Vidyalankar Institute of Technology

An Autonomous Institute affiliated to University of Mumbai

Bachelor of Technology

in

Computer Engineering 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/ she 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 Programme Courses consisting of Programme 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 Programme 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 programme 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 Courses (OEC) and Multidisciplinary Minor (MDM). 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 other institutes of repute 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, our framework offers Honors/ Honours by Research/ Double Minor (Multidisciplinary Minor and Specialization Minor) degree in each UG 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 Computer Engineering
Vidyalankar Institute of Technology

Chairman, Academic Council
Vidyalankar Institute of Technology

Second Year B. Tech. Computer Engineering **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	PCCE02T	Microprocessor	Theory	2	15	20	40	075
PC_PCC	PCCE02P	Microprocessor Lab	Practical	1	25	-	25	050
PC_PCC	PCCE04T	Analysis of Algorithms	Theory	2	15	20	40	075
PC_PCC	PCCE04P	Analysis of Algorithms Lab	Practical	1	25	-	25	050
PC_PCC	PCCE05T	Database Management Systems	Theory	2	15	20	40	075
PC_PCC	PCCE05P	Database Management Systems Lab	Practical	1	25	-	25	050
HSSM_EEMC	EEMC01	Design Thinking	Theory + Practical	3	50	-	50	100
HSSM_AEC	AEC03	Presentation Skills	Practical	1	50	-	-	050
MDC_MDM	MDMXX[#]	MD M Course1 of chosen Title	As per list below	4	45	30	50	125
Total Credits				**20**				

[*]Selection based on the subset of courses made available by the Institute for the semester.
[#]Selection based on the MD M Title chosen by the student.

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

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.

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

Learners are required to go through the Appendix-A 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-A.

Multidisciplinary Elective Course-1 (MDMXX)

MD M 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. Computer Engineering **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	PCCE06T	Computer Graphics	Theory	2	15	20	40	075
PC_PCC	PCCE06P	Computer Graphics Lab	Practical	1	25	-	25	050
PC_PCC	PCCE07T	Operating Systems	Theory	2	15	20	40	075
PC_PCC	PCCE07P	Operating Systems Lab	Practical	1	25	-	25	050
SC_VSEC	VSEC03	Python Programming	Practical	2	50	-	25	075
HSSM_VEC	VEC01T	Professional Skills	Theory	2	15	20	40	075
HSSM_VEC	VEC01P	Professional Skills Lab	Practical	1	25	-	25	050
ELC_CEP	CEP01*	Social Service Internship/ Project	Practical	2	25	-	50	075
MDC_MDM	MDMXX#	MD M Course2 of chosen Title	As per list below	4	45	30	50	125
Total Credits				**20**				

***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).

#Selection based on the MD M Title chosen by the student.

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

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-2 (MDMXX)

MD M 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. Computer Engineering - 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: BSC05

Vertical_Sub-Vertical: BSES_BSC

Preamble:

This course introduces students to various discrete structures concepts that is helpful for understanding many fundamental topics in computer science.

Pre-requisites:
Basic Mathematics

Course Objectives:

- Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving.
- Students will acquire a comprehensive understanding of relations and functions which play crucial roles in computer science across various domains.
- Understand the use of graph theory in programming applications.
- Understand the concept of groups and cyclic group.
- Understand the concept codes in Encoding-Decoding function.
- Apply the Number Theory to different applications using theorem

Course Outcomes:

Student will be able to:
CO1: Use the basic principles of sets and operations in sets and apply counting principles to determine probabilities
CO2: Apply relations and to determine their properties
. CO3: Interpret different traversal methods for trees and graphs. Model problems in Computer Science using graphs and trees.
CO4: Use the properties of algebraic structures
CO5: Understand the concept codes in Encoding-Decoding function.
CO6: Apply the Number Theory to different applications using theorem

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	0	3	0

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	20	30	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.

Detailed Syllabus:

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 (3 sets) • Partition of set, Counting Principle • Pigeonhole Principle • Mathematical Induction	6
2	Relations and Functions	• Definition of Relation • Representation & Properties of Relation • Closure properties of Relation (Reflexive, Symmetric and Transitive) • Partial Order and Equivalence Relation. • Composite and Circular Relation. • Definition of Function, Types of Function • Inverse Function, Composite Functions.	8
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	8
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.	8
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	6

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	9
Total			**45**

Text Books:

1. C. L. Liu, "Elements of Discrete Mathematics", TMH, ISBN 10:0-07-066913-9.
2. N. Biggs, "Discrete Mathematics", 3rd Ed, Oxford University Press, ISBN 0 –19-850717–8.
3. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw-Hill, ISBN 978-0-07-288008-3
4. Cryptograph and Network Security by B. A. Forouzan & D. Mukhopadhyay, 11th edition, McGraw Hill Publication.
5. K.C. Chaudhary, A First Course in Number Theory, Asian Books Private Limited

Reference Books:

1. Bernard Kolman, Robert C. Busby and Sharon Ross, "Discrete Mathematical Structures", Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450.
2. Narsingh Deo, "Graph with application to Engineering and Computer Science", Prentice Hall of India, 1990, 0 – 87692 – 145 – 4.
3. Eric Gossett, "Discrete Mathematical Structures with Proofs", Wiley India Ltd, ISBN:978-81- 265-2758-8.
4. Sriram P. And Steven S., "Computational Discrete Mathematics", Cambridge University Press, ISBN 13: 978-0-521-73311-3.
5. Elementary Number Theory and its applications by Kenneth H. Rosen, 5th edition, Addison Wesley Publication.

Course Name: Microprocessor

Course Code: PCCE02T

Vertical_Sub-Vertical: PC_PCC

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 Pre-requisite:

1. Fundamentals of Computer Hardware and Networking
2. Fundamentals of Logic Circuits

Course Objectives:

- To develop background knowledge and core expertise in Microprocessor
- 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:

After successful completion of the course students will be able to:

CO1: Understand the basics of RISC & CISC architecture and 8086 microprocessor.

CO2: Apply concept of assembly language programming to develop simple application programs.

CO3: Analyze and understand the necessity of the peripheral chips.

CO4: Design simple microprocessor-based system with memory & I/O devices.

CO5: Appreciate and understand the advantages of advanced microprocessors.

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	75

Detailed Syllabus:

Module No.	Module Name	Contents	Hours
1	Introduction to Microprocessor	Fundamental Units of a Computer	04
		Introduction to Buses	
		Compare RISC & CISC architecture	
		Basic concept of – Clock cycle, Machine cycle, Instruction cycle	
2	8086 Architecture and PIN configuration	8086 - Bus Interface Unit, Control unit, Programmers Model	06
		Concept of Segmentation, Physical Address, Logical Address	
		8086 – Pin description, Power on and manual Reset ckt., Minimum and Maximum Modes,	
3	8086 Addressing Modes & Instruction set	8086- Addressing Modes	06
		8086 - Instruction set	
		Assembler directives and assembly language programming with 8086	
4	Peripheral Chips	Concept of parrel peripheral interface and study of 8255 (PPI)	06
		Interrupt structure of 8086 and study of 8259 (PIC)	
		Concept of DMA and study of 8237 (DMAC)	
5	8086 Based System Design	Address decoders for memory interfacing	04
		Interfacing of RAM, EPROM, and I/O chips with 8086	
6	Advanced Microprocessors	Introduction to the architecture of Pentium Processor and concept of Superscalar Architecture	04
		Comparative study of salient features of 8086, 80186, 80286, 80386, 80486 and Pentium processor.	
		Total	**30**

Text Books:

1. Douglas Hall, 'Microprocessors and Interfacing', TMH 2005
2. John Uffenbeck, '8086 Family: Design, programming and interfacing', PH, 2001
3. Barry Brey, 'The intel microprocessor 8086/8088,80186/8088,80286,80386,80486, Pentium and Pentium Pro Processor architecture, programming and interfacing', PHI1997

Course Name: Microprocessor Lab

Course Code: PCCE02P

Vertical_Sub-Vertical: PC_PCC

Preamble:

A professional in any field of computing should not regard the computer as just a black box that executes programs by magic. All students of computing should acquire some understanding and appreciation of a computer system's functional components, their characteristics, their performance, and their interactions. Students need to understand the addressing modes, instruction set of a microprocessor and should be able to develop simple application programs.

Course Pre-requisite:

1. Fundamentals of Computer Hardware and Networking Lab
2. Fundamentals of Logic Circuits Lab

Course Objectives:

- To introduce learners with instruction set of a microprocessor.
- To introduce learners with enough assembly language to enhance their knowledge on today's most widely used microcomputer family.
- To Improving learners systems programming skills through programming exercises carried out by students.
- Learners are expected to implement solutions to problems using the concepts they will take through the course.

Course Outcomes:

After successful completion of the course students will be able to:
CO1: Understand instruction set/format of a microprocessor.
CO2: Understand concept of assembly language programming.
CO3: Develop assembly language program for simple applications.

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

Suggested list of Practicals:

Sr. No.	Practicals
1	Introduction to assembler directives
2	Introduction to assembler like TASM, MASM etc.
3	ALP using ADD, SUB, MUL, DIV instructions
4	ALP using AND, OR, XOR instructions
5	ALP for BCD to ASCII & ASCII to BCD conversion
6	ALP for HEX to ASCII & ASCII to HEX conversion
7	ALP to find out smallest & largest of the array
8	ALP to sort the array in ascending & descending order
9	ALP using BIOS routine for keyboard interface
10	ALP using BIOS routine for display interface

Reference Books:

1. Douglas Hall, 'Microprocessors and Interfacing', TMH 2005

2. John Uffenbeck, '8086 Family: Design, programming and interfacing', PH, 2001

3. Barry Brey, 'The intel microprocessor 8086/8088,80186/8088,80286,80386,80486, Pentium and Pentium Pro Processor architecture , programming and interfacing', PHI1997

Course Name: Analysis of Algorithms

Course Code: PCCE04T

Vertical_Sub-Vertical: PC_PCC

Preamble:
The course covers the fundamental principles and techniques used in designing and analyzing algorithms. Students will learn how to analyze the performance of algorithms, measure their efficiency, and compare different algorithms based on their time and space complexity. The course is designed for students with a solid understanding of programming and data structures. By the end of the course, students will have a deep understanding of the principles of algorithm design and analysis and will be equipped with the tools and techniques necessary to develop efficient algorithms for a wide range of computational problems.

Pre-requisites:

1. Data Structures

Course Objectives:

- To provide a deep understanding of algorithmic design and analysis techniques that enable the development of efficient and effective algorithms for solving computational problems.
- To develop a strong foundation in the theory of algorithms, including concepts such as time and space complexity, algorithmic paradigms, data structures, graph algorithms, sorting and searching, and dynamic programming.
- To equip students with the tools and techniques necessary to compare and evaluate the performance of different algorithms and choose the best algorithm for a given problem.
- To provide students with the knowledge and skills required for a successful career in software development, data analysis, and other fields that require strong analytical and problem-solving abilities.

Course Outcomes:

Learner will be able to:
CO1: Analyze the time and space complexity of algorithms.
CO2: Apply and Analyze Divide and Conquer strategy to solve given problems.
CO3: Apply and Analyze Greedy strategy to solve given problems.
CO3: Apply and Analyze Dynamic Programming strategy to solve given problems.
CO4: Apply and Analyze Backtracking, Branch and Bound strategy to find solution for the given problems.
CO5: Classify a problem as computationally tractable or intractable and discuss strategies to address intractability.

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	75

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	Introduction to Algorithm Analysis	Performance analysis: Space, and Time complexity, Growth of function. Asymptotic Notations: Big-Oh, Omega Theta notation. Analysis of selection sort, insertion sort and Naïve String-Matching Algorithm. Recurrences: The substitution method, Recursion tree method, Master method.	8
2	Divide and Conquer Approach	General method, Analysis of Merge sort and Quick sort, Finding minimum and maximum algorithms and their Analysis, Analysis of Binary search.	4
3	Greedy Method Approach	General Method, Analysis of Minimum cost spanning trees: Kruskal and Prim's algorithm, Single source shortest path: Analysis of Dijkstra's Algorithm, Fractional Knapsack Problem and Job Sequencing with Deadlines	6
4	Dynamic Programming Approach	General Method, Finding nth term in Fibonacci series, Single Source Shortest Path: Bellman Ford Algorithm All Pair Shortest Path: Floyd Warshall's Algorithm, Longest Common Subsequence,0/1 Knapsack Problem, Matrix Chain Multiplication and Sum of Subset Problem.	7
5	Backtracking and Branch and Bound	General Method, Backtracking: N-queen problem, Graph Coloring. Branch and Bound: 15 Puzzle problem, Travelling Salesperson Problem	3
6	Introduction to Complexity Theory	The class P and NP. Polynomial reduction. NP-Complete Problems. NP-Hard Problems	2
Total			**30**

Text Books:

1. T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005.
2. Jon Kleinberg, Eva Tardos "Algorithm Design", Pearson Education.
3. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms" University Press.

Reference Books:

1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw-Hill Edition.
2. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI.

Course Name: Analysis of Algorithms Lab

Course Code: PCCE04P

Vertical_Sub-Vertical: PC_PCC

Preamble:

The course covers the fundamental principles and techniques used in designing and analyzing algorithms. Students will learn how to analyze the performance of algorithms, measure their efficiency, and compare different algorithms based on their time and space complexity. The course is designed for students with a solid understanding of programming and data structures. By the end of the course, students will have a deep understanding of the principles of algorithm design and analysis and will be equipped with the tools and techniques necessary to develop efficient algorithms for a wide range of computational problems.

Pre-requisites:

- Data Structures Lab

Course Objectives:

- To introduce the methods of designing and analyzing algorithms.
- Design and implement efficient algorithms for a specified application.
- Strengthen the ability to identify and apply suitable algorithms for the given real-world problem.
- Analyze worst-case running time of algorithms and understand fundamental algorithmic problems.

Course Outcomes:

At the end of the course, the students will be able to
CO1: Implement the algorithms using different approaches.
CO2: Analyze the complexities of various algorithms.
CO3: Apply and Analyze Greedy strategy to solve given problems.

Course Scheme:

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

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	--	25	50

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.

Suggested List of Practical's:

Sr No.	Suggested Topic(s)
1.	Introduction: Selection sort, Insertion sort
2.	Divide and Conquer Approach: Finding Minimum and Maximum, Merge sort, Quick sort, Binary search
3.	Greedy Method Approach: Single source shortest path- Dijkstra Fractional Knapsack problem Job sequencing with deadlines Minimum cost spanning trees-Kruskal and Prim's algorithm
4.	Dynamic Programming Approach: Single source shortest path- Bellman Ford All pair shortest path- Floyd Warshall 0/1 knapsack Longest common subsequence
5.	Backtracking: N-queen problem Graph coloring

Text Books:

1. T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005.
2. Jon Kleinberg, Eva Tardos "Algorithm Design", Pearson Education.
3. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms" University Press.

Reference Books:

1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw-Hill Edition.
2. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI.

Course Name: Database Management Systems

Course Code: PCCE05T

Vertical_Sub-Vertical: PC_PCC

Preamble:

The goal of the course is to introduce the students to relational database design. This course covers the design and implementation of databases using SQL commands.

Pre-requisites:

Data Structure

Course Objectives:

- Develop entity relationship data model and its mapping to relational model.
- Learn relational algebra and Formulate SQL queries.
- Apply normalization techniques to normalize the database.
- Understand concept of transaction, concurrency control and recovery techniques.

Course Outcomes:

Learner will be able to:
CO1: Recognize the need of database management system.
CO2: Design ER and EER diagram for real life applications.
CO3: Construct relational model and write relational algebra queries.
CO4: Formulate SQL queries.
CO5: Apply the concept of normalization to relational database design.
CO6: Describe the concept of transaction, concurrency and recovery.

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 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	Introduction Database Concepts	Introduction, Characteristics of databases, File system v/s Database system, Data abstraction and data Independence, DBMS system architecture, Database Administrator	2
2	Entity–Relationship Data Model	The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation, Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation	4
3	Relational Model and relational Algebra	Introduction to the Relational Model, relational schema and concept of keys. Mapping the ER and EER Model to the Relational Model, Relational Algebra-operators, Relational Algebra Queries.	6
4	Structured Query Language (SQL)	Overview of SQL, Data Definition Commands, Integrity constraints: key constraints, Domain Constraints, Referential integrity, check constraints, Data Manipulation commands, Data Control commands, Set and string operations, aggregate function-group by, having, Views in SQL, joins, Nested and complex queries, Triggers	6
5	Relational-Database Design	Pitfalls in Relational-Database designs, Concept of normalization, Function Dependencies, Armstrong Axioms of functional dependency, Closure set of attributes, Equivalence of Functional dependency, First Normal Form, 2NF, 3NF, BCNF	6
6	Transaction Management, Concurrency and Recovery	Transaction concept, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, Serializability-Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols, Recovery System: Log based recovery, Deadlock handling	6
Total			**30**

Text Books:

1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6thEdition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 5thEdition, Pearson Education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH

Reference Books:

1. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management Thomson Learning, 5thEdition.
2. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dream Tech Press.
3. G. K. Gupta, Database Management Systems, McGraw Hill, 2012

Course Name: Database Management Systems Lab

Course Code: PCCE05P

Vertical_Sub-Vertical: PC_PCC

Preamble:

The goal of the course is to introduce the students to relational database design. This course covers the design and implementation of databases using SQL commands.

Pre-requisites:

Data Structure Lab

Course Objectives:

- To explore design and develop of relational model.
- To present SQL and procedural interfaces to SQL comprehensively
- To introduce the concepts of transactions and transaction processing

Course Outcomes:

Learner will be able to:

CO1: Design ER /EER diagram and convert it to relational model for the real world application.
CO2: Apply DDL, DML, DCL and TCL commands.
CO3: Write simple and complex queries.
CO4: Use PL / SQL Constructs.
CO5: Demonstrate the concept of concurrent transactions execution and frontend-backend connectivity.

Course Scheme:

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

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

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.

Suggested List of practicals

Sr. No.	Suggested Topic(s)
1	Identify the case study and detail statement of problem. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.
2	Mapping ER/EER to Relational schema model
3	Create a database using Data Definition Language (DDL) and apply integrity constraints for the specified System
4	Apply DML Commands for the specified system
5	Perform Simple queries, string manipulation operations and aggregate functions.
6	Implement various Join operations.
7	Perform Nested and Complex queries
8	Perform DCL and TCL commands
9	Implementation of Views and Triggers.
10	Demonstrate Database connectivity

Text Books:

1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6thEdition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 5thEdition, Pearson Education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH

Reference Books:

1. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management Thomson Learning, 5thEdition.
2. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dream Tech Press.
3. G. K. Gupta, Database Management Systems, McGraw Hill, 2012

Course Name: Design Thinking

Course Code: EEMC01

Vertical_Sub-Vertical: HSSM_EEMC

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.

Pre-requisites:

NIL

Course Objectives:

- To provide 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:

1. Understand the concepts of design thinking approaches
2. Create design thinking teams and conduct design thinking sessions
3. Apply both critical thinking and design thinking in parallel to solve problems
4. Apply design concept to their daily work

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory + Practical	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.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Design Thinking Overview	What is different about design thinking, Design thinking skills, Design thinking mindset, Principles of Design thinking	2
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	4
3	Design Thinking approach in stages	Apply design thinking framework, emphasize with customers/users, Define the problem, Ideate, Prototype, Test solution.	7
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,	7
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	8
6	Adopt and Adapt Design thinking	Cautions and pitfalls – assumptions, pitfalls and cautions in design thinking workgroups, Best practices	2
Total			**30**

Reference Books:

1. Tim Brown "Change by Design - How Design Thinking Transforms Organisations 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

Vertical_Sub-Vertical: HSSM_AEC

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:

Learner 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, create 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 cultural diversity.

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	50	-	-	050

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	Personal Branding	Introduction to Personal Branding –Purpose, Significance, Benefits and Techniques to build a personal brand. Corporate/Organisational Branding. Online identity of Brand on social media. Maintenance and Improvement of your Brand Factors affecting your Brand	6
2	Corporate Presentations	Business Presentation Tips Digital Presentations PAIBOC Model and Minto Pyramid Principles	4
3	Business Plan Presentations	Introduction to Business Plans Company Overview & Industry Analysis Persuasive Communication in Marketing Strategy Operations Strategy in Financial Management Implementation Plan	6
4	Storyboarding and Storytelling	Visual Story Telling Video Presentations Story Structure with images Film and Animation	4
5	Placement Readiness	Mock HR Interviews Mock GDs Aptitude Tests Placement ready resume	6
6	Global Communication	An introduction to inter-cultural communication Introduction to languages and cultures Global media in mass communication Tips to become a global citizen Respecting cultural diversity	4
Total			**30**

Guidelines to conduct practical sessions:

1. Personal Branding (X3)
2. Corporate Presentations (X2)
3. Business Plan Presentations (X3)
4. Storyboarding and Storytelling (X2)

5. Placement Readiness (X3)
6. Global Communication (X2)

List of Assignments:

1. Personal Branding (Individual)
2. Corporate Presentations (Group)
3. Business Plan Presentations (Group)
4. Storyboarding and Storytelling (Group)
5. Global Communication (Individual)

Recommended Online Courses:

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

Reference Books:

1. Personal Development for Life and Work, Wallace and Masters, Thomson Learning
2. Organizational Behaviour, Robbins Stephens, Pearson Education
3. Me 2.0: 4 Steps to Building Your Future, Dan Schawbel, Diversion Books
4. Branding Pays: The Five-Step System to Reinvent Your Personal Brand, Karen Kang, Branding Pays Media
5. The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience, Carmine Gallo, McGraw Hill Education
6. Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds, Carmine Gallo, St. Martin's Press
7. The Storytelling Animal: How Stories Make Us Human, Jonathan Gottschall, Mariner Books
8. Made to Stick: Why Some Ideas Survive and Others Die, Chip Heath and Dan Heath, Random House
9. The Culture Map: Decoding How People Think, Lead, and Get Things Done Across Cultures, Erin Meyer, Public Affairs
10. Kiss, Bow, or Shake Hands: The Bestselling Guide to Doing Business in More Than 60 Countries, Terri Morrison and Wayne A. Conaway, Adams Media
11. Brand Thinking and Other Noble Pursuits, Debbie Millman, Allworth
    Building a Brand Story: Clarify Your Message So Customers Will Listen, Donald Miller, HarperCollins

Course Title: Introduction to Bioinformatics

Course Code: MDMBI01

Vertical/Sub-Vertical: MDC_MDM

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

Pre-requisites: NIL

Course Objectives:

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

Course Outcomes:

Students will be able to:
CO1: Explain foundational molecular biology concepts and their relevance to bioinformatics, including DNA, RNA, proteins, and gene functions.
CO2: Access, compare, and utilize various biological databases and sequence file formats to retrieve and analyze genomic and proteomic data effectively.
CO3: Apply key sequence alignment algorithms and computational techniques to analyze biological sequences and construct phylogenetic relationships.
CO4: Implement bioinformatics algorithms and data structures to solve problems in genomics, proteomics, and systems biology, including gene prediction and motif discovery.
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.

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	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	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.	8
2	Biological Database	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)	8
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	8
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	12
5	Applications of Bioinformatics	Bioinformatics in personalized medicine, Drug discovery and vaccine design, Agriculture and animal genomics Role of AI/ML in bioinformatics	9
		Total	**45**

Reference books:

1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laborator 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

Vertical_Sub-Vertical: 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 identify entrepreneurial opportunities.

CO3: Create basic business models using Business Model Canvas.

CO4: Evaluate entrepreneurial case studies and pitch early-stage ideas.

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMIE01	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 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 Model Design	• Business Model Canvas • Value Proposition Design • Customer Segments and Customer Discovery	6
5	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 Title: Introduction to Business Development and Marketing Principles

Course Code: MDMBD01

Vertical_Sub-Vertical: MDC_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: NIL

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:

Students 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	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.

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 journeys, 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 Open Courseware

Course Name: Fundamentals of Robotics and Control

Course Code: MDMRB01

Vertical_Sub-Vertical: MDC_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.

Pre-requisites:

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

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.

Course Outcome:

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:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
MDMRB01	3	2	3	1

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 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

Detailed syllabus of Second Year Semester-IV

Course Name: Engineering Mathematics-IV

Course Code: BSC07

Vertical_Sub-Vertical: BSES_BSC

Preamble:

The course aims to help students understand probability, analyze probability distributions, apply statistical methods, and test hypotheses using t-tests, F-tests, and chi-square tests and to optimize the function linear and non-linear programming techniques are included.

Pre-requisites:

Basic Mathematics

Course Objectives:

- Understanding the Statistical Techniques like Probability Distribution and Correlation and Regression to solve real world problems.
- Ability to write the suitable hypothesis and apply appropriate testing procedure
- Understand the important applications of Non-parametric test.
- To understand the concept of linear and Non-linear programming problem to optimize the function.

Course Outcomes:

Student will be able to:

CO1: Use statistical methods to analyze and interpret data sets.
CO2: Analyze the behaviour of discrete and continuous probability distributions.
CO3: Apply the statistics for testing the significance of the given large and small sample data
CO4: Use the non-parametric test for testing of Hypothesis
CO5: Apply LPP technique to optimize the functions
CO6: Apply various techniques of Operation research to solve Non-Linear Programming Problems

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 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	Statistical techniques	Correlation: Covariance, Karl Pearson's Correlation Coefficient. Spearman's rank correlation coefficient, Regression lines, fitting of first- and second-degree curves	8
2	Probability Distribution	Random Variable: Probability distribution for discrete and continuous random variable, Bayes Theorem (without proof) Expectation, Variance, Probability distributions: Poisson and Normal distributions.	8
3	Testing of Hypothesis	Formation of Hypothesis, Test of significance: Test of significance for Small samples: t- Test for single mean, difference of means	6
4	Non-parametric test and Anova	Chi-square test for goodness of fit and independence of attributes, F- test for ratio of variances, Analysis of Variance (One Way ANOVA)	7
5	Linear Programming	Simplex method, Big-M method (Method of penalty) Duality, Dual of LPP and Dual simplex method	8
6	Non-linear programming	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)	8
Total			**45**

Text Books:

1. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India.
2. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, Wiley.
3 S. C. Gupta and V. K. Kapoor , "Fundamentals of Statistics"
4 J. K. Sharma , "Operations Research: Theory and Applications" Macmillan Publishers India, 1997.

Reference Books:

1. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India
2. D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, Wiley.
3. J. L. Devore, Probability and Statistics for Engineering and the Sciences, Cengage Learning.
4. Operations Research: Theory and Applications" by S.D. Sharma and Kedar Nath Ram Nath. Singiresu S.Rao, Engineering Optimization, New Age International.

Course Name: Computer Graphics

Course Code: PCCE06T

Vertical_Sub-Vertical: PC_PCC

Preamble:
The goal of the course is to introduce students to the technical concepts behind creating synthetic computer-generated images, focusing on underlying mathematical concepts covering geometrical and attribute related features. This course attempts to uncover various 2D and 3D rendering techniques.

Pre-requisites:
Data Structure
Structured Programming Approach

Course Objectives:

- To enable learners to understand the basics of computer graphics, including the principles of image representation, display technology, and color models.
- To enable learner to understand 2D and 3D geometric transformations, including translation, scaling, rotation, orthographic and perspective projection.
- To enable learners to design and implement graphical user interfaces (GUIs) for software applications.

Course Outcomes:

Learner will be able to:
CO1: Understand the basic concepts of Computer Graphics.
CO2: Demonstrate various algorithms for scan conversion, for filling of basic geometrical objects and their comparative analysis.
CO3: Apply geometric transformations, viewing and clipping on graphical objects.
CO4: Explore 3-D geometric transformations, curve representation techniques and projections methods.
CO5: Understand visible surface detection techniques and illumination models.

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	Introduction and Overview of Graphics System.	Definition and Representative uses of Computer Graphics, Classification of application areas, Overview of Coordinate Systems, Definition of Scan Conversion, Rasterization and Rendering. Raster Scan & Random Scan Displays, Architecture of Raster Graphics System with display processor, Architecture of Random Scan Systems.	2
2	Raster Algorithms.	Scan Conversions of Point, Line, and Circle: DDA Algorithm and Bresenham Algorithm for Line Drawing, Midpoint Algorithm for Circle. Aliasing, Antialiasing Techniques like Pre and Post Filtering, Super Sampling, and Pixel Phasing. Filled Area Primitives: Scanline Polygon Fill Algorithm, Inside Outside Tests, Boundary Fill and Flood fill Algorithm.	8
3	Two Dimensional Geometric Transformations, Viewing and Clipping.	Basic transformations: Translation, Scaling, Rotation. Matrix Representation and Homogeneous Coordinates, Composite Transformation. Viewing Transformation Pipeline and Window to Viewport Coordinate Transformation. Clipping Operations: Point Clipping, Line Clipping Algorithms: Cohen–Sutherland, Midpoint Subdivision, Liang–Barsky, Polygon Clipping Algorithms: Sutherland–Hodgeman and Weiler – Atherton Algorithm.	8
4	Three-Dimensional Object Representations, Geometric Transformations and 3D Viewing.	Boundary Representation and Space Partitioning Representation: Polygon Surfaces, Bezier Curve B-Spline Curve, Fractal-Geometry: Fractal Dimension, Koch Curve. 3D-Transformations: Translation, Rotation, Scaling and Reflection. Composite Transformations: Rotation about an Arbitrary Axis. 3D-Transformation Pipeline Projections– Parallel and Perspective Projection. (Matrix Representation).	6
5	Visible Surface Detection.	Classification of Visible Surface Detection Algorithm, Back Surface Detection Method: Depth Buffer Method, Scan Line Method, Area Subdivision Method.	4
6	Illumination Models and Surface Rendering	Basic Illumination Models: Diffused reflection, Phong Specular Reflection Model, Halftone and Dithering Techniques, Polygon Rendering: Constant shading, Gouraud Shading, Phong Shading.	2
Total			**30**

Textbooks:

1. "Computer Graphics C version" by Hearn & Baker, 2nd Edition, Pearson Publication, ISBN-13: 978-8177587654.
2. "Computer Graphics Principles and Practice in C", by James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, 2nd Edition, Pearson Publication, ISBN-0201121107, ISBN-9780201121100.
3. "Computer Graphics", by Samit Bhattacharya, Oxford Publication. ISBN: 9780198096191.

4. “Computer Graphics”, by Rajesh K. Maurya, Wiley India Publication, ISBN-13:978-81-265-3100, ISBN:81-265-3100-2

Reference Books:

1. “Procedural Elements for Computer Graphics ” by D. Rogers , Tata McGraw-Hill Publications.
2. “Computer Graphics”, by Zhigang Xiang , Roy Plastock , Schaum’s Outlines McGraw-Hill Education.
3. “Computer Graphics using OpenGL , by F.S.Hill , Jr. ,Third edition, Pearson Publications.

Course Name: Computer Graphics Lab

Course Code: PCCE06P

Vertical_Sub-Vertical: PC_PCC

Preamble:

The goal of the course is to introduce students to the technical concepts behind creating synthetic computer-generated images, focusing on underlying mathematical concepts covering geometrical and attribute related features. This course attempts to uncover various 2D and 3D rendering techniques.

Pre-requisites:

Data Structure Lab
Structured Programming Lab

Course Objectives:

- To enable learner to develop practical experience with raster algorithms for line, circle drawing and creating/ manipulating images.
- To enable learners to apply 2D & 3D geometric transformations to create visual effects and animations.
- To enable learners to use viewing transformations to define a camera position and orientation. Also implement clipping algorithms to remove parts of an image that are outside the view.

Course Outcomes:

Learner will be able to:
CO1: Understand various algorithms to draw lines in computer graphics applications, display lines with varying thickness and styles.
CO2: Understand and implement various area fill algorithms to efficiently fill areas with colors or patterns in computer graphics applications.
CO3: Apply 2D & 3D geometric transformations and clipping operations on an object to create visual effects and animations.
CO4: Understand Open GL library functions to generate graphical objects and create animated sequences in graphics applications.

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

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.

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Implement DDA Line Drawing algorithms and Bresenham algorithm.
2.	Program to display thick line, dotted line, and dashed line.
3.	Line generation using parallelism approach.
4.	Implement midpoint Circle algorithm.
5.	Implement Area Filling Algorithm: Boundary Fill, Flood Fill, Scan line Polygon Fill
6.	Implement Curve: Bezier for n control points, B Spline (Uniform)
7.	Implement Fractal (Koch Curve).
8.	Character Generation: Bit Map method and Stroke Method
9.	Implement 2D Transformations: Translation, Scaling, Rotation, Reflection, Shear.
10.	Implement Line Clipping Algorithm: Cohen Sutherland / Liang Barsky.
11.	Implement polygon clipping algorithm.
12.	Program to represent a 3D object using polygon surfaces and then perform 3D transformation.
13.	Program to perform projection of a 3D object on Projection Plane: Parallel and Perspective.
14.	Study of Open GL library functions and using it to generate graphical objects.
15.	Program to perform surface rendering using Open GL functions.
16.	Program to generate an animated sequence.

Textbooks:

1. "Computer Graphics C version" by Hearn & Baker, 2nd Edition, Pearson Publication, ISBN-13: 978-8177587654.
2. "Computer Graphics Principles and Practice in C", by James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, 2nd Edition, Pearson Publication, ISBN-0201121107, ISBN-9780201121100.
3. "Computer Graphics", by Samit Bhattacharya, Oxford Publication. ISBN: 9780198096191.
4. "Computer Graphics", by Rajesh K. Maurya, Wiley India Publication, ISBN-13:978-81-265-3100, ISBN:81-265-3100-2

Reference Books:

1. "Procedural Elements for Computer Graphics " by D. Rogers , Tata McGraw-Hill Publications.
2. "Computer Graphics", by Zhigang Xiang , Roy Plastock , Schaum's Outlines McGraw-Hill Education.
3. "Computer Graphics using OpenGL , by F.S.Hill , Jr. ,Third edition, Pearson Publications.

Course Name: Operating Systems

Course Code: PCCE07T

Vertical_Sub-Vertical: PC_PCC

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.

Pre-requisites:

Data Structure

Course Objectives:

- To enable learner to understand how operating system manages allocation and deallocation of different resources needed by user/ application.
- To enable learner to understand how operating system controls access to various resources and provides security.
- To enable learner to evaluate performance of different approaches used by operating systems, for effective resource utilization.

Course Outcomes:

Learner will be able to:
CO1: Understand the benefits of software modularity and how it applies to OS design.
CO2: Compare various OS scheduling policies based on performance parameters.
CO3: Analyze methods to achieve synchronization and handle deadlocks.
CO4: Evaluate performance of Memory allocation and replacement policies.
CO5: Compare various files and I/O management techniques.
CO6: Understand how principles of general OS are applied in Linux OS.

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	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	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,	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.	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 Virtual Memory: Demand Paging, Page Replacement Strategies: FIFO, Optimal, LRU, Thrashing, Kernel Memory Allocation	6
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	5
6	The Linux System	Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, File Systems, Network Structure, Security	3
Total			**30**

Textbooks:

1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8thEdition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9thEdition, 2016, ISBN 978-81-265-5427-0
3. Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rdEdition.

Reference Books:

1. Sumitabha Das, "UNIX: Concepts and Applications", McGraw Hill, 4thEdition
2. Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rdEdition

Course Name: Operating Systems Lab

Course Code: PCCE07P

Vertical_Sub-Vertical: PC_PCC

Preamble:

The course introduces learners to Linux shell commands and simulate various algorithms used by general OS for managing resources. This courses project will explore the key operating system facilities in the relative isolation of an OS development framework with the goal of maximizing experiential learning.

Pre-requisites:

Data Structure Lab

Course Objectives:

- To enable learner to visualize the working of operating system by simulating techniques used by it to manage resources.
- To enable learner to apply techniques of process synchronization in multithreaded programs and hence develop concurrent applications.

Course Outcomes:

Learner will be able to:
CO1: Understand various shell commands of Linux OS.
CO2: Compare performance of different process scheduling policies.
CO3: Perform process/ thread synchronization for consistency and concurrency.
CO4: Simulate OS techniques for memory and virtual memory management.
CO5: Develop project to explore key OS facilities.

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

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.

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Linux commands
2.	Non-Preemptive process Scheduling
3.	Preemptive process Scheduling
4.	Process synchronization using mutex locks.
5.	Deadlock Handling
6.	Dynamic memory allocation techniques
7.	Adddress translation in virtual memory
8.	Page replacement policies
9.	Disk scheduling techniques

Textbooks:

1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8thEdition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9thEdition, 2016, ISBN 978-81-265-5427-0
3. Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rdEdition.

Reference Books:

1. Sumitabha Das, "UNIX: Concepts and Applications", McGraw Hill, 4thEdition
2. Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rdEdition

Course Name: Python Programming

Course Code: VSEC03

Vertical_Sub-Vertical: SC_VSEC

Preamble:

This course is designed to take students from beginner to advanced Python programming. It covers the fundamentals of Python programming, as well as advanced topics such as object-oriented programming, multithreading, web development and data analysis. Students will gain practical experience through hands-on programming assignments and projects.

Pre-requisites:

- Basic knowledge of Python programming
- Understanding of basic concepts in databases
- Familiarity with HTML, CSS, and JavaScript for web development

Course Objectives:

- To enable learner to understand variables, data types, control structure, functions, file handling in python.
- To enable learners to write programs using object-oriented programming concepts in Python.
- To enable learners to understand the use of different python libraries in data analysis.
- To enable learners to create web applications using python web framework.

Course Outcomes:

Learner will be able to:
CO1: Understand the variables, data types, control structure, functions and modules in Python.
CO2: Understand and implement the data structure of python such as List, Tuple, String, Dictionary Set.
CO3: Understand and apply object-oriented programming concepts in Python to write programs.
CO4: Perform CRUD operations on databases and understand File handling in Python.
CO5: Perform data analysis and visualization using Python libraries such as NumPy, Pandas, and Matplotlib.
CO6: Understand Multithreading and Explore python web framework for developing python-based web application.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	4	-	2

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	50	-	25	075

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Python Programming	Overview of Python programming. Basic syntax, data types, and control structures in Python. Function and Modules in Python. Date and Time modules.	8
2	Data Structures in Python	Lists, Tuples, String, Dictionaries, Sets Implementing Stack & Queue using Python data structures. List comprehension in python.	12
3	Object-Oriented Programming (OOP) in Python	Class and object creation. inheritance, and polymorphism, absract class. Exception handling in python.	12
4	File Handling, GUI Programming and database connectivity.	Reading and writing files in Python. Desing GUI using Tkinter library. Connecting to databases using Python. Performing CRUD operations on databases using Python.	10
5	Data Analysis and Visualization using Python	Introduction to Python libraries for data analysis and visualization Using NumPy, Pandas, and Matplotlib for data analysis and visualization	8
6	Multi-Threading & Web Development in Python	Introduction to multi-threading in Python. Creating threads and managing threads. Introduction to Python Webframework.	10
Total			**60**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Programs to explore basics of python likes input output statements, conditional & control statements.
2.	Programs to understand function, module in python.
3.	Programs to use python data structure- List, Tuple, String, Dictionary & Set.
4.	Programs to implement stack & Queue data structure.
5.	Programs to use list comprehension in python.
6.	Programs to create classes and object in python.
7.	Programs to implements inheritance, and polymorphism, absract class concepts in python.
8.	Programs to demonstrate exception handling.
9.	Programs to understand file handling in python.
10	Creating GUI with python containing widgets such as labels, textbox,radio,checkboxes and custom dialog boxes.
11	Program to demonstrate CRUD(create, read, update and delete) operations on database (SQLite/MySQL) using python.
12	Program to demonstrate use of NumPy: Array objects.
13	Program to demonstrate Data Series and Data Frames using Pandas.
14	Programs on Threading using python.

15	Program on simple socket for basic information exchange between server and client.
16	Program on Web application using python framework.

Textbooks:

1. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press.
2. Beginning Python: Using Python 2.6 and Python 3.1, James Payne Wrox Publication.
3. Introduction to computing and problem solving using python , E Balagurusamy,McGraw Hill Education.

Reference Books:

1. Learn Python the Hard Way, Zed A. Shaw, Pearson Education.
2. Learn Python the Hard Way: (3rd Edition) (Zed Shaw's Hard Way Series).
3. Eric Matthes, "Python Crash Course, A Hands – on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
4. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

Course Name: Professional Skills

Course Code: VEC01T

Vertical_Sub-Vertical: HSSM_VEC

Preamble:

The course will groom learners in the areas of developing professional etiquettes, building digital profiles, imbibing workplace ethics, and organizational behavior. This course will also be an essential guide in building business communication and soft skills concepts.

Pre-requisites:

Nil

Course Objectives:

- To introduce the concepts of the job application process and digital profile building.
- To create awareness of professional etiquettes and corporate culture in tune with 21st Century soft skills.
- To enable learners to enrich their personality through self-awareness and SWOT analysis and understand various interpersonal skills required for the workplace.
- To build the foundations of professional ethics and corporate social responsibility among learners.

Course Outcomes:

Learner will be able to:

CO1: Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume.

CO2: Acquire basic proficiency in building a digital profile by demonstrating an awareness of professional and ethical responsibilities.

CO3: Understand the nuances of professional etiquettes and professionalism.

CO4: Enrich their personality through SWOT analysis, identify their personality traits and learning styles

CO5: Develop interpersonal skills to build effective professional relations.

CO6: Demonstrate awareness of contemporary issues, knowledge of ethical responsibilities and CSR.

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	Employment Skills	Job Application & Resume Writing, Group Discussion, Interview Skills, Digital Profile Building (ePortfolio, LinkedIn)	10
2	Professional Etiquettes	Corporate Grooming and Workplace Etiquette, Telephone Etiquette, Netiquettes, Telephone Etiquette, Digital Footprints, Social Media, Personal Profile Privacy	4
3	Interpersonal Skills	Assertiveness, Negotiation, Leadership, Team Building, Problem Solving, Decision Making, Cultural and Emotional Intelligence	6
4	Ethics	Introduction to Ethics, Plagiarism and Online, Plagiarism Checker, Patents, Trademark and Copyrights and GI – Geographical Indicators, Professional Ethics, Corporate Social Responsibility (CSR) –Information Confidentiality	4
5	Personality Enrichment	SWOT Analysis and JOHARI window, Developing Positive Attitude, Personality Types and Learning Styles, Vision and Goal Setting, Stress Management and Time Management	4
6	21st Century Skills	Creative Thinking, Critical Thinking, Collaboration and Communication	2
Total			**30**

Suggested List of Assignments:

1. Draft a Cover Letter and a Resume in response to a job vacancy advertisement (Individual)
2. Role plays and documentation on Professional Etiquettes (Group)
3. Role Play and documentation on Interpersonal Skills (Group)
4. Analysis of case studies on Ethics (Individual)
5. SWOT Analysis (Individual)
6. Assignment on 21st Century Skills (Group)

Suggested Online Courses:

1. LinkedIn Mastery: Creating an awesome profile – https://www.udemy.com/course/linkedin-mastery-creating-an-awesome-profile/
2. Soft Skills: The 11 Essential Career Soft Skills – https://www.udemy.com/course/soft-skills-the-11-essential-career-soft-skills/
3. Understanding Personality Types at Work – https://www.udemy.com/course/understanding-personality-types-at-work/
4. Speak English Professionally: In Person, Online & On the Phone - https://www.coursera.org/learn/speak-english-professionally
5. How to Write a Resume (Project Centered Course) https://www.coursera.org/learn/how-to-write-a-resume
6. Interviewing and Resume Writing in English Specialization https://www.coursera.org/specializations/english-interview-resume
7. Build Your Professional ePortfolio in English – https://www.coursera.org/learn/eportfolio-english

Reference Books:

1. Wallace and Masters, "Personal Development for Life and Work", Thomson Learning, 2021.
2. Dr. K.Alex, "Soft Skills", S. Chand and company, 2014.
3. Robbins Stephens, "Organizational Behaviour", Pearson Education, 2016.
4. Dorch, Patricia, "What Are Soft Skills?", Executive Dress Publisher, NewYork, 2013.
5. Francis Peter, "Soft Skills and Professional Communication", Tata McGraw Hill, 2019.
6. Kitty O Locker, "Business Communication- Building Critical Skills", McGraw Hill, Sixth Edition.
7. Chaturvedi and Chaturdevi, "Business Communication - Concepts Cases and Applications", Pearson, 2021.
8. Jones, "How to Speak Fluently", Indian Publishing House, 2021.

Course Name: Professional Skills Lab

Course Code: VEC01P

Vertical_Sub-Vertical: HSSM_VEC

Preamble:

The course, Professional Skills for the Workplace, will groom students in the areas of developing professional etiquettes, building digital profiles, imbibing workplace ethics, and organizational behavior. This course will also be an essential guide in building business communication and soft skills concepts.

Pre-requisites:

Nil

Course Objectives:

Student will be able to:

- Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews, and writing resume.
- Acquire basic proficiency in building a digital profile on LinkedIn, etc. and demonstrate an awareness of professional etiquettes through role play.
- Develop interpersonal skills to build effective professional relations by participating in seminars and quizzes.
- Demonstrate awareness of contemporary issues, knowledge of ethical responsibilities and CSR through case studies.
- Enrich their personality through SWOT analysis, identify their personality traits and learning styles through diagnostic tests.
- Demonstrate awareness of 21st century skills through poster presentation and discussions.

Course Outcome:

Student will be able to:
CO1: Observe and participate in Group Discussions and Mock Interviews on the lines of campus placement training.
CO2: Build a digital profile by demonstrating awareness of a professional persona.
CO3: Identify various interpersonal skills through participation in presentations and role play.
CO4: Differentiate between ethical and non-ethical behaviour through analysis of case studies.
CO5: Identify their personality traits and learning styles through activities like SWOT analysis.
CO6: Demonstrate awareness of 4 C's relevant to 21st Century Skills.

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

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.

Suggested list of Practicals:

1. Icebreakers – Introducing others
2. GD Practice Session 01
3. GD Practice Session 02
4. Final GD – ISA
5. Mock Interviews
6. Digital Profiling/ E-portfolio
7. Role Play on Professional Etiquettes
8. Quizzes on interpersonal skills
9. Case Studies on Ethics
10. Personality Enrichment – SWOT Analysis, JOHARI Window
11. Personality Enrichment - Identifying self-learning styles, MBTI test
12. Poster Presentation/Other activities on 21st Century Skills

Course Name: Social Service Internship/ Project

Course Code: CEP01

Vertical_Sub-Vertical: ELC_CEP

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:

Students 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:

Students 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
-	1 per week + 45*	-	2

*1 hour / week slot will be provided during the semester (in regular timetable). Additional work of 45 hours of field work needs to be completed during the semester (besides regular timetable) or after the semester (during inter- semester break).
NOTE: As per Institute guidelines, result 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	25	-	50	075

Course Title: Algorithms and Data Structures in Bioinformatics

Course Code: MDMBI02

Vertical_Sub-Vertical: MDC_MDM

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.

Pre-requisites: Introduction to Bioinformatics (MDMBI01)

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: Apply fundamental data structures and algorithms (arrays, trees, graphs, hashing, etc.) to solve computational problems in bioinformatics.

CO2: Analyze and implement sequence alignment algorithms for comparing DNA, RNA, and protein sequences, including global, local, and heuristic approaches.

CO3: Construct and interpret phylogenetic trees using distance-based and character-based algorithms for evolutionary analysis.

CO4: Use algorithmic and statistical models, such as HMMs and motif-finding tools, to predict genes and regulatory elements in genomic sequences.

CO5: Design and evaluate scalable bioinformatics workflows and pipelines using big data technologies and cloud platforms for handling large-scale genomic datasets.

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	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	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	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**

Reference books:

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

Vertical_Sub-Vertical: 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 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.

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Course Outcomes:

Students will be able to:

CO1: Design MVPs and apply lean startup methods

CO2: Conduct market and competitor analysis.

CO3: Prepare financial models and pitch decks.

CO4: Understand legal frameworks and intellectual property

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMIE02	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	Lean Startup Methodology	• MVP (Minimum Viable Product) • Pivoting and iteration • Build-Measure-Learn loop	8
2	Market Research and Strategy	• TAM-SAM-SOM analysis • Competitive analysis • Go-to-market strategy	8
3	Startup Finance	• Basics of financial modelling • Unit economics, pricing, and revenue models • Funding sources: bootstrapping, angels, VCs, crowdfunding	10
4	Legal & Regulatory Aspects	• Company formation: types and registration • IPR basics: patents, trademarks, copyrights • Compliance and taxation	6
5	Business Plan Development	• Writing an effective business plan • Pitch deck essentials	7
		Total	**45**

Tutorials (1 Credit):

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

Reference books:

1. Peter Thiel ,Zero to One: Notes on startups, or how to build the future, Crown Business 2014
2. E,ric Ries The Lean Startup, Crown Business 2011
3. Brad Feld ,Venture Deals, Wiley Publications

Course Title: Financial Basics for Engineers and Technopreneurs

Course Code: MDMBD02

Vertical_Sub-Vertical: MDC_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 analyse 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:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMBD02	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

Vertical_Sub-Vertical: MDC_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 (MDMRB01)

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: Analyse 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:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
MDMRB02	3	2	3	1

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

Appendix-A

Guidelines for Multidisciplinary Elective Courses and Minor Degree

In alignment with the NEP objectives and the evolving demands of the engineering profession, the introduction of a Multidisciplinary Minor Degree within the Undergraduate Engineering Programme aims to foster academic breadth, innovation, and cross-domain competency. These guidelines are formulated to support the structured integration of multidisciplinary elective courses, enabling students to pursue focused study in areas beyond their core engineering discipline.

Department of Computer Engineering offers the following Multidisciplinary Minor Degree Titles for B.Tech. Computer Engineering students:

1. Bioinformatics (BI)
2. Innovation, Entrepreneurial and Venture Development (IE)
3. Business Development, Marketing and Finance (BD)
4. Robotics (RB)

It should be noted that it is mandatory to choose one Multidisciplinary Minor (MD M) Degree Programme as a part of B.Tech. Computer Engineering degree.

Bioinformatics (BI): Courses to be completed successfully for MD M in Bioinformatic.

Semester	Course Code	Course Name
V	MDMBI01	Introduction to Bioinformatics
VI	MDMBI02	Algorithms and Data Structures in Bioinformatics
VII	MDMBI03	Machine Learning Applications in Bioinformatics

Innovation, Entrepreneurial and Venture Development (IE): Courses to be completed successfully for MD M in Innovation, Entrepreneurial and Venture Development.

Semester	Course Code	Course Name
V	MDMIE01	Foundations of Innovation and Entrepreneurship
VI	MDMIE02	Startup Planning and Development
VII	MDMIE03	Innovation Management and Scaling Startups

Business Development, Marketing and Finance (BD): Courses to be completed successfully for MD M in Business Development, Marketing and Finance.

Semester	Course Code	Course Name
V	MDMBD01	Introduction to Business Development and Marketing Principles
VI	MDMBD02	Financial Basics for Engineers and Technopreneurs
VII	MDMBD03	Strategic Marketing and Business Planning

Robotics (RB): Courses to be completed successfully for MD M in Robotics (RB).

Semester	Course Code	Course Name
V	MDMRB01	Fundamentals of Robotics and Control
VI	MDMRB02	Machine Vision and Robotic Perception
VII	MDMRB03	Intelligent Mobile Robotics