) LTD., New Delhi (2004).
S. S. Dara, "Engineering Chemistry", Chand & Co, New Delhi (2006)
Jain and Jain, "Engineering Chemistry", Dhanpat Rai & Co (PVT.) LTD, New Delhi (2006).

Reference Books:

1. B.R. Puri and L.R. Sharma, "Principles of Physical Chemistry", 45th Edition, Vishal Publishing Co. 2012.
2. Peter Atkins, "Physical Chemistry", XI th ed, Oxford, United Kingdom, Oxford University Press, 2017
3. V. K. Ahluwalia, "Green Chemistry: A textbook", Alpha Science International
4. J. D. Lee, "Concise Inorganic Chemistry"
5. V.R.Gowariker, "Polymer Science", New Age International Publication
6. S.K.Kulkarni, "Introduction to Nanotechnology"
7. C. N. Banwell, Elaine M. McCash, "Fundamentals of Molecular Spectroscopy", (4th edition), Tata McGraw Hill.
8. Y.R. Sharma, "Elementary Organic Spectroscopy", S. Chand and Co.
9. William D. Callister, "Materials Science and Engineering: An Introduction", Wiley
10. Mel Schwartz, "Smart Materials", CRC Press New York, 2009
11. Dimitris C. Lagoudas, "Shape Memory Alloys", Springer, New York, 2008
12. Micky Rakotondrabe, "Smart Materials- Based Actuators at Micro/Nano-Scale", Springer Science + Business Media, New York, 2013
13. Computer and Chemistry: introduction to programming and numerical methods T. R. Dickson, Freeman (1968)
14. Computer programs for chemistry D. F. Detar W. A. Benjamin Inc, New York Vol. 1-3 (1968-69)

Course Name: Psychology

Course Code: OEC11

Category: OE

Preamble:

Psychology is a science that seeks to understand behavior and mental processes and a profession that applies empirical knowledge to improve the lives of people. It is a broad discipline. Psychologists study the intersection of two critical relationships: one between brain function and behavior, and one between the environment and behavior. Because it is a scientific discipline, psychologists follow scientific methods, using careful observation, experimentation, and analysis.

This course allows students to apply knowledge about the psychological principles to understand how psychology can address and solve complex, real-world situations of the human experience, including the personal and interpersonal challenges, workplace, health, product design, law and more.

Pre-requisites: NIL

Course Objectives:

The objective of this course is to facilitate the learners with the understanding of concepts of psychology and the cognitive processes that affect behavior, such as, motivation, emotion, problem solving, creativity, concept formation, judgement and decision making.
It also focuses on the application of psychological principles in the effective interpersonal and group functioning, such as, communication, conflict and negotiation, leadership.
It aims at understanding how people interact with machines and technology. Using psychological science to guide the design of products, systems and devices we use every day.

Course Outcomes:

Learner will be able to:

CO1: Increase the understanding of self and others

CO2: Overcome biases and become more empathic and understanding of others and ourselves.

CO3: Improve goal setting behavior, communication, leadership, and group functioning.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Tutorial	Theory	Tutorial
2	1	2	1

Assessment guidelines:

Head of Learning	ISA	Total
Theory	100	100

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Foundations of Psychology	Introduction to psychology, historical evolution, schools of thought (behaviorism, cognitive psychology, and humanism), and research methods.	5
2	Cognitive Processes	Perception, attention, memory, problem-solving, decision-making, and the role of emotions in cognition.	6
3	Emotional Intelligence and Motivation	Theories of motivation (Maslow's hierarchy, self determination theory) & Emotional intelligence in daily life.	4
4	Social Psychology and Relationships	Interpersonal relationships, and conflict resolution strategies.	6
5	Psychology in Modern Contexts	Workplace psychology, human-computer interaction, psychological aspects of social media, and mental health awareness in the digital age.	5
6	Case Study Analysis	Application of psychological theories to real- world scenarios: interpersonal conflicts, mental health challenges, workplace dynamics, and teamwork.	4
Total			**30**

Reference Books:

1. 1.Baron, R. A., & Kalsher, M. J. (2008). Psychology: From Science to Practice (2nd ed.). Pearson Education. 2.Schultz, D., & Schultz, S. E. (2010). Psychology and Work Today (10th ed.). Pearson Prentice Hall.
2. Matlin, M. W. (2009). Cognition (7th ed.). Wiley.

3. Eysenck, M. W., & Keane, M. T. (2015). Cognitive Psychology: A Student's Handbook (7th ed.). Psychology Press.
4. Goleman, D. (1995). Emotional Intelligence: Why It Can Matter More Than IQ. Bantam Books.
5. Ryan, R. M., & Deci, E. L. (2017). Self-Determination Theory: Basic Psychological Needs in
6. Motivation, Development, and Wellness. Guilford Publications.
7. Sternberg, R. J. (2009). Applied Cognitive Psychology: Perceiving, Learning, and Remembering. New Delhi: Cengage Learning India.
8. Myers, D. G. (2013). Social Psychology (11th ed.). McGraw-Hill.
9. Aronson, E. (2011). The Social Animal. Worth Publishers.
10. Capuzzi, D., & Gross, D. R. (2007). Counseling and Psychotherapy: Theories and Interventions (4th ed.). Pearson Prentice Hall.
11. Khosrow-Pour, M. (2018). Social Media Marketing: Breakthroughs in Research and Practice. IGI Global.
12. Galotti, K.M. (2007). Cognitive Psychology in and out of the Lab. (4th ed.). Thomson Learning.
13. Goldstein, E. B. (2005). Cognitive Psychology: Connecting Mind, Research, and Everyday Experience. Wadsworth/ Thomson Learning.
14. Jones, G.R., & Mathew, M. (2009). Organisational theory, design, and change. 5th ed., Pearson Education,
15. Dorling Kindersley India, New Delhi.
16. Landy, F. J., & Conte, J. M. (2009). Work In The 21st Century: An Introduction to Industrial and Organizational Psychology, 3rd Edition Wiley-Blackwell.
17. Luthans, F. (2005). Organizational Behavior. (10th ed.). McGraw Hill.
18. Matthewman, L., Rose, A., & Hetherington, A. (2009). Work Psychology: An introduction to Human Behaviour in workplace. Oxford university press.
19. Schultz, D., & Schultz, S. E. (2010). Psychology and Work Today (10th ed.). Pearson Prentice Hall.
20. Singh, D. (2006). Emotional intelligence at work: A professional guide. 3rd ed., New Delhi, Sage publications.
21. Sternberg, R.J. (2009). Applied Cognitive Psychology: Perceivnig, Learning, and Remembering. New Delhi: Cengage learning India, Indian reprint 2009.
22. Robbin, Judge and Vohra (2012): Organizational Behaviour, ed.xiv, Pearson-Education, New Delhi.
23. Sakaran, U. (2008), Organizational Behaviour, TMH, N. Delhi.
24. Newstrom J W and K Davis (2010): Organizational Behaviour: Human Behaviour at Work, ed. v., New Delhi: TATA McGraw.
25. F. Luthans (2011): Organizational Behaviour, ed. vii, PHI, New Delhi.
26. Prasad L.M. (2010): Organization Theory and Behaviour, HPH, New Delhi.
27. Mullins L.J. (2009): Management and Organizational Behaviour, Pearson-Education, N. Delhi.
28. Khanna Sushama (2011): "Udai Pareek's Understanding Organizational Behaviour", revised and updated,
29. Oxford University Press, New Delhi.
30. McShane, Glinow, Sharma: (2008): Organizational Behaviour 4th Edition, TATA McGraw Hill, New Delhi.
31. Academy of Management Executive, 16, 67–79.
32. Academy of Management Journal, 44, 1251–1262.
33. Journal of Applied Psychology, 90, 497–508.
34. Journal of Applied Psychology, 92, 885–892.

35. Personnel Psychology, 53, 625–642; Langfred, C. W. (2007).
36. Personnel Psychology, 46, 823–850; Magjuka, R. J., & Baldwin, T. T. (1991).
37. Personnel Psychology, 44, 793–812; Vinokur-Kaplan, D. (1995).
38. Journal of Applied Behavioral Science, 31, 303–327.
39. Journal of Applied Psychology, 92, 1189–1199.
40. Surowiecki, J. (2005). The wisdom of crowds. New York: Anchor Books.
41. Science Quarterly, 4, 84–110; Shin, S. J., & Zhou, J. (2007).
42. Journal of Applied Psychology, 92, 1709–1721.

Course Name: Principle of Communication

Course Code: OE13

Vertical/ Sub-Vertical: Multidisciplinary Courses

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: BS14P-Physics

Pre-requisite for: IT06T (Computer Network)

Recommended Semester: 3

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
OE13	2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (OE13)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:
This course introduces to basic working of Analog and Digital communication system. It is used to understand different analog as well as digital modulation techniques we use for transmission of signals in different applications. It helps to determine impact of noise on communication system.

Course Objectives:
- To introduce the fundamentals of communication systems including the basic structure, types of communication channels, and the distinctions between analog and digital communication methods.
- To develop a strong understanding of noise and its impact on communication systems by exploring various noise types, key parameters, and mathematical models such as the Friis formula and equivalent noise temperature.
- To impart knowledge of modulation techniques, covering both amplitude and angle modulation, along with their generation, detection, performance metrics (such as bandwidth and power), and practical receiver architectures like TRF and superheterodyne receivers.
- To familiarize students with pulse and digital modulation techniques, including sampling theory, PAM, PWM, PPM, PCM, and delta modulation, and to introduce digital line coding methods relevant to modern communication systems.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Define and identify the basic components and types of communication systems, including analog and digital channels.	Remembering
CO2	Explain various types of noise, their parameters such as SNR, noise factor, and noise figure, and their impact on communication systems.	Understanding
CO3	Apply amplitude and angle modulation techniques in the analysis of communication signals, including power and bandwidth calculations.	Applying
CO4	Analyze the performance and characteristics of AM and FM receivers, including TRF and superheterodyne configurations.	Analysing
CO5	Evaluate the performance of pulse analog modulation and digital modulation techniques, including PCM, DM, and ADM, based on signal quality and bandwidth requirements.	Evaluating
CO6	Design a basic communication system using appropriate analog or digital modulation techniques for a given application scenario.	Creating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to communication systems	Basic block diagram of Analog and Digital communication system. Types of communication channel. ***Self-Learning Topics***: *application areas of Analog and Digital communication.*	2
2	Noise in communication system	Basics of signal representation and analyses, Types of Noise, Noise Parameters-Signal to Noise ratio, Noise factor, Noise Figure, Friss formula and equivalent noise temperature. ***Self-Learning Topics***: *Introduction to Fourier Transform and its property.*	4
3	Amplitude and Angle Modulation Technique	Need for modulation, Amplitude modulation techniques, DSBFC-AM, DSBSC-AM, SSB-AM- block diagram, Spectrum, waveform, bandwidth, power calculations. Generation of AM and its different types, TRF receiver and Super heterodyne receiver and its characteristics. Angle Modulation FM: Principle of FM, Waveform, spectrum, bandwidth. FM generation: Direct method (Varactor diode), Indirect method (Armstrong method). FM demodulator-Foster Seeley Discriminator. ***Self-Learning Topics***: *Use of AM and FM in modern communication Technology.*	10
4	Pulse Analog Modulation and Digital Modulation	Sampling Theorem, PAM, PWM and PPM generation and degeneration. Quantization process, Pulse code modulation, delta modulation, Adaptive delta modulation. Introduction to line codes. ***Self-Learning Topics***: *Line coding and ISI.*	7

5	Multiplexing Techniques	Principle of Time Division Multiplexing, Frequency Division Multiplexing, Wavelength Division Multiplexing, Code Division Multiplexing. ***Self-Learning Topics***: *Orthogonal Frequency Division Multiplexing, Space Division Multiplexing.*	3
6	Digital Band Pass Modulation Techniques	Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Q-PSK generation and detection.	4
Total			**30**