AC: 02/26
Item No: 06

The Bombay Salesian Society's

Don Bosco Institute of Technology, Mumbai

(An Autonomous Institute affiliated to University of Mumbai)

CURRICULUM STRUCTURE FOR SECOND YEAR ENGINEERING

SEMESTER IV

Department of Mechanical Engineering

(As per NEP 2020)

(Scheme: DB25-V1)

Effective from Academic Year 2025 – 2026

1. Preamble

Don Bosco Institute of Technology, Kurla, Mumbai, proudly celebrates the achievement of autonomous status—an academic milestone that reaffirms our steadfast commitment to excellence, holistic development, and student-centric learning. This autonomy empowers us to craft and implement a curriculum that is forward-looking, contextually relevant, and deeply rooted in our institutional values and the aspirations of our nation.

As an autonomous institution affiliated with the University of Mumbai, DBIT embraces the opportunity to restructure its academic framework in alignment with the University Grants Commission (UGC) guidelines and the National Education Policy (NEP) 2020. This curriculum framework outlines the undergraduate engineering programs for the EXTC, COMP, IT, and MECH branches. It reflects NEP's emphasis on multidisciplinary learning, flexibility, and outcome-based education, while staying true to the Don Bosco educational philosophy.

The curriculum adopts a top-down approach, beginning with the institutional Vision and Mission, which guides the definition of Program Educational Objectives (PEOs) and Program Outcomes (POs). These outcomes are used to shape Course Outcomes (COs) and the content and assessment methods of each course. This ensures that all academic efforts remain aligned with the broader goals of transforming learners into technically sound, ethically responsible and socially aware citizens. Importantly, this curriculum has been shaped through extensive consultations with stakeholders, including industry experts, academic peers, alumni, and students—to ensure that it remains aligned with contemporary industry requirements and societal expectations. Their inputs have been instrumental in designing a framework that bridges the gap between academic learning and practical applicability.

Key Objectives in developing syllabus are:

1. **Develop Strong Technical Foundations:** Equip students with robust knowledge and skills in core engineering domains to solve real-world problems through design, analysis, and innovation.
2. **Foster Research, Innovation, and Entrepreneurship:** Cultivate a spirit of inquiry, critical thinking, and entrepreneurial mindset to promote research-based problem-solving and startup culture.
3. **Enhance Interdisciplinary and Industry-Ready Competencies:** Integrate emerging technologies, multidisciplinary learning, and practical exposure to prepare students for dynamic industry requirements and lifelong learning.
4. **Promote Ethical, Sustainable, and Socially Responsible Engineering Practice:** Inculcate ethics, human values, and environmental consciousness to enable students to contribute meaningfully to society and sustainable development.
5. **Empower Communication, Leadership, and Teamwork Abilities:** Strengthen students' soft skills, collaboration, and leadership to perform effectively in diverse professional and global environments

Academic design includes:

- A Choice-Based Credit System (CBCS) for flexibility
- A range of Minor and Honors options to encourage specialization and research
- Opportunities for field engagement, internships, and experiential learning
- Emphasis on skill enhancement and future workforce needs
- Integration of ethical reasoning, social awareness, and environmental consciousness

As an institution inspired by the values of Saint John Bosco, we strive to create a joyful and inclusive learning environment that fosters creativity, curiosity, and compassion. Through this curriculum framework, we renew our pledge to produce graduates who are not only professionally competent but also committed to the greater good of society.

2. Vision and Mission

Vision:

DBIT will be known to have an innovative, enjoyable, and holistic learning environment that transforms individuals into socially conscious citizens the Don Bosco way, and will lead in research and entrepreneurship in the area of sustainable technologies.

Mission:

1. To create future engineers who work with honesty and integrity and excel in the use of technology for the benefit of the underprivileged.
2. To train engineers to be innovative problem-solvers and entrepreneurs who engage in research and lifelong learning.
3. To provide a diverse and stimulating environment for staff and students to grow holistically.

3. Curriculum Design Philosophy

The curriculum is structured in alignment with the National Education Policy (NEP) 2020 and UGC guidelines. It follows a top-down approach wherein the institutional Vision and Mission guide the Program Educational Objectives (PEOs) and Program Outcomes (POs). These shapes the Course Outcomes (COs) and form the foundation for the course structure, the delivery, and the assessments.

Key design principles include:

- Emphasis on Outcome-Based Education (OBE) with clear mappings of COs to POs
- Integration of core technical knowledge with interdisciplinary electives
- Inclusion of vocational skills, internships, and community engagement
- Development of entrepreneurship and research aptitude through minor and honors pathways
- Encouragement of ethical, sustainable, and socially responsible engineering practices

This approach ensures that the curriculum remains academically rigorous, industry-relevant, and value-driven.

4. Credit Guidelines and Allocation

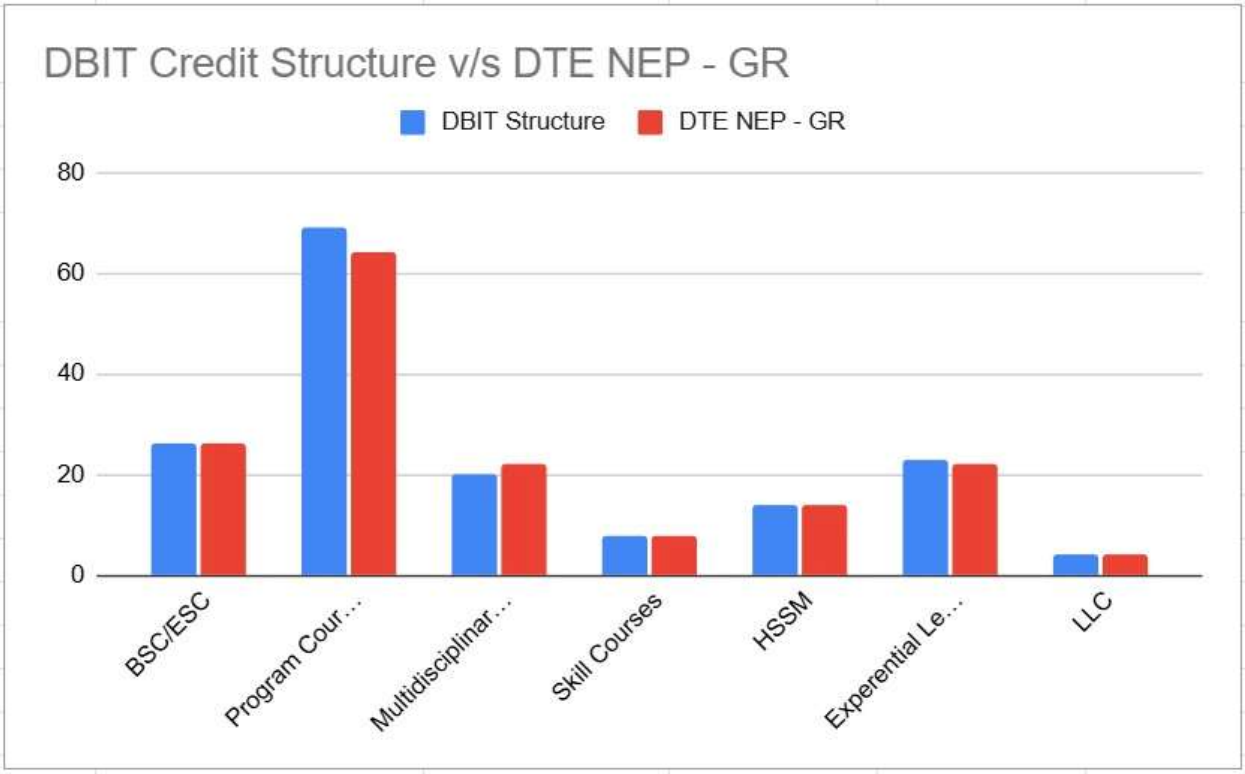
The curriculum is delivered through a structured credit system as follows:

Activity Type	Credit Definition
Theory Course	1 Credit = 15 Contact Hours
Laboratory / Studio / Workshop	1 Credit = 30 Contact Hours
Internship / Field Work	1 Credit = 40 Hours or 02 weeks
Seminar / Group Discussions	1 Credit = 15 Hours
Community Engagement / Field Project	1 Credit = 30 Hours

DBIT Curriculum Credit Structure: (FE to BE)

Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits	DTE Credits
Basic Science Course	BSC/ESC	9	6							15	14-18
Engineering Science Course		7	4							11	12 - 16
Programme Core Course (PCC)	Program Courses		3	16	14	6	6	6		51	44-56
Programme Elective Course (PEC)						3	3	6	6	18	20
Multidisciplinary Minor (MDM)	Multidisciplinary Courses				3	4	4	3		14	14
Open Elective (OE) Other than a particular program						2	2	2		6	8
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	3	3	2						8	8
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)		2			2				4	4
Entrepreneurship/Economics/ Management Courses					2		2			4	4
Indian Knowledge System (IKS)			2							2	2
Value Education Course (VEC)		2		2						4	4
Research Methodology	Experiential Learning Courses					2				2	4
Community. Engagement. Project (CEP)/ Field Project				1	1	1				3	2
Project							3	3		6	4
Internship/ OJT									12	12	12
Co-curricular Courses (CC)	Liberal Learning Courses		1		1		1		1	4	4
Total Credits (Major)		21	21	21	21	20	21	20	19	164	160- 176

Graphical Representation:



5. Degree Options and Exit Pathways

Students are offered flexible learning pathways through the following options:

Undergraduate Degree Options:

- B.E. –164 credits
- B.E. with Minor/Honors – 182 credits
- B.E. Honors with Research – 182 credits

Multiple Entry-Exit Options (Aligned with NEP 2020):

Exit Options	Credits Structure
Certificate after Year 1:	42 Credits + 08 credits (04 credit Exit course + 04 Summer internship).
Diploma after Year 2:	84 credits + 08 credits (04 credit Exit course + 04 Summer internship).
B. Vocational Degree after Year 3:	125 credits + + 08 credits (04 credit Exit course + 04 Summer internship).

Credits earned are banked in the **Academic Bank of Credits (ABC)** for lifelong learning flexibility.

Abbreviations Used:

AEC	Ability Enhancement Course
AEL	Ability Enhancement Laboratory
BSC	Basic Science Course
BSL	Basic Science Laboratory
CEP	Community Engagement Project
CC	Co-curricular Courses
CIE	Continuous Internal Evaluation
EEM	Entrepreneurship, Economics and Management
ELC	Experiential Learning Courses
ESC	Engineering Science Course
ESE	End Semester Examination
ESL	Engineering Science Laboratory
FP	Field Project
HSSM	Humanities Social Science and Management
IKS	Indian Knowledge System
L	Lecture
LLC	Liberal Learning Courses
MDM	Multidisciplinary Minor
MSE	Mid Semester Exam
OE	Open Elective
OJT	On Job Training
P	Practical
PCC	Program Core Course
PCL	Program Core Laboratory
PEC	Program Elective Course
T	Tutorial
VEC	Value Education Course
VSEC	Vocational and Skill Enhancement Course

UG Second Year Mechanical Engineering Program
Curriculum Scheme and structure
Semester IV

Course Code	Course Vertical	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
25ME4PCC01	**PCC**	Theory of Machines	3	-	1	3	-	1	4
25ME4PCC02	**PCC**	Fluid Mechanics & Hydraulic Machines	3	2	-	3	1	-	4
25ME4PCC03	**PCC**	Thermal Systems	3	2	-	3	1	-	4
25ME4PCC04	**PCC**	Digital Manufacturing Systems	-	2*+2	-	-	2	-	2
25XX4MDMYY	**MDM**	Multidisciplinary Minor@	2	2	-	2	1	-	3
25ME4CEP01	**CEP**	Community Engagement Project	-	2	-	-	1	-	1
25IL4EEM01	**EEM**	Entrepreneurship Essentials	2	-	-	2	-	-	2
25IL4LLCXX	**LLC**	Liberal Learning Course	-	2$	-	-	1	-	1
		Total	**13**	**14**	**1**	**13**	**7**	**1**	**21**

* Two hours of practical class to be conducted for full class as demo/discussion

@ Students must select one Multidisciplinary Minor (MDM) course provided by a different Engineering department than their own

$ Two hours of activity to be conducted for full class relative to respective LLC.

UG Second Year Mechanical Engineering Program
Examination Scheme & Assessment Structure
Semester IV

Course Code	Course Vertical	Course Name	Examination Marks						
			CA	MSE	ESE	TW	OR	PR	Total
25ME4PCC01	**PCC**	Theory of Machines	20	30	50	25	-	-	125
25ME4PCC02	**PCC**	Fluid Mechanics & Hydraulic Machines	20	30	50	25	-	25	150
25ME4PCC03	**PCC**	Thermal Systems	20	30	50	25	25	-	150
25ME4PCC04	**PCC**	Digital Manufacturing Systems	50	-	-	25	-	25	100
25XX4MDMYY	**MDM**	Multidisciplinary Minor	20	30	50	25	-	-	125
25ME4CEP01	**CEP**	Community Engagement Project	-	-	-	25	25	-	50
25IL4EEM01	**EEM**	Entrepreneurship Essentials	50	-	-	-	-	-	50
25IL4ELLCXX	**LLC**	Liberal Learning Course	50	-	-	-	-	-	50
		Total Marks	**230**	**120**	**200**	**150**	**50**	**50**	**800**

List of Multidisciplinary Minor (MDM) courses

Sr. No.	Course Code	Name of the Course	Department offering the course
1	25CE4MDM01	Web Development	Computer Engineering
2	25IT4MDM01	Data Science & Algorithms	Information Technology
3	25ET4MDM01	Embedded Systems	Electronics & Telecommunications Engineering
4	25ET4MDM02	Sensor Technology	

List of Liberal Learning Courses (LLC)

Sr. No.	Course Code	Name of the Course
1	25IL4LLC01	**Rhythm & Motion:** A Journey Through Dance
2	25IL4LLC02	**Introduction to Dramatics:** Exploring Theatre Arts
3	25IL4LLC03	**Swaranjali:** Introduction to Vocal Music (Singing)
4	25IL4LLC04	**Strings & Strokes:** An Introduction to Musical Instruments
5	25IL4LLC05	Traditional Rangolis of India
6	25IL4LLC06	Foundations of Photography
7	25IL4LLC07	**Tradition & Craft:** Hands-On Indian Art
8	25IL4LLC08	LLC – Sports & Fitness

UG Second Year Mechanical Engineering Program
Assessment Methodology

Type of Courses	Assessment Tools	Marks Distribution
Theory	**CA-20**	Certification: NPTEL (20 Marks) (Approved by instructor) OR Any two Pedagogies (10 marks each) • MCQ /Class Test • Case study/Assignment • GATE based Tutorial • MOOCs Certification (Approved by Instructor) • Open Book Test • Working model / simulation of a course-based concept.
Theory (PCC – Lab)	**CA-50**	Choose any Pedagogy from the following list summing upto maximum 50 marks: • MCQ /Class Test (10 marks) • Case study/Assignment (10 marks) • GATE based Tutorial (10 marks) • MOOCs Certification (Approved by Instructor) (10 marks) • Open Book Test (10 marks) • Working model / simulation of a course-based concept (30 Marks)
Theory (VEC)	**CA-50**	• Active Participation = 5 marks • MCQ /Class Test= 10 marks • Assessment of the activity carried out by student = 25 marks • Assignment = 10 marks
Workshop	**CA-50**	• Active Participation = 5 marks • Trade 1# = 15 marks • Trade 2# = 15 marks • Trade 3# = 15 marks # Based on the performance and satisfactory completion of trade wise tasks.
Liberal Learning Courses (LLC)	**CA-50**	• Active Participation = 5 marks • Assessment of the Activity carried out by student = 25 marks • Cultural Event Participation = 10 marks • Technical Event Participation = 10 marks
Theory	**MSE**	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • For each question, A and B should be based on the same CO. • MSE should be based on 50% syllabus. • Time: 90 minutes (1 hour 30 minutes)

		• Total Marks: 30
Theory	**ESE**	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • Q4 A or B - 10 marks • Q5 A or B - 10 marks • For each question, A and B should be based on the same CO. • ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE. • Time: 120 minutes (2 hours) • Total Marks: 50
Course - Laboratory	**TW- 25**	• Active Participation (Lab) = 5 marks • Laboratory Report = 10 marks • Laboratory performance = 10 marks Based on the performance and satisfactory completion of assigned laboratory work.
Community Engagement project	**TW-25**	• Active Participation = 05 marks • Project Report = 10 marks • Progress presentations (min 02) & demonstration = 10 marks
Tutorial	**TW-25**	• Active Participation = 5 marks • Tutorial Submission = 20 marks Tutorials should cover the entire syllabus.
Laboratory	**OR-25**	Oral examination will be based on the entire syllabus.
Laboratory	**PR-25**	Practical examination will be based on the experiments performed by the students during laboratory sessions.

Weightage of COs across all assessments*:

Course Outcomes	Weightage (Percentage)
CO-1, CO-2	20-30
CO-3, CO-4	40-50
CO-5, CO-6	20-30

***Note: Total weightage of all COs should be 100%**

Heads of Passing:

a. **Passing Criteria for Theory Course:** 40% of maximum marks in CA, MSE, ESE taken together

b. **Passing Criteria for Laboratory/Tutorial (Term Work):** 40% of maximum marks

c. **Passing Criteria for Oral/Practical:** 40% of maximum marks

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
25ME4PCC01	Theory of Machines	L	P	T	L	P	T	Total
		3	-	1	3	-	1	4
		Examination Scheme						
			CA	MSE	ESE	TW	OR	PR	Total
		Theory	20	30	50	-	-	-	100
		Lab/Tut	-	-	-	25	-	-	25
		Total	125						

Pre-Requisite Courses:	25FE1ESC01: Engineering Graphics
	25FE2ESC01: Engineering Mechanics

Course Overview:

This course provides a systematic understanding of the motion and dynamic behavior of mechanical systems used in engineering applications. It enables students to represent mechanical motion using graphical and analytical methods, forming a foundation for Analysing system behavior under operating conditions. The course emphasizes the relationship between system geometry, constraints, and motion characteristics, helping students predict performance and response. Students develop the ability to determine motion parameters, evaluate performance, and interpret dynamic effects in mechanical systems. The course also introduces methods to assess smoothness, stability, and effectiveness of motion transmission. Through problem-solving and representation-based approaches, students gain skills relevant to analysis, evaluation, and solution development in mechanical engineering practice. Overall, the course builds analytical thinking essential for advanced studies and engineering applications involving machines.

Module 1 establishes the foundational framework for understanding how mechanical systems are structured and how motion is constrained and classified. It forms the basis for representing and modeling mechanical motion in later analysis.

Module 2 focuses on determining motion characteristics of mechanical systems using systematic graphical techniques. Emphasis is placed on accurate representation and interpretation of motion parameters.

Module 3 This module deals with developing mechanisms that produce a required motion profile. It emphasizes motion smoothness, continuity, and suitability for given functional requirements.

Module 4 examines motion transmission between interacting mechanical elements like gears. It emphasizes analysis of velocity relationships and effectiveness of motion transfer

Module 5 addresses the evaluation of mechanical systems used for transmitting motion and power

like clutches, brakes, belts etc. It focuses on understanding how forces, torque, and operating conditions affect performance.

Module 6 introduces the effects of dynamic forces and moments on mechanical systems during operation. It focuses on understanding system behavior under varying motion and loading conditions.

Course Outcomes	After successful completion, the students will be able to	
	CO1	**Define** standard terminology, notations, and classifications related to mechanical motion and machine elements. **(Remembering)**
	CO2	**Explain** the principles governing motion, force transmission, and dynamic effects in mechanical systems. **(Understanding)**
	CO3	**Apply** graphical and analytical methods to determine motion and performance parameters of mechanical systems. **(Applying)**
	CO4	**Analyse** motion transmission and dynamic response of mechanical systems under given operating conditions. **(Analysing)**
	CO5	**Evaluate** the suitability and performance characteristics of mechanical systems based on given functional requirements. **(Evaluating)**
	CO6	**Develop** graphical layouts or simplified analytical models to satisfy specified motion or power transmission needs. **(Creating)**

Syllabus:

Module No.	Unit No.	Topics	Hours
1		**Kinematics of Mechanical Systems: Fundamentals**	06
		After completing this module, students will be able to: • Define basic terminology, notations, and classifications used to describe mechanical motion and system structure. • Explain how constraints and connectivity influence motion in mechanical systems. • Apply mobility criteria to determine degrees of freedom of mechanical systems.	
	1.1	Structure, Machine, Mechanism, Kinematic link & its types, Kinematic pairs, Types of constrained motions, Types of Kinematic pairs, Kinematic chains, Types of joints.	
	1.2	**Degree of freedom (mobility):** Kutzbach mobility criterion, Grűbler's criterion & its limitations	
	1.3	**Inversions:** Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions	
		Self-Learning Topics: Straight-Line Generating Mechanisms	

2	**Kinematic Analysis of Mechanical Motion**		
	After completing this module, students will be able to: • Recall standard notations and graphical conventions used for motion analysis. • Explain the significance of velocity and acceleration in describing system motion. • Apply graphical methods to determine velocity and acceleration parameters of mechanical systems.		**08**
	2.1	Velocity Analysis of Mechanisms (mechanisms up to 6 links) Velocity analysis by instantaneous centre of rotation method (Graphical approach), Velocity analysis by relative velocity method (Graphical approach)	
	2.2	Acceleration Analysis of Mechanisms (mechanisms up to 6 links) Acceleration analysis by relative method including pairs involving Coriolis acceleration (Graphical approach)	
	Self-Learning Topics: Instantaneous Centre of Rotation: Concept and Physical Significance		
3	**Kinematic Synthesis of Prescribed Motion**		**06**
	After completing this module, students will be able to: • Identify motion requirements and terminology associated with prescribed mechanical motion. • Explain the effect of motion characteristics on smoothness and continuity of system operation. • Develop suitable graphical layouts to achieve specified motion requirements.		
	3.1	Cam and its Classification based on shape, follower movement, and manner of constraint of follower; Followers and its Classification based on shape, movement, and location of line of movement; Cam and follower terminology	
	3.2	Motions of the follower: Constant velocity, SHM, Constant acceleration and deceleration (parabolic), Cycloidal	
	Self-Learning Topics: Comparison of Follower Motion Types Based on Kinematic Characteristics		
4	**Kinematic Analysis of Motion Transmission Systems**		**8**
	After completing this module, students will be able to: • Identify terminology and classifications related to motion transmission systems. • Explain conditions required for uniform and effective motion transmission. • Analyse velocity ratios and motion transmission behavior of mechanical systems.		
	4.1	**Gears:** Introduction, Types of gears and applications, Gear terminology, Condition for constant velocity ratio−conjugate profiles, profiles used in gears. Interference of involute teeth, methods of preventing interferences through undercutting, length of path of contact and contact ratio, number of teeth to avoid interference	
	4.2	**Gear Trains:** Simple, compound, planetary and epicyclic gear trains	

	Self-Learning Topics: Practical Applications of Simple, Compound, and Epicyclic Gear Trains		
5	**Dynamics of Motion Control and Power Transmission Systems**		**10**
	After completing this module, students will be able to: • Define standard terms and performance parameters related to motion and power transmission systems. • Explain principles governing force, torque, and power transmission in mechanical systems. • Evaluate performance characteristics of mechanical systems under given operating conditions.		
	5.1	**Clutches:** Study and analysis of single plate clutch, multiple plate clutches and cone clutches.	
	5.2	**Brakes:** Types of brakes. viz. block and shoe brakes, band brake, band and block brakes [No Problems]	
	5.3	**Dynamometers:** Types of dynamometers, classification, Prony brake, Rope brake belt transmission dynamometers [No Problems]	
	5.4	**Chains:** Types of chains, Chordal action, Variation in velocity ratio, length of chain [No Problems]	
	5.5	**Belts:** Introduction, Types and all other fundamentals of belting, Dynamic analysis –belt tensions, condition of maximum power transmission	
	Self-Learning Topics: Industrial Applications of Clutches, Brakes, and Dynamometers		
6	**Dynamics of Rotating Mechanical Systems**		**07**
	After completing this module, students will be able to: • Define terms and notations associated with dynamic behaviour of rotating systems. • Explain the principles governing dynamic effects in rotating mechanical systems. • Analyse system response under dynamic and inertial loading conditions.		
	6.1	**Governors:** Introduction to Centrifugal and Inertia governors, Force analysis of Porter and Hartnell Governor including performance characteristics, Governor effort and Power	
	6.2	**Gyroscope:** Introduction, Gyroscopic couple and its effect on spinning bodies, Naval ships during steering, pitching, rolling and their stabilization	
	Self-Learning Topics: Applications of Gyroscopic Effects in Engineering Systems		
		Total	**45**

List of Tutorials: (Minimum 10 Tutorials)

Tutorial No.	Title of the tutorial
1	**Kinematic links and Pairs** **Objective** To understand and classify different links and kinematic pairs in real mechanical systems. **Outcomes** Students will be able to identify and categorize links and kinematic pairs in practical machine configurations.
2	**Degrees of Freedom, Kutzbach Criterion, Gruebler's Criterion** **Objectives** To understand and apply mobility criteria for determining degrees of freedom of planar mechanisms. **Outcomes** Students will be able to calculate the degree of freedom of mechanisms using Kutzbach and Gruebler's criteria
3	**Inversions in Mechanisms** **Objectives** To study different inversions of kinematic chains and their practical applications. **Outcomes** Students will be able to dentify and analyse various inversions of mechanisms used in engineering systems
4	**Applied Motion Analysis of Cam Mechanisms** **Objectives** To Analyse cam-follower systems and understand motion characteristics of followers **Outcomes** Students will be able to Interpret displacement diagrams and Analyse motion of cam mechanisms
5	**Determine acceleration of links including Coriolis component.** **Objectives** To apply graphical methods for acceleration analysis in mechanisms including Coriolis component. **Outcomes** Students will be able to determine acceleration of links in mechanisms involving relative motion
6	**Determine belt tensions and power transmitted in conveyor belt systems** **Objectives** To Analyse belt drive systems for transmission of motion and power. **Outcomes** Students will be able to Calculate belt tensions and power transmitted in belt drive systems

7	**Evaluate torque transmission capability of clutches in automotive systems.** **Objectives** To study torque transmission capability and performance of clutch systems. **Outcomes** Students will be able to evaluate torque transmitting capacity of clutches under given conditions
8	**Calculate velocity ratio and shaft speeds in simple gear systems** **Objectives** To understand velocity ratio and speed relationships in simple gear systems. **Outcomes** Students will be able to Calculate velocity ratio and shaft speeds in simple gear trains
9	**Analyse speed relationships in Gear trains used in machines**. **Objectives** To Analyse motion transmission in compound and complex gear trains. **Outcomes** Students will be able to determine speed relationships in gear trains used in machines
10	**Analyse equilibrium speed and sensitiveness of engine governors.** (Experiment Based) **Objectives** To determine the controlling force at a given speed and evaluate the sensitiveness of the governor at different sleeve lifts, governor effort and power under varying operating conditions**.** **Outcomes** Students will be able to understand the working principle of centrifugal governors, analyze the relationship between speed and sleeve lift, determine how controlling force varies with speed, evaluate the sensitiveness of different governors (Porter, Hartnell), calculate governor effort and power for different configurations
11	**Calculate gyroscopic couple acting on rotating systems in vehicles and ships.** (Experiment Based) **Objective** To determine the gyroscopic couple of a gyroscope at a given speed. **Outcomes** Students will be able to Understand the concept of gyroscopic motion and its applications, how gyroscopic couple is generated due to change in angular momentum, calculate the moment of inertia of the rotor, aanalyse the relationship between speed, precession, and gyroscopic effect.

Text Books:

1. S.S. Ratan, “Theory of Machines”, Tata McGraw Hill
2. Ghosh and A.K. Mallik, “Theory of Mechanisms and Machines”, East-West Press

Reference Books:

1. J.J. Uicker, G.R. Pennock, and J.E. Shigley, "Theory of Machines and Mechanism", Oxford Higher Education
2. P.L. Ballaney, "Theory of Machines", Khanna Publishers
3. M.A. Mostafa, "Mechanics of Machinery", CRC Press
4. R.L. Norton, "Kinematics and Dynamics of Machinery", McGraw Hill
5. A.G. Erdman, G.N. Sander, and S. Kota, "Mechanism Design: Analysis and Synthesis Vol I", Pearson

Useful Links:

1. https://nptel.ac.in/courses/112/105/112105268/
2. http://www.nptelvideos.in/2012/12/kinematics-of-machines.html

Assessment Methodology:

Assessment Tools	Marks Distribution
Continuous Assessment (CA) 20 marks	Certification: NPTEL (20 Marks) (Approved by instructor) **OR** Any two Pedagogies (10 marks each) • MCQ /Class Test • Case study/Assignment • GATE based Tutorial • MOOCs Certification (Approved by Instructor) • Open Book Test • Working model / simulation of a course-based concept.
Mid Semester Examination (MSE) (30 Marks)	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • For each question, A and B should be based on the same CO. • MSE should be based on 50% syllabus. • Time: 90 minutes (1 hour 30 minutes) • Total Marks: 30
End Semester Examination (ESE) (50 Marks)	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • Q4 A or B - 10 marks • Q5 A or B - 10 marks • For each question, A and B should be based on the same CO. • ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE. • Time: 120 minutes (2 hours) • Total Marks: 50
Tutorial (TW – 25 marks)	• Active Participation = 5 marks • Tutorial Submission = 20 marks Tutorials should cover the entire syllabus.

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
		L	P	T	L	P	T	Total
		3	2	-	3	1	-	4
		Examination Scheme						
25ME4PCC02	Fluid Mechanics and Hydraulic Machines		CA	MSE	ESE	TW	OR	PR	Total
		Theory	20	30	50	-	-	-	100
		Lab/Tut	-	-	-	25	-	25	50
		Total	150						

Pre-Requisite Course:	Engineering Mechanics
	Engineering Mathematics
	Applied Thermodynamics

Course Overview:

This course focuses on the principles, fluid properties, various forces acting when fluid is at rest and in motion, effect of viscosity for flow through pipes, forces on submerged body, study of turbine and pumps. It develops the ability to represent, Analyse, and evaluate fundamental relations using various principles and mathematical modeling.

Module 1 covers fundamentals of fluid properties, pressure measurement and forces acting when fluid is at rest.

Module 2 enables to understand behaviors of fluid under motion and effect of viscosity for flow between plates and pipes.

Module 3 focuses on Bernoulli's principle, forces on bends and flow measurement devices.

Module 4 covers flow through pipes and its losses, forces on submerged body.

Module 5 addresses study of turbines.

Module 6 covers pumps and its performance parameters.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Understand** fluid properties, pressure concepts, and basics of fluid at statics or kinematics, Bernoulli's principle, terminologies for turbine and pumps. **(Remembering)**
	CO2	**Explain** fluid properties, pressure and force concepts when fluid at statics or kinematics, Bernoulli's principle, working of turbine and pumps along with its terminologies. **(Explain)**
	CO3	**Apply** fundamental to solve numerical on fluid properties, pressure and force measurement when fluid is at statics or kinematics, Bernoulli's principle, turbine and pumps. **(Applying)**
	CO4	**Analysis** inter-relationship between fluid properties, pressure and forces, effect of shape and arrangement on energy consumption for pipes, turbine and pumps. **(Analysing)**

	CO5	**Evaluate** impact of other parameters on fluid properties, pressure and forces, energy consumption in flow through pipe, turbine and pumps. **(Evaluating)**
	CO6	**Design** pipe network and pumping system **(Creating)**

Syllabus:

Module No.	Unit No.	Topics	Hours
1		**Fluid Properties and Hydrostatics**	07
		After completing this module, students will be able to: • Explain key fluid properties such as density, specific gravity, viscosity, surface tension, and vapor pressure, and describe their significance in engineering applications. • The learner will be able to apply Pascal's law and principles of hydrostatics to determine pressure distribution, buoyancy force, and forces on plane and curved surfaces. • The learner will be able to explain and estimate blower and pump head requirements using pressure measurement data and hydrostatic relationships.	
	1.1	Fluid Properties: Density, specific gravity, viscosity, surface tension, vapor pressure	
	1.2	Hydrostatics: Pascal law, pressure measurement, application in blower and pump head estimation, Buoyancy force, forces on plane and curved surface	
		Self-Learning Topic: Concept of Metacentric height and stability of body (floating and submerged)	
2		**Fluid Kinematics and Viscous Flow**	06
		After completing this module, students will be able to: • Explain the concepts of fluid kinematics, Lagrangian and Eulerian descriptions, and different types of fluid flow. • Analyse the Hagen–Poiseuille equation and the relationship between pressure gradient and shear stress to estimate viscous flow characteristics in pipes and between parallel plates. • Understand boundary-layer behavior and interpret flow patterns using streamlines, pathlines, streaklines, velocity potential, and stream function.	
	2.1	Concept of fluid kinematics, Lagrangian and Eulerian methods, Types of fluid flow	
	2.2	Viscous flow through pipe & between parallel plates, Hagen-Poiseuille equation, Relation between pressure gradient & shear stress	
		Self-Learning Topic: Concept of boundary layer, stream line, Pathline, Streaklines, velocity potential and stream function	
3		**Forces on bends and flow measurement**	
		After completing this module, students will be able to:	

	• Explain Bernoulli's theorem and its assumptions, and describe its applications in pumps, pipe flow, and forces on pipe bends. • Apply Bernoulli's equation to determine flow parameters and evaluate performance of flow-measuring devices such as Venturi meters, orifice meters, Pitot tubes, and ultrasonic flow meters. • Interpret flow behavior and fundamentals of Computational Fluid Dynamics (CFD) for analysing complex fluid-flow systems.		
	3.1	Bernoulli's theorem, and its applications for pumps and flow through pipes, forces on bends	
	3.2	Flow measurement devices: Venturi meter, orifice meter, Pitot tube, ultrasonic flow meter	
	Self-Learning Topic: Concept of CFD and its application		
4	**Flow through pipes and Submerged body**		**08**
	After completing this module, students will be able to: • Design in pipe network. • Calculate head losses and flow characteristics in pipe networks using Darcy–Weisbach and related correlations, and assess surge effects in pipelines. • Explain lift and drag forces on submerged bodies, interpret flow separation phenomena (including spinning balls and aircraft applications), and relate them to the Reynolds Transport Theorem concepts.		
	4.1	Flow through pipe: Major and minor losses in pipes, Pipes in series and parallel, Water hammer and surge tanks, Moody's chart	
	4.2	Forces on submerged bodies: Lift and drag forces, flow over spinning ball, application on aero plane, frictional forces due to drag force	
	Self-Learning Topics: Concept of Reynolds Transport theorem and flow separation		
5	**Turbines and pumps classification**		**07**
	After completing this module, students will be able to: • Explain the basic theory, classification, and working principles of impulse and reaction turbines, including the concept and types of draft tubes. • Apply turbine theory to estimate work done, power output, and efficiencies under different operating conditions. • Analyse turbine performance characteristics and interpret the role of governing and water hammer effects in hydraulic turbine operation.		
	5.1	Hydraulic Turbines: Basic theory, classification of turbines, theory of impulse and reaction turbines, estimation of work done, efficiency,	
	5.2	Characteristics of turbines, concept of draft tube and its types	
	Self-Learning Topic: Governor and water hammering		

6	**Pumps**		
	After completing this module, students will be able to: • Explain the classification of pumps, pumping-system characteristics, and the working principles of centrifugal and positive-displacement pumps. • Evaluate pump performance. • Analyse performance characteristics of pumping systems, including the effect of series and parallel pump operation, and interpret the role of air vessels and indicator diagrams in reciprocating pumps.		
	6.1	Classification of pumps, definition of pumping systems and system characteristics	**09**
	6.2	Centrifugal pumps: Construction, estimation of work done, efficiency, characteristics, determination of operating point, cavitation and NPSH, specific speed of pumps, concept of multistage	
	6.3	Positive Displacement Pump: Types and applications, general feature of reciprocating pumps, definition of head, discharge, work done and efficiency, indicator diagram (no numerical on reciprocating pump). Use of air vessel (only application, no numerical)	
	Self-Learning Topic: System and pump characteristics when pumps are connected in series and parallel		
		Total	**45**

List of Experiments:

Experiment No.	Title of the Experiment
1	**Verification of Bernoulli's principle** **Objectives** To understand Bernoulli's principle. To perform measurements and validate energy conservation in fluid flow. **Outcomes** Students will be able to verify Bernoulli's theorem experimentally and Analyse results.
2	**Determine the coefficient of discharge of Venturi meter** **Objectives** To understand Venturi meter construction and working. **Outcomes** Students will be able to calculate coefficient of discharge and evaluate flow characteristics.
3	**Determine the coefficient of discharge of Orifice meter** **Objectives** To understand Orifice meter construction and working. **Outcomes** Students will be able to determine discharge coefficient and compare with theoretical values.

4	**Determining frictional coefficient of various pipes** **Objectives** To study friction losses in pipes and understand effect of pipe material **Outcomes** Students will be able to calculate friction factor and Analyse pipe flow losses.
5	**Determining coefficients across pipe fittings** **Objectives** To study losses due to pipe fittings and to understand minor losses in fluid flow. **Outcomes** Students will be able to evaluate loss coefficients for different fittings.
6	**Estimating efficiency of reciprocating pump** **Objectives** To study working of reciprocating pump and to measure discharge and power input. **Outcomes** Students will be able to calculate pump efficiency and Analyse performance.
7	**Estimating efficiency of centrifugal pump** **Objectives** To understand centrifugal pump operation and to measure head, discharge and input power. **Outcomes** Students will be able to determine efficiency and plot performance curves.
8	**Estimating efficiency of Pelton turbine** **Objectives** To study impulse turbine operation and to Analyse jet impact on buckets. **Outcomes** Students will be able to evaluate turbine efficiency and performance parameters.
9	**Estimating efficiency of Francis turbine** **Objectives** To understand reaction turbine working and to Analyse energy conversion in turbines. **Outcomes** Students will be able to determine efficiency and operating characteristics.
10	**Estimating work done on flat and curve vanes** **Objectives** To study impact of jet on vanes and to Analyse force and work transfer. **Outcomes** Students will be able to calculate work done and compare flat vs curved vane performance.
11	**Estimating efficiency of Gear Pump** **Objectives** To understand gear pump operation and to measure discharge and power consumption. **Outcomes** Students will be able to evaluate efficiency and working characteristics.
12	**Study the impact of fluid temperature on NPSH** **Objectives** To understand concept of NPSH and study effect of temperature on cavitation. **Outcomes** Students will be able to evaluate NPSH variation and predict cavitation conditions.

List of Assignments:

(Minimum 4 problems on the following topics)

Sr. No.	Title of the Assignment
1	Fluid Properties, Hydrostatics forces and pressure measurement
2	Kinematics and viscous flow
3	Flow through Venturi, orifice & Pitot tube and Forces on bends
4	Flow through pipes and over submerged body
5	Hydraulic Turbine
6	Pumps

Text Books:

1. Modi and Seth, Hydraulic and Fluid Mechanics including hydraulic machine, Rajson Publications
2. R K Bansal, Laxmi Publicaiton, fluid Mechanics and Hydraulic machines, 11th Edition 2025

Reference Books:

1. Yunus A Cengel and John M Cimbala, Tata McGraw Hill Education, Fluid Mechanics 3rd Edition. (2014)
2. Frank M White, McGraw Hill Education, Fluid Mechanics
3. BEE handbook for pumps
4. Perry's Chemical engineers' Handbook, Don W Green, Marylee Z Southard

Useful Links:

1. Fluid Mechanics: https://nptel.ac.in/courses/101104808
2. Hydraulic Machinery: https://nptel.ac.in/courses/112103249
3. Pumps, water turbine and blowers: https://nptel.ac.in/courses/112104117
4. Introduction to fluid Machines: https://nptel.ac.in/courses/112105182

Assessment Methodology:

Assessment Tools	Marks Distribution
Continuous Assessment (CA) (20 marks)	Certification: NPTEL (20 Marks) (Approved by instructor) **OR** Any two Pedagogies (10 marks each) • MCQ /Class Test • Case study/Assignment • GATE based Tutorial • MOOCs Certification (Approved by Instructor) • Open Book Test • Working model / simulation of a course-based concept.
Mid Semester Examination (MSE) (30 Marks)	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • For each question, A and B should be based on the same CO. • MSE should be based on 50% syllabus. • Time: 90 minutes (1 hour 30 minutes) • Total Marks: 30

End Semester Examination (ESE) (50 Marks)	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • Q4 A or B - 10 marks • Q5 A or B - 10 marks • For each question, A and B should be based on the same CO. • ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE. • Time: 120 minutes (2 hours) • Total Marks: 50
Term Work (25 Marks)	• Active Participation (Lab) = 5 marks • Laboratory Report = 10 marks • Laboratory performance = 10 marks Based on the performance and satisfactory completion of assigned laboratory work.
Practical (25 Marks)	• Practical examination will be based on the experiments performed by the students during laboratory sessions.

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
25ME4PCC03	Thermal Systems	L	P	T	L	P	T	Total
		3	2	-	3	1	-	4
		Examination Scheme						
			CA	MSE	ESE	TW	OR	PR	Total
		Theory	20	30	50	-	-	-	100
		Lab/Tut	-	-	-	25	25	-	50
		Total	150						

Pre-Requisite Course:	25ME3PCC04 : Thermodynamics

Course Overview:

The Thermal Systems course introduces students to fundamental and applied concepts of energy conversion and thermal engineering systems used in power generation, propulsion, and industrial applications. The course builds on basic thermodynamics like the study, operation, and performance evaluation of boilers, steam and gas turbines, jet propulsion systems, air compressors, and key components like columns and condensers used in thermal and power systems. Emphasis is placed on understanding system operation, performance evaluation, efficiency improvement, and real-world engineering applications. This course prepares students for advanced studies in power engineering, refrigeration, HVAC, and energy systems.

Module 1 introduces the classification, construction, accessories, modern developments and performance evaluation of steam generators used in thermal power plants.

Module 2 covers the working principles, classification, velocity analysis, and performance evaluation of impulse and reaction steam turbines.

Module 3 focuses on the classification, working, performance improvement methods, and applications of gas turbine systems.

Module 4 provides an understanding of jet and rocket propulsion principles, engine classification, performance parameters, and aerospace applications.

Module 5 deals with the types, working, performance analysis, and energy efficiency improvement of industrial air compressor systems.

Module 6 introduces separation processes and condenser systems, including their construction, working principles, and industrial applications

Course Outcomes	After successful completion of this course the students will be able to	
	CO1	**Recall** the fundamental concepts related to various components of thermal systems. **(Remembering)**
	CO2	**Explain** the working principles and operation related to various components of thermal systems. **(Understanding)**
	CO3	**Apply** thermodynamic equations to evaluate thermal system performance **(Applying)**
	CO4	**Analyse** the effect of operating parameters on the performance, efficiency, and losses of thermal systems. **(Analysing)**
	CO5	**Evaluate** thermal systems and components based on efficiency, suitability, and applications, including energy conservation aspects and environmental impact. **(Evaluating)**
	CO6	**Design** or propose performance improvement methods, or energy-efficient solutions for a practical engineering application. **(Creating)**

Syllabus:

Module No.	Unit No.	Topics	Hours
1		**Steam Generators**	10
		After completing this module, students will be able to: • Recall the classification, components, mountings, accessories, and terminology of boilers and steam generators. • Explain the construction, working principles, draught systems, and modern steam generators using diagrams. • Apply boiler performance equations to determine equivalent evaporation and boiler efficiency for given data.	
	1.1	Layout of Thermal Power Plant, Classification of boiler, Difference between Fire tube and Water tube boiler with examples, Low pressure and high pressure boilers, once through boiler, important features of HP boilers	
	1.2	Boiler mountings – water level indicators, pressure gauges, safety valves, stop valves, feed check valve, blow-off valves, fusible plugs, manhole, handhole covers and mud box Boiler Accessories - economiser, air preheater, superheater, steam separator, steam trap, steam injector, feed pump, ejector	
	1.3	Introduction to modern steam generators, supercritical boilers, Draught systems (natural and artificial)	
	1.4	Equivalent evaporation of boilers, Boiler performance, Boiler efficiency.	
	Self-Learning Topics: IBR and Non-IBR Boilers, Recuperators		
2		**Steam Turbine**	08
		After completing this module, students will be able to:	

	• Recall the classification, components, and terminology related to steam turbines. • Explain the working principles of impulse and reaction turbines and compounding using velocity diagrams. • Apply velocity triangle relations to calculate turbine efficiencies and performance parameters.		
	2.1	Basic of steam turbine, Classification, compounding of turbine, Turbine performance parameters - blade efficiency, stage efficiency and overall efficiency.	
	2.2	Impulse turbine –velocity diagram, Condition for max efficiency, Numerical on Simple Impulse turbine (De-Laval turbine) of single stage only.	
	2.3	Reaction turbine, Degree of reaction, Parson's turbine, Condition for maximum efficiency, Numerical on Parson's turbine only.	
	Self-Learning Topics: Study of the control methods, maintenance practices, and troubleshooting of steam turbines used in power generation and industrial applications.		
3	**Gas Turbines**		**08**
	After completing this module, students will be able to: • Recall the components, cycles, and classifications of gas turbine systems • Explain the working of open and closed cycle gas turbines based on the Brayton cycle. • Apply thermodynamic relations to evaluate work output, efficiency, and performance of gas turbines. • Analyse the effect of intercooling, reheating, and regeneration on gas turbine performance.		
	3.1	Construction and working of gas turbine, Actual Brayton cycle, open and closed cycle gas turbine	
	3.2	Methods to improve efficiency and specific output, open cycle with intercooling, reheat, and regeneration	
	3.3	Effect of operating variable on thermal efficiency and work ratio, Applications of gas turbine	
	Self-Learning Topics: Study of performance and operating systems, control and diagnostic systems, materials used, and modern efficiency enhancement techniques in power generation systems and jet engines.		
4	**Jet Propulsion Engines**		**05**
	After completing this module, students will be able to: • Recall the principles, classification, and components of jet and rocket propulsion systems. • Explain thrust generation, working principles, performance parameters and engine configurations of jet and rocket engines. • Evaluate different propulsion systems based on performance, limitations, and applications.		

	4.1	Introduction to jet propulsion and its applications, Basic principles of jet propulsion and momentum theory, Classification of jet propulsion engines, Components and working principle of turbojet, turbofan, turboprop, and ramjet engines.	
	4.2	Introduction to rocket propulsion and space propulsion systems, Basic principles of rocket motion and rocket thrust, Classification of rockets: solid, liquid, and hybrid propellant rockets, Components and working of solid and liquid propellant rocket engines.	
	4.3	Thrust, Thrust power, Propulsive efficiency and thermal efficiency, Advantages, limitations, and applications of jet propulsion systems and rocket propulsion systems	
	Self-Learning Topics: Control and operational aspects of jet engines, Cooling methods in rocket engines		
5	**Air compressor**		**08**
	After completing this module, students will be able to: • Recall types, components, and terminology of air compressors • Explain the working of reciprocating, centrifugal, and axial compressors with and without intercooling. • Apply compressor performance equations to calculate work input and efficiencies. • Analyse the impact of multi-staging, losses, surging, and choking on compressor performance. • Evaluate energy conservation methods in compressed air systems		
	5.1	Introduction and general classification of reciprocating compressor positive displacement, single stage and Multi Staging of reciprocating compressor, Two stage air compressors, intercooler, after cooler, perfect and imperfect intercooling	
	5.2	Minimum work, Compressor performance parameters - Volumetric efficiency, Isothermal, isentropic, adiabatic and overall efficiency.	
	5.3	Energy Conservation in Compressed air system - Compressed air network, Leak detection in compressed air network, Load unload test, pump-up test, Methods to improve performance.	
	5.4	Centrifugal and Axial compressor, surging and choking of compressor.	
	Self-Learning Topics: Applications of compressed air systems in industry		
6	**Columns and condensers**		**06**
	After completing this module, students will be able to: • Recall the classification, components, and terminology of columns and condensers. • Explain the operating principles of distillation, absorption columns, and condenser systems. • Apply basic heat transfer and separation concepts to thermal system equipment. • Analyse vapour–liquid equilibrium and operating issues in columns and condensers.		

	6.1	Columns (Distillation and Absorption Columns) - Introduction to separation processes in thermal systems, Classification of columns: distillation columns, absorption columns, stripping columns, Basic components of a column: trays, packing, reboiler, condenser, feed plate, Types of trays: sieve tray, bubble cap tray, valve tray, Packed columns: types of packing and applications, Vapour–liquid equilibrium, Operating principles of distillation columns.	
	6.2	Condensers - Definition and purpose of condensers in thermal systems, Classification of condensers: Surface condenser and Jet condenser, Types of surface condensers: downflow, central flow, regenerative, Construction and working of condensers, Heat transfer process in condensers, Vacuum creation and air leakage problems.	
	Self-Learning Topics: Industrial applications of columns in power plants and process industries, Applications of condensers in steam power plants and refrigeration systems		
		Total	**45**

List of Experiments:

Sr. No.	Title of the Experiment
1	**Demonstration / e-learning of Steam Generators** – Boilers, modern boilers, super-critical boiler, Draught systems (natural and artificial), IBR and Non-IBR Boilers, Recuperators **Objective:** To familiarize students with the classification, construction, working principles, and modern developments of steam generators including supercritical boilers and draught systems. **Outcome:** Learner will be able to • identify different types of boilers • explain their working principles • distinguish conventional and modern steam generation systems.
2	**Demonstration / e-learning of Boiler mountings and accessories.** **Objective** To study various boiler mountings and accessories and understand their functions in safe and efficient boiler operation. **Outcome:** Learner will be able to • identify boiler mountings and accessories and explain their role in boiler safety, control, and efficiency.
3	**Trial on reciprocating compressor** **Objective:** To experimentally evaluate the performance of a reciprocating compressor and determine key performance parameters. **Outcome:** Learner will be able to • calculate volumetric efficiency, work input, and overall performance of a reciprocating compressor using experimental data.

4	**Study of rotary compressors on vane/screw/lobe type for a unique industrial application** (Individual activity and report) **Objective:** To study the construction, working, and industrial applications of rotary compressors such as vane, screw, and lobe types. **Outcome:** Learner will be able to • explain the working principles and identify suitable industrial applications of different rotary compressors.
5	**Presentation on various energy conservation techniques in compressed air system, Leak detection in compressed air network, Load unload test, pump-up test, Methods to improve performance.** (Individual activity and presentation) **Objective:** To Analyse various energy conservation techniques and performance improvement methods in compressed air systems. **Outcome:** Learner will be able to • evaluate energy-saving methods and recommend suitable techniques to improve compressor system efficiency.
6	**Study of Environmental Impact of Thermal Systems - Sources of pollution in thermal power plants and industries, Types of pollutants - Gaseous pollutants (CO_2, CO, NO_x, SO_2), Particulate matter and ash, Thermal pollution.** (Group activity and presentation for a unique application) **Objective:** To study sources and types of pollution caused by thermal systems and their environmental impact. **Outcome:** Learner will be able to • identify pollutants, explain their sources, and assess the environmental impact of thermal systems.
7	**To study the impact of pollution caused by thermal systems on human health and the environment, to estimate carbon footprint from common energy-related activities, and to understand their role in global warming.** (Group activity and presentation for a unique application) **Objective:** To Analyse the impact of thermal system emissions on human health and estimate carbon footprint from energy-related activities. **Outcome:** Learner will be able to • evaluate environmental and health impacts of emissions and estimate carbon footprint contributing to global warming.
8	**Study of Emission Control Techniques - Need for emission control in thermal systems, Methods of reducing air pollution (Electrostatic precipitators, Bag filters, Cyclone separators and Scrubbers), Control of NO_x and SO_2 emissions.** (Group activity and presentation in a batch for a unique application)

	Objective: To study various emission control devices and techniques used in thermal systems. **Outcome:** Learner will be able to • explain and evaluate emission control methods such as ESP, scrubbers, and filters for reducing air pollution.
9	**Study of Ash handling systems in thermal power plants, Noise control methods, Role of renewable integration and efficiency improvement in reducing emissions, Environmental regulations and standards.** (Group activity and presentation in a batch for a unique application) **Objective:** To understand ash handling systems, noise control methods, and environmental regulations in thermal power plants. **Outcome:** Learner will be able to • Analyse emission reduction techniques and explain regulatory requirements for environmental protection.
10	Study of industrial applications of columns in power plants and process industries and applications of condensers in steam power plants and refrigeration systems. . (Individual activity and report on a unique industrial application for column as well as condenser) **Objective:** To study the industrial applications and working of columns and condensers in thermal and process industries. **Outcome:** Learner will be able to • apply thermal concepts to evaluate the suitability and performance of columns and condensers in real applications.
11	**Industrial visit to thermal power plant/compressor manufacturing industry** **Objective:** To provide practical exposure to real-time thermal systems and industrial practices. **Outcome:** Learner will be able to • correlate theoretical concepts with industrial operations and propose improvements in system performance and efficiency.

List of Home Assignments:

Sr. No.	Title of the Assignment	No. of Problems
1	Performance of boilers	4
2	Steam Turbine	4
3	Gas Turbine	4
4	Air Compressors	4

Text Books:

1. A Textbook of Production Technology, P. C. Sharma, 2022, S Chand Publication
2. Production Technology, R. K. Jain, 2022, Dnyaandeep Publication.
3. Manufacturing Science, A. Ghosh and A. K. Malik, Second edition, 2010, Affiliated East-West Press

Reference Books:

1. Tool Design, Donaldson, 5th Edition, 2017, McGraw Hill Education.
2. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, 2016, Apress.
3. Cyber-Physical Systems: From Theory to Practice by Danda B. Rawat, Joel Rodrigues, Ivan Stojmenovic, 2015, C.R.C. Press.
4. Optimization of Manufacturing Systems using Internet of Things by Yingfeng Zhang, Fei Tao, 2017, Academic Press (AP), Elsevier

Useful Links:

Links for online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/112/107/112107219/
2. https://nptel.ac.in/courses/112/107/112107215/
3. https://nptel.ac.in/courses/112/107/112107084/

Assessment Methodology:

Assessment Tools	Marks Distribution
Continuous Assessment (CA) (20 marks)	Certification: NPTEL (20 Marks) (Approved by instructor) OR Any two Pedagogies (10 marks each) • MCQ /Class Test • Case study/Assignment • GATE based Tutorial • MOOCs Certification (Approved by Instructor) • Open Book Test • Working model / simulation of a course-based concept.
Mid Semester Examination (MSE) (30 Marks)	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • For each question, A and B should be based on the same CO. • MSE should be based on 50% syllabus. • Time: 90 minutes (1 hour 30 minutes) • Total Marks: 30

End Semester Examination (ESE) (50 Marks)	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • Q4 A or B - 10 marks • Q5 A or B - 10 marks • For each question, A and B should be based on the same CO. • ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE. • Time: 120 minutes (2 hours) • Total Marks: 50
Term Work (25 Marks)	• Active Participation (Lab) = 5 marks • Laboratory Report = 10 marks • Laboratory performance = 10 marks Based on the performance and satisfactory completion of assigned laboratory work.
Oral (25 Marks)	Oral examination will be based on the entire syllabus.

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
		L	P	T	L	P	T	Total
		-	2* + 2	-	-	2	-	2
		Examination Scheme						
25ME4PCC04	Digital Manufacturing Systems		CA	MSE	ESE	TW	OR	PR	Total
		Theory	50	-	-	-	-	-	50
		Lab/Tut	-	-	-	25	-	25	50
		Total	100						

Pre-Requisite Courses:	Engineering Mechanics
	Engineering Graphics
	Engineering Mathematics

Course Overview:

This course introduces core CAD/CAM concepts, including geometric modeling, computer graphics, and their role in the product life cycle. It covers 2D and 3D transformations, data handling, and basic AI ideas for smarter design and manufacturing. It also teaches fundamentals of NC, CNC, and DNC with manual programming for 3-axis machines. In addition, it explains key additive manufacturing and RP/3D printing methods, STL generation, and their use in engineering and biomedical applications.

Module 1 : Computer Aided Design

Introduces parametric curves and fundamental geometric modeling techniques used in modern CAD systems, and explains CAD/CAM integration across the product life cycle.

Module 2 : **Geometric Transformations**

Develops the use of 2D and 3D geometric transformations, matrix representations, and data manipulation concepts needed for computer-aided design and intelligent manufacturing.

Module 3 : **Subtractive Manufacturing**

Covers the basics of NC/CNC/DNC systems and builds the ability to write and understand manual CNC part programs for common machining operations.

Module 4 : Additive Manufacturing - 1

Presents key additive manufacturing and rapid prototyping processes, including STL generation, and compares their working principles, applications, advantages, and limitations.

Module 5 : **Additive Manufacturing - 2**

Focuses on advanced applications of additive manufacturing in design validation, functional testing, science and medicine, as well as rapid tooling and rapid manufacturing.

Module 6 : **CAD with Reverse Engineering**

Introduces reverse engineering and biomedical modeling workflows, guiding students from non-contact scanning or CT/MR image data to processed point clouds and final CAD models.		
Course Outcomes	After successful completion of this course, the students will be able to	
	CO1	**Define** the fundamental concepts of computer graphics, geometric modeling, CNC/DNC systems, rapid prototyping, and computer-integrated manufacturing. (**Remembering**)
	CO2	**Explain** the principles of geometric modeling, transformations, and manufacturing processes, and describe the role of CAD/CAM integration in design and production. (**Understanding**)
	CO3	**Apply** geometric modeling and transformation techniques using CAD tools and generate toolpaths and STL data for manufacturing applications (**Applying**)
	CO4	**Analyse** the interrelation between CAD, CAM systems by evaluating geometric models, CNC programming strategies, and additive/subtractive manufacturing techniques for process optimization. (**Analysing**)
	CO5	**Evaluate** various CAD/CAM/CAE and manufacturing technologies, including CNC machining, rapid prototyping, and virtual manufacturing, in terms of accuracy, efficiency, and cost-effectiveness (**Evaluating**)
	CO6	**Design** and integrate complete digital manufacturing workflows by combining CAD modeling, CAM toolpath generation, additive/subtractive manufacturing, and reverse engineering concepts for intelligent and automated production systems (**Creating**)

Syllabus:

Module No.	Unit No.	Topics	Hours
1		**Computer Aided Design**	04
		Learning Outcomes: • Define parametric curves and geometric modeling techniques in CAD. • Explain the role and integration of CAD/CAM in the product life cycle • Classify mechanical systems based on their motion characteristics.	
	1.1	**Introduction to CAD/CAM**: CAD/CAM In product life cycle, CAD/CAM integration and file formats.	
	1.2	**Parametric Representation of Geometry:** Parametric representation of line, circle, ellipse & parabola, Cubic Spline Curve, Bezier curves and B-Spline curve	
	1.3	**Geometric Modeling Techniques:** Constructive solid geometry (CSG), Boundary Representation (B-Rep), Wire Frame Modeling, Solid Modeling, Surface Modeling, Parametric Modeling, feature-based modeling, Feature recognition, Design by feature	

	Self-Learning Topics: Comparison and Applications of Geometric Modeling Techniques		
2	**Geometric Transformations**		**06**
	Learning Outcomes: • Define 2D and 3D geometric transformations and matrix representations. • Apply transformation techniques to manipulate objects in CAD.		
	2.1	**2D and 3D Transformations:** Translation, Rotation, Scaling, Reflection and Shear, Concatenations, Matrix representation, Problems on 2D and 3D Transformations.	
	2.2	**Geometric Data Manipulation & Storage:** Object-oriented programming on Transformations, Artificial Intelligence in Design & Manufacturing, Representation of Knowledge, and Knowledge base Engineering	
	Self-Learning Topics: Applying 2D and 3D Transformations in Designing Mechanical Components using CAD Software		
3	**Subtractive Manufacturing**		**06**
	Learning Outcomes: • Explain CNC programming strategies and manual part programming. • Apply manual programming to generate CNC toolpaths. • Analyse CNC programming for process optimization.		
	3.1	**Introduction to NC/CNC/DNC:** NC/CNC/DNC machines, Machining Centers, Coordinate system	
	3.2	**CNC machining practices and programming:** CNC setup, and operation of two- and three- axis CNC machines programming using manual part programming method, Canned Cycles, do loop, MACRO/Subroutine	
	Self-Learning Topics: Manual CNC Part Programming with Canned Cycles for Drilling and Pocket Milling Operations		
4	**Additive Manufacturing-1**		**06**
	Learning Outcomes: • Apply STL generation and RP process selection for manufacturing. • Analyse RP process selection for different product requirements. • Evaluate RP technologies for efficiency and suitability.		
	4.1	**Introduction to RP Processes:** Introduction to RP and its need, Classification of RP Processes, Advantages & disadvantages.	
	4.2	RP Processes: Process overviews, STL file Generation, Working Principle, Application, Advantages & disadvantages: of Stereolithography Apparatus (SLA) & Selective Laser Sintering (SLS), 3D Printing, Fused Deposition Modeling (FDM), and Laminated Object Manufacturing (LOM)	

	Self-Learning Topics: Comparative Study of SLA, SLS, FDM, LOM in Terms of Working Principle, Applications, Advantages, and Limitations		
5	**Additive Manufacturing-2**		**04**
	Learning Outcomes: • Apply RP/rapid tooling for product validation and testing. • Analyse RP workflows for process optimization. • Evaluate RP/rapid tooling for cost and time effectiveness.		
	5.1	**Rapid Applications:** RP Applications in Design, Concept Models, Form & fit checking, Functional testing, CAD data verification, Science & Medicine, RP processes for MEMS, Photolithography.	
	5.2	**Rapid Tooling:** Introduction, Applications, and case study discussion on Rapid Tooling & Rapid Manufacturing	
	Self-Learning Topics: Understanding STL File Generation and Its Role in Rapid Prototyping Workflows		
6	**CAD with Reverse Engineering**		**04**
	Learning Outcomes: • Analyse reverse engineering workflows for accuracy and efficiency. • Evaluate reverse engineering for cost and time savings. • Design a complete reverse engineering workflow for a product.		
	6.1	**Reverse Engineering:** Reverse Engineering: Noncontact surface scanning, point cloud data processing, and CAD model development	
	6.2	**Modeling based on Biomedical data:** Introduction to medical imaging, Computed tomography (CT), Magnetic resonance (MR), its process and development of a CAD model from medical images.	
	Self-Learning Topics: Case study with Step-by-Step Workflow for Developing CAD Models from Non-Contact Scanning and Medical Imaging Data (CT/MRI)		
		Total	**30**

List of Experiments:

Experiment No.	Title of the Experiments
1	**Simulation of Drilling and Contour Milling** **Objective** To develop CAM toolpaths for basic hole-making and edge-profiling operations using Fusion 360. **Outcome**

	Students will be able to generate G-code and verify tool motion for drilling and contour cycles.
2	**Simulation of Open Contour and Pocket Milling** **Objective** To differentiate between open and closed boundary machining strategies and apply 2D milling toolpaths. **Outcome** Students will be able to optimize step-over and depth-of-cut parameters for efficient material removal in pockets.
3	**Simulation of Slot Milling and Face Milling** **Objective** To simulate surface finishing and slotting operations while optimizing tool engagement. **Outcome** Students will be able to produce refined CNC code for high-quality surface finishes and precise slot geometry.
4	**Simulation of Straight and Taper Turning** **Objective** To apply CNC turning fundamentals to create cylindrical and conical profiles in a virtual environment. **Outcome:** Learner will be able to • define turning coordinate systems and compare different taper-cutting strategies.
5	**Simulation of Facing and Threading** **Objective** To program lathe operations for end-face flattening and standardized screw thread generation. **Outcome** Students will be able to evaluate the efficiency of threading cycles and validate thread profiles against specs.
6	**Simulation of Single and Multiple Grooving** **Objective** To design and simulate toolpaths for external grooves and complex recessed features. **Outcome** Students will be able to plan multi-feature turning processes and select appropriate grooving tools.
7	**Physical Execution: Drilling and Contour Milling** **Objective** To bridge the gap between simulation and reality by machining a physical workpiece on a desktop CNC. **Outcome**

	Students will be able to set work/tool offsets and Analyse the accuracy of a physically machined contour.
8	**Physical Execution: Slot, Pocket, and Face Milling** **Objective** To execute complex milling toolpaths on a physical machine and monitor real-time cutting conditions. **Outcome** Students will be able to judge process capability and measure the dimensional accuracy of milled pockets/slots.
9	**Physical Execution: Turning, Facing, and Grooving** **Objective** To manufacture a turned component on a desktop CNC lathe using self-generated G-code. **Outcome** Students will be able to troubleshoot physical machining errors and suggest process improvements for lathe operations.
10	**Design for 3D Printing (DF3DP)** **Objective** To model a component specifically optimized for Additive Manufacturing constraints in Fusion 360. **Outcome** Students will be able to identify and mitigate potential printing failures (like overhangs) during the design phase.
11	**Freeform Design Technique** **Objective** To utilize T-Splines and surface modeling to create ergonomically or aerodynamically complex parts. **Outcome** Students will be able to justify organic design choices for functional applications like consumer products.
12	**FDM 3D Printing and Reporting** **Objective** To convert a CAD model into a physical prototype using an FDM printer and document the entire workflow. **Outcome** Students will be able to operate a slicer, manage 3D print parameters, and author a comprehensive technical report.

Text Books:

1. CAD/CAM: Principles and Applications – P.N. Rao, McGraw-Hill Education
2. Computer Graphics for Engineers – Anupam Saxena and Birendra Sahay Pearson Education

3. Rapid Prototyping: Principles and Applications in Manufacturing – Chua Chee Kai, Leong Kah Fai, and Lim Chu-Sing, World Scientific Publishing

Reference Books:

1. Mastering CAD/CAM – Ibrahim Zeid, McGraw-Hill Education
2. Automation, Production Systems, and Computer-Integrated Manufacturing – Mikell P. Groover, Pearson Education,
3. Principles of Computer-Aided Design and Manufacturing – Farid Amirouche, Pearson Education
4. Numerical Control and Computer-Aided Manufacturing – T.K. Kundra, P.N. Rao, and N.K. Tewari, McGraw-Hill Education
5. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing – Ian Gibson, David Rosen, and Brent Stucker, Springer

Useful Links:

1. https://nptel.ac.in/courses/112102101
2. https://nptel.ac.in/courses/112102102
3. https://nptel.ac.in/courses/112104289
4. https://nptel.ac.in/courses/112102103
5. https://nptel.ac.in/courses/112104265

Assessment Methodology:

Assessment Tool	Marks Distribution
Continuous Assessment (CA) (50 Marks)	Choose any Pedagogy from the following list summing upto maximum 50 marks: • MCQ /Class Test (10 marks) • Case study/Assignment (10 marks) • GATE based Tutorial (10 marks) • MOOCs Certification (Approved by Instructor) (10 marks) • Open Book Test (10 marks) • Working model / simulation of a course-based concept (30 Marks)
Term Work (25 Marks)	• Active Participation (Lab) = 5 marks • Laboratory Report = 10 marks • Laboratory performance = 10 marks Based on the performance and satisfactory completion of assigned laboratory work.
Practical (25 Marks)	• Practical examination will be based on the experiments performed by the students during laboratory sessions.

The Bombay Salesian Society's

Don Bosco Institute of Technology, Mumbai

(An Autonomous Institute affiliated to University of Mumbai)

CURRICULUM STRUCTURE
Multi-Disciplinary Minor (MDM) Courses

(As Per NEP 2020)

Scheme: DB25-V1

(w.e.f. AY 2025-2026)

Preface

The evolving landscape of higher education emphasizes the need for students to acquire knowledge that extends beyond the boundaries of a single discipline. In alignment with the broader vision of the National Education Policy (NEP) 2020, engineering education increasingly encourages students to explore learning opportunities that integrate concepts from multiple domains. The Multi-Disciplinary Minor (MDM) Courses offered at Don Bosco Institute of Technology (DBIT), Mumbai, reflect this academic approach by providing structured pathways for students to develop competence in areas outside their primary field of study.

Multi-Disciplinary Minor courses enable students to broaden their academic exposure while pursuing their core engineering program. Through these courses, learners are encouraged to engage with complementary areas of knowledge that enhance their analytical ability, problem-solving skills, and intellectual curiosity. Such interdisciplinary learning supports the development of well-rounded professionals who are capable of understanding complex real-world challenges from multiple perspectives.

The MDM framework allows students to pursue a focused set of courses in a chosen domain, thereby enabling deeper engagement with emerging technologies, interdisciplinary applications, and contemporary areas of study. This approach encourages learners to build additional competencies that complement their primary discipline and strengthen their academic and professional profile.

These courses emphasize conceptual understanding, application-oriented learning, and collaborative exploration of ideas. Students are encouraged to participate in discussions, case studies, project-based learning, and practical activities that promote critical thinking and innovation. Such learning experiences help develop adaptability, creativity, and interdisciplinary awareness—skills that are increasingly essential in modern professional environments.

Multi-Disciplinary Minor courses also play an important role in fostering intellectual flexibility among students. By interacting with concepts from diverse academic fields, learners develop the ability to connect ideas, integrate knowledge, and apply learning in varied contexts. This exposure strengthens their readiness to work in multidisciplinary teams and address complex societal and technological challenges.

The following pages present the syllabi and structure of the Multi-Disciplinary Minor courses offered as part of the academic curriculum at DBIT. The document outlines the objectives, learning outcomes, and academic components associated with these courses. It serves as a reference for students and faculty members to understand the scope and academic expectations of the MDM framework.

The contents of this document may be reviewed and updated periodically by the Academic Council and other academic bodies of the institute in accordance with evolving academic practices and institutional priorities.

Through the Multi-Disciplinary Minor courses, DBIT aims to nurture engineers who possess not only strong disciplinary knowledge but also the interdisciplinary perspective required to contribute effectively to innovation, research, and societal development.

Course Code	Course Name	Teaching Scheme (Hrs./ Week)			Credits Assigned			
25CE4MDM01	Web Development	L	P	T	L	P	T	Total
		2	2	-	2	1	-	3
		Examination Scheme						
			CA	MSE	ESE	TW	OR	PR	Total
		Theory	20	30	50	-	-	-	100
		Lab/Tut	-	-	-	25	-	–	25
		Total	125						

Pre-Requisite Courses:	25FE1VSEC02 - Problem Solving using C programming.

Course and Module Overview:

This course provides a structured and comprehensive introduction to web development, covering both client-side and server-side technologies along with database integration. The course begins with fundamental concepts of web communication, including clients, servers, HTTP protocols, and the structure of web applications. It then progresses to front-end development using HTML, CSS, and JavaScript, enabling students to design and develop interactive and responsive web pages.

Further, the course introduces modern full-stack development using the MERN stack (MongoDB, Express.js, React.js, Node.js). Students learn how different components of a web application interact, including user interface design, server-side scripting, API development, and database operations. The course emphasizes practical implementation, data flow analysis, and performance considerations, culminating in the development of a simple full-stack web application.

Module 1 introduces fundamentals of web development including HTTP, clients, servers, HTML, and CSS. Helps students understand webpage structure and styling.

Module 2 covers JavaScript, DOM, and event handling for adding interactivity. Enables dynamic content manipulation and basic form validation.

Module 3 introduces MERN stack components and basics of Node.js and Express. Helps in understanding backend development and simple API creation.

Module 4 focuses on React.js including components, props, state, and hooks. Enables development of reusable and interactive user interfaces.

Module 5 covers MongoDB operations and Express.js backend development. Helps in building APIs and connecting applications with databases.

Module 6 integrates React, Node, Express, and MongoDB into a full-stack application. Provides hands-on experience in building and connecting complete web systems.

Overall, the course equips students with fundamental and practical skills in full-stack web development, enabling them to design, develop, and deploy basic web applications. It builds a strong foundation for advanced topics such as cloud computing, microservices, and scalable web architectures, and prepares students for internships and careers in software and web development.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Identify** basic concepts of web technologies, front-end tools, server-side components, databases, and the MERN stack. **(Remembering)**
	CO2	**Explain** how web pages, scripts, servers, APIs, and databases work together in a complete web application. **(Understanding)**
	CO3	**Use** HTML, CSS, JavaScript, React, Node.js, Express, and MongoDB to build functional parts of a web application. **(Applying)**
	CO4	**Analyse** data flow between frontend, backend, and database, and break down how different MERN components interact. **(Analysing)**
	CO5	**Evaluate** web application performance, select suitable web technologies, and validate user input, API responses, and database operations. **(Evaluating)**
	CO6	**Design** and develop a simple full-stack MERN application integrating user interface, server logic, and database operations. **(Creating)**

Module No.	Unit No.	Topics	Hours
1		**Introduction to Web Development**	06
		After completing this module, students will be able to: • Describe basic web concepts including clients, servers, and communication protocols • Explain HTTP request-response cycle and working of web applications • Understand HTML structure and semantic elements for webpage design • Apply CSS for styling web pages using different selectors and properties • Analyse how web pages are structured and rendered in browsers	
	1.1	Web Essentials: Clients, Servers and Communication, The Internet, Basic Internet protocols, World wide web, HTTP Request Message, HTTP Response Message, Web Clients, Web Servers	
	1.2	HTML: fundamental syntax and semantics, Tables, Lists, Image, HTML5 control elements, Semantic elements, Drag and Drop.	
	1.3	**CSS3:** Inline, embedded and external style sheets – Rule cascading, Syntax, Inclusion, Color, Background, Fonts, Tables, lists, CSS3 selectors.	
		Self-Learning Topics: HTML5 Audio Video controls	

2	**Front End Development**		04
	After completing this module, students will be able to: • Describe basic concepts of JavaScript including variables, operators, and functions • Apply conditional statements and functions to solve simple problems • Explain the Document Object Model (DOM) and its role in web development • Implement form validation using regular expressions • Analyse and handle events to create interactive web pages		
	2.1	**Java Script:** Introduction to JavaScript: Variables, Operators, Conditional Statements, Functions.	
	2.2	Document Object Model- Introduction to the DOM, Defining the DOM, Dom Tree, Simple form validation-Regular Expressions—patterns, flags, matching, validation applications.	
	2.3	Event Handling- Events, Fetch & Callbacks: Event Flow, Event Handlers/Listeners, The Event Object, Types of Events.	
	Self-Learning Topics: Date Object - Getting and setting date & time values		
3	**Introduction to MERN Stack**		05
	After completing this module, students will be able to: • Describe the components of the MERN stack and their roles • Install and set up Node.js and MongoDB environments • Explain the concept of npm and package management • Develop basic server-side programs using Node.js • Create simple APIs using Express and understand JSON data format.		
	3.1	What is MERN-MongoDB, Express, React, Node, Installing Node.js & MongoDB	
	3.2	Understanding npm and packages, Basics of Node.js: running a simple JS program, creating a very simple API using Express (GET request)	
	Self-Learning Topics: Understanding JSON Data Format		
4	**Web Programming using React JS**		05
	• After completing this module, students will be able to: • Describe the fundamentals of React and its component-based architecture • Develop UI components using React elements and components • Explain and use state and props for dynamic data handling • Implement event handling and hooks in React applications		

	• Display and manage lists of data in user interfaces		
	4.1	**React Framework:** Introduction to React JS, Components and Elements of React.	
	4.2	React State and Props, Handling events in React Events, Hooks Displaying list of items in UI.	
	Self-Learning Topics: Passing props between components		
5	**MongoDB-Database Operations and Express.js**		**05**
	After completing this module, students will be able to: • Describe NoSQL databases and their advantages over traditional databases • Perform CRUD operations using MongoDB • Connect MongoDB with Node.js applications • Develop backend services using Express framework and routing • Explain middleware and handle HTTP request–response objects		
	5.1	Introduction to NoSQL databases, CRUD operations in MongoDB Connecting MongoDB with Node.js.	
	5.2	Introduction to Express framework,Creating routes (GET, POST, PUT, DELETE), Middleware concept, Working with request & response objects	
	Self-Learning Topics: Difference Between SQL and NoSQL Databases		
6	**MERN Integration**		**05**
	After completing this module, students will be able to: • Explain the integration of frontend, backend, and database in MERN stack • Connect React applications with Express backend APIs • Perform basic CRUD operations using MongoDB • Fetch and display API data in React applications • Develop a simple full-stack MERN application		
	6.1	Connecting React frontend with Express backend, CRUD app using MERN, Simple MongoDB data read/write, Basic Create & Read operations, Fetching and displaying API data in React	
	Self-Learning Topics: Testing APIs in Postman		
		Total	**30**

List of Experiments:

Experiment No.	Title of the Experiment
1	**Design a static web page using headings, paragraphs, lists, tables, images, and semantic elements.** **Objective** To identify and apply basic concepts of web technologies and use HTML elements to design a structured static web page. **Outcome** Students will be able to create structured web pages using HTML and demonstrate understanding of fundamental web concepts and front-end components.
2	**Create a web form using HTML5 input types and form elements.** **Objective** To understand how web pages collect user input and use HTML5 form elements to design interactive forms. **Outcome** Students will be able to design forms that capture user data effectively and explain how form data is used in web applications.
3	**Apply inline, internal, and external CSS for colors, fonts, layout, and basic responsiveness.** **Objective** To identify front-end styling techniques and apply CSS to improve layout, design, and responsiveness of web pages. **Outcome** Students will be able to style web pages using different CSS methods and evaluate suitable styling approaches for better UI design.
4	**Implement JavaScript programs using variables, operators, conditions, and functions.** **Objective** To understand scripting in web applications and implement JavaScript programs using basic programming constructs. **Outcome** Students will be able to develop scripts that add dynamic behaviour to web pages and explain how scripts interact with web content.
5	**Implement mouse and keyboard events such as click, hover, and keypress on a web page.** **Objective** To analyse user interaction with web pages and implement event handling using JavaScript. **Outcome** Students will be able to create interactive web applications by handling events and analysing how user actions affect application behaviour.

6	**Validate user inputs using DOM manipulation and regular expressions.** **Objective** To evaluate input validation techniques and implement validation using DOM manipulation and regular expressions. **Outcome** Students will be able to validate user inputs effectively and ensure data correctness in web applications.
7	**Develop a basic server and implement GET and POST APIs using Express.js.** **Objective** To understand server-side components and APIs and develop a basic server using Express.js. **Outcome** Students will be able to build server-side applications and explain how APIs handle client-server communication.
8	**Perform Create and Read operations in MongoDB and connect the database with Node.js.** **Objective** To identify database concepts and perform Create and Read operations while connecting MongoDB with Node.js. **Outcome** Students will be able to interact with databases, manage data, and analyse data flow between server and database.
9	**Create a React application using components, props, state, and hooks to render data.** **Objective** To understand front-end frameworks and develop dynamic user interfaces using React components, props, state, and hooks. **Outcome** Students will be able to build modular UI components and analyse how data flows within a React application.
10	**Develop a simple full-stack MERN application integrating React frontend, Express backend, and MongoDB database.** **Objective** To design and integrate frontend, backend, and database components of a MERN stack application and analyse interaction between them. **Outcome:** Students will be able to develop a complete full-stack web application and evaluate the performance and integration of different MERN components.

Text Books:

1. J. Duckett, *HTML and CSS: Design and Build Websites*, 1st edition, John Wiley & Sons, 2011.Computer Graphics for Engineers – Anupam Saxena and Birendra Sahay Pearson Education

2. J. Duckett, *JavaScript and JQuery: Interactive Front-End Web Development*, 1st edition, John Wiley & Sons, 2014.
3. M. Haverbeke, *Eloquent JavaScript: A Modern Introduction to Programming*, 3rd edition, No Starch Press, 2018.
4. A. Banks and E. Porcello, *Learning React: Modern Patterns for Developing React Apps*, 2nd edition, O'Reilly Media, 2020.

Reference Books:

1. E. Brown, Learning JavaScript, 3rd edition, O'Reilly Media, 2016.
2. Casciaro and L. Mammino, Node.js Design Patterns, 3rd edition, Packt Publishing, 2020.
3. K. Chodorow, *MongoDB: The Definitive Guide*, 3rd edition, O'Reilly Media, 2019.

Useful Links:

1. Web Development Tutorials (HTML, CSS, JavaScript, React, Node, MongoDB): https://www.w3schools.com/
2. MongoDB Tutorial (Beginner to Advanced): https://www.w3schools.com/mongodb/
3. Express.js & Node.js Web Development Guide:

   https://developer.mozilla.org/en-US/docs/Learn_web_development/Extensions/Server-side/Express_Nodejs/Introduction
4. JavaScript Programming with React, Node & MongoDB (Coursera Specialization): https://www.coursera.org/specializations/javascript-programming-with-react-node-mongodb

Assessment Methodology:

Assessment Tool	Marks Distribution
Continuous Assessment (CA) (50 Marks)	Certification: NPTEL (20 Marks) (Approved by instructor) **OR** Any two Pedagogies (15 marks each) • MCQ /Class Test • Case study/Assignment • GATE based Tutorial • MOOCs Certification (Approved by Instructor) • Open Book Test • Working model / simulation of a course-based concept.
Mid Semester Examination (MSE) (30 Marks)	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • For each question, A and B should be based on the same CO. • MSE should be based on 50% syllabus. • Time: 90 minutes (1 hour 30 minutes) • Total Marks: 30

End Semester Examination (ESE) (50 Marks)	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • Q4 A or B - 10 marks • Q5 A or B - 10 marks • For each question, A and B should be based on the same CO. • ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE. • Time: 120 minutes (2 hours) • Total Marks: 50
Term Work (25 Marks)	• Active Participation (Lab) = 5 marks • Laboratory Report = 10 marks • Laboratory performance = 10 marks Based on the performance and satisfactory completion of assigned laboratory work.

Course Code	Course Name	Teaching Scheme (Hrs./ Week)			Credits Assigned			
25IT4MDM01	Data Structure and Algorithm	L	P	T	L	P	T	Total
		2	2	-	2	1	-	3
		Examination Scheme						
			CA	MSE	ESE	TW	OR	PR	Total
		Theory	20	30	50	-	-	-	100
		Lab/Tut	-	-	-	25	-	–	25
		Total	125						

Pre-Requisite Courses:	25FE1VESC02 - Problem Solving using C programming

Course Overview:

The course Data Structure and Algorithm is designed to provide students with a strong foundation in organizing, managing, and processing data structure efficiently using appropriate data structures and algorithms. The course introduces fundamental concepts such as Abstract Data Types (ADTs), algorithm design principles, and complexity analysis, enabling students to evaluate algorithmic efficiency using asymptotic notations. Emphasis is placed on both linear and non-linear data structures, along with their practical implementations using arrays and linked representations. Students gain hands-on experience in applying stacks, queues, trees, graphs, searching, sorting, and hashing techniques to solve real-world computational problems.

Module 1 introduces the basic concepts and classifications of data structures, highlighting the need for structured data organization in programming. Students explore primitive and non-primitive data structures, linear and non-linear structures, and Abstract Data Types (ADTs). The module also covers algorithm fundamentals, including properties, design techniques, and performance evaluation. A strong focus is placed on asymptotic notations (Big O, Omega, Theta) to Analyse time and space complexity, enabling students to compare algorithm efficiency.

Module 2 focuses on Lists as an Abstract Data Type, covering both array-based and linked list implementations. Students learn about different types of linked lists, including singly, doubly, and circular linked lists. All fundamental operations such as insertion, deletion, traversal, merging, updating, and copying are studied along with their performance analysis. Practical applications like Polynomial arithmetic helps students understand real-life use cases of linked lists.

Module 3 introduces Stacks and Queues as ADTs, emphasizing their operations and implementations using arrays and linked lists. Students explore stack applications such as reversing data and expression conversion. Queue concepts include linear queues, circular queues, priority queues, and their implementations. The module also highlights expression evaluation techniques and double-ended queues, strengthening students' understanding of sequential data processing

Module 4 introduces Stacks and Queues as ADTs, emphasizing their operations and implementations using arrays and linked lists. Students explore stack applications such as reversing data and expression conversion. Queue concepts include linear queues, circular queues, priority queues, and their implementations. The module also highlights expression evaluation techniques and double-ended queues, strengthening students' understanding of sequential data processing.

Module 5 introduces graphs as a data structure for modeling networks and relationships. Students learn graph terminologies and representation methods using adjacency matrices and adjacency lists. Graph traversal techniques such as Breadth First Search and Depth First Search are studied along with applications like topological sorting. Real-world applications of graphs in networking are emphasized.

Module 6 focuses on efficient data retrieval and organization techniques. Students study linear and binary search algorithms, followed by basic sorting techniques such as selection sort, insertion sort, and bubble sort. The module also introduces hashing concepts, including hash functions, collision handling, and resolution techniques like chaining and open addressing. Advanced sorting techniques such as merge sort are included s self-learning topics.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Identify** fundamental concepts of data structures, algorithms, Abstract Data Types (ADTs), and asymptotic notations. **(Remembering)**
	CO2	**Explain** the functioning, implementation, and applications of linear and non-linear data structures, including arrays, linked lists, stacks, queues, trees, and graphs. **(Understanding)**
	CO3	**Select** appropriate data structures and ADT operations (insertion, deletion, traversal, etc.) to solve computational and real-world problems efficiently. **(Applying)**
	CO4	**Analyse** the time and space complexity of array-based and linked-list-based implementations, and evaluate algorithm performance using asymptotic techniques. **(Analysing)**
	CO5	**Evaluate** the searching, sorting, hashing, and expression processing techniques (infix, postfix, evaluation) using suitable data structures. **(Evaluating)**
	CO6	Design and develop solutions for real-life problems using data structures. **(Creating)**

Syllabus:

Module No.	Unit No.	Topics	Hours
1		**Introduction to Data Structures and Algorithms**	05
		After completing this module, students will be able to: • Explain the need for data structures and classify them into primitive and non-primitive types. • Distinguish between linear and non-linear data structures and their use cases. • Define Abstract Data Types (ADTs) and relate them to practical implementations. • Describe fundamental algorithm properties and common design techniques. • Analyse time and space complexity using asymptotic notations (Big-O, Ω, Θ). • Compare algorithms based on efficiency and performance metrics.	
	1.1	Data Structures concepts: Definition, classification, and need for data structures. Types of data structures: primitive, non-primitive, linear, and non-linear, Abstract Data Types (ADT)	
	1.2	Concept of algorithms: properties, design techniques, and performance analysis. Asymptotic notation: Big O, Omega, Theta with examples	
		Self-Learning Topics: Comparative growth analysis of functions	
2		**Linear Data Structure – LISTS**	04
		After completing this module, students will be able to: • Describe Lists as an Abstract Data Type and explain their characteristics. • Implement array-based and linked list representations. • Differentiate between singly, doubly, and circular linked lists. • Perform fundamental operations such as insertion, deletion, traversal, merging, updating, and copying. • Analyse the performance of list operations in different implementations. • Apply linked lists to solve problems such as polynomial arithmetic.	
	2.1	List as an ADT, Array-based implementation, Linked List implementation.	
	2.2	Types of Linked List- Singly linked lists, doubly linked lists and circular linked lists.	
	2.3	All operations (Insertion, Deletion, Merge, Traversal, update, copying etc.) with singly linked lists, doubly linked lists and their analysis.	
		Self-Learning Topics: Reversing a singly linked list, Applications of linked lists - Polynomial arithmetic	
3		**Linear Data Structure – STACKS & QUEUES**	

	After completing this module, students will be able to: • Explain Stacks and Queues as Abstract Data Types. • Implement stacks and queues using arrays and linked lists. • Apply stack operations to problems such as data reversal and expression conversion. • Describe different queue types including linear, circular, priority, and double-ended queues. • Implement expression evaluation techniques using stacks. • Analyse the efficiency of stack and queue operations in sequential data processing.		**06**
	3.1	Introduction to Stack, Stack as ADT, ADT Operations on Stack, Array and Linked List representation of Stack, Applications – Reversing data, Conversion of Infix to prefix and postfix expression.	
	3.2	Introduction to Queue, Queue as an ADT, operations on Queue, Implementation of Linear Queue, Circular and Priority Queue using arrays and Linked List.	
	Self-Learning Topics: Evaluation of postfix and prefix expressions, Double Ended Queue		
4	**Non-Linear Data Structure – TREES**		**05**
	After completing this module, students will be able to: • Define trees and explain basic tree terminologies. • Differentiate between various tree structures and representations. • Perform tree traversal techniques such as preorder, inorder, and postorder. • Implement binary trees and binary search trees. • Analyse the time complexity of tree operations. • Apply tree-based structures to solve hierarchical data problems.		
	4.1	Tree Terminologies, Tree as an ADT, Binary Tree - Operations, Tree Traversals, Binary Search Tree (BST) - Operations	
	Self-Learning Topics: AVL Tree, Applications		
5	**Non-Linear Data Structure – GRAPHS**		**03**
	After completing this module, students will be able to: • Explain graph concepts, terminologies, and applications. • Represent graphs using adjacency matrices and adjacency lists. • Implement graph traversal techniques such as Breadth First Search (BFS) and Depth First Search (DFS). • Apply graph algorithms to problems such as topological sorting. • Analyse the computational complexity of graph traversal algorithms.		

	• Relate graph concepts to real-world applications such as networking and routing.		
	5.1	Graph Terminologies, Graph representation: adjacency matrix and list	
	5.2	Graph traversal: BFS, DFS with applications, Applications of Graphs - Topological sorting.	
	Self-Learning Topics: Graph applications in networking		
6	**Searching, Sorting & Hashing**		**07**
	After completing this module, students will be able to: • Implement linear and binary search algorithms. • Compare searching techniques based on time complexity and applicability. • Implement basic sorting algorithms such as selection, insertion, and bubble sort. • Explain hashing concepts, hash functions, and collision resolution techniques. • Apply hashing methods such as chaining and open addressing. • Explore advanced sorting techniques like merge sort as a self-learning component.		
	6.1	Searching: Linear Search and Binary Search: Concepts and Implementation	
	6.2	Sorting: Selection Sort, Insertion Sort, Bubble Sort	
	6.3	Hashing: Hash Functions, Overflow handling, Collision & Collision Resolution Techniques, Linear hashing, Hashing with chaining, Separate Chaining, Open Addressing.	
	Self-Learning Topics: Merge Sort		
		Total	**30**

List of Experiments:

Experiment No.	Title of the Experiment (Perform any 10 of the following)
1	**Implementation of Insertion and deletion in a specific position in an Array using Function.** **Objective** To understand and implement insertion and deletion operations at specific positions in an array using functions. **Outcome** Students will be able to perform and analyse array operations and understand their time complexity.
2	**Implementation of recursive programs using functions.** **Objective** To understand recursion and implement basic recursive algorithms using functions. **Outcome**

	Students will be able to design recursive solutions and compare them with iterative approaches.
3	**Array Implementation of Stack** **Objective** To implement stack operations (push, pop, peek) using arrays. **Outcome** Students will be able to use stack ADT and understand the LIFO principle in problem solving.
4	**Array Implementation of Linear and Circular Queue** **Objective** To implement creation and operations (insertion, deletion, traversal) on singly linked lists. **Outcome** Students will be able to differentiate between linear and circular queues and apply FIFO principle efficiently.
5	**Implementation of Singly Linked List** **Objective** To implement creation and operations (insertion, deletion, traversal) on singly linked lists. **Outcome** Students will be able to dynamically manage data using linked list structures.
6	**Implementation of Doubly Linked List** **Objective** To implement doubly linked lists and perform bidirectional traversal and operations. **Outcome** Students will be able to efficiently perform operations using forward and backward links.
7	**Implementation of Stack using Linked List** **Objective** To implement stack ADT using linked list representation. **Outcome** Students will be able to overcome array limitations and implement dynamic stack operations.
8	**Implementation of Binary Search Tree and Traversals** **Objective** To implement Binary Search Tree (BST) and perform traversal techniques (inorder, preorder, postorder). **Outcome** Students will be able to organize hierarchical data and apply traversal methods.

9	**Reversing a List using Stack** **Objective** To use stack for reversing elements of a list. **Outcome** Students will be able to apply stack concepts in solving practical problems.
10	**Infix to Postfix Conversion using Stack** **Objective** To convert infix expressions to postfix using stack ADT. **Outcome** Students will be able to understand operator precedence and expression handling.
11	**Evaluation of Postfix Expression using Stack** **Objective** To evaluate postfix expressions using stack operations. **Outcome** Students will be able to implement expression evaluation algorithms.
12	**Implementation of Deque using Linked List** **Objective** To implement a double-ended queue (deque) using linked lists. **Outcome** Students will be able to perform insertion and deletion at both ends efficiently.

Text Books:

1. Reema Thareja, "Data Structures using C", 3rd Edition, Oxford, 2023.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, W. H. Freeman and Company, 2008.
3. "Introduction to Algorithms" – Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein (CLRS), 4th Edition (2022).

Reference Books:

1. "Data Structures and Algorithms Made Easy" – Narasimha Karumanchi, Latest (2022) – CareerMonk Publications.
2. "Data Structures and Algorithm Analysis in C++" – Mark Allen Weiss, 4th Edition.
3. Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, "Data Structures Using C", Pearson Publication, 2nd edition, 2015.

Useful Links:

1. Use visualization tools like Visualgo or Pythontutor.
2. https://nptel.ac.in/courses/106/102/106102064/
3. Data Structure using C Programming - Course (swayam2.ac.in)

Assessment Methodology:

Assessment Tool	Marks Distribution
Continuous Assessment (CA) (50 Marks)	Certification: NPTEL (20 Marks) (Approved by instructor) **OR** Any two Pedagogies (15 marks each) • MCQ /Class Test • Case study/Assignment • GATE based Tutorial • MOOCs Certification (Approved by Instructor) • Open Book Test • Working model / simulation of a course-based concept.
Mid Semester Examination (MSE) (30 Marks)	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • For each question, A and B should be based on the same CO. • MSE should be based on 50% syllabus. • Time: 90 minutes (1 hour 30 minutes) • Total Marks: 30
End Semester Examination (ESE) (50 Marks)	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • Q4 A or B - 10 marks • Q5 A or B - 10 marks • For each question, A and B should be based on the same CO. • ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE. • Time: 120 minutes (2 hours) • Total Marks: 50
Term Work (25 Marks)	• Active Participation (Lab) = 5 marks • Laboratory Report = 10 marks • Laboratory performance = 10 marks Based on the performance and satisfactory completion of assigned laboratory work.

Course Code	Course Name	Teaching Scheme (Hrs./ Week)			Credits Assigned			
25ET4MDM01	Embedded System	L	P	T	L	P	T	Total
		2	2	-	2	1	-	3
		Examination Scheme						
			CA	MSE	ESE	TW	OR	PR	Total
		Theory	20	30	50	-	-	-	100
		Lab/Tut	-	-	-	25	-	-	25
		Total	125						

Pre-Requisite Courses:	25FE1VSEC01: C Programming
	25FE1ESC02: Basic Electrical and Digital Electronics

Course and Module Overview:

This course provides a strong foundation in sensors, microcontrollers, and embedded systems with an application-oriented approach aligned to Industrial IoT. It enables students to understand physical parameters, sensing techniques, and the role of sensors in embedded applications. The course covers microprocessor and microcontroller fundamentals, 8051 architecture and programming, sensor and actuator interfacing, and Embedded C programming. Students also learn signal conditioning, peripheral interfacing, and communication protocols, helping them design and implement complete embedded solutions for real-world and industrial IoT applications.

Module 1 introduces the basic concepts, architecture, and applications of microprocessors and microcontrollers in embedded systems. It builds foundational understanding of embedded platforms and their role in processing real-world signals.

Module 2 module provides detailed knowledge of the 8051 microcontrollers, including its architecture, instruction set, and on-chip peripherals. It enables students to understand microcontroller programming and its application in embedded system design.

Module 3 covers the principles, characteristics, and selection of sensors and actuators used in embedded and Industrial IoT applications. It helps students understand sensing techniques and choose appropriate components for real-world systems.

Module 4 focuses on interfacing sensors and actuators with microcontrollers for monitoring, control, and automation. It develops skills in integrating hardware components to build simple embedded applications.

Module 5 introduces embedded system concepts and Embedded C programming. It enables students to develop structured programs and implement logic for real-time embedded applications.

Module 6 covers signal conditioning, ADC/DAC interfacing, and communication protocols required for embedded systems. It enables students to design and integrate complete hardware-software solutions for data acquisition and control.

Overall, this course develops strong fundamentals in microcontrollers, sensors, and embedded system design. It enables students to integrate hardware and software for building real-world automation and IoT-based applications. The course prepares learners to design efficient, reliable, and intelligent embedded systems used in modern engineering solutions.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Describe** the functional block diagram of microprocessors and microcontrollers along with different types of memories. **(Remembering)**
	CO2	**Explain** the differences between general-purpose computing systems and embedded systems, including types of sensors and transducers. **(Understanding)**
	CO3	**Select** suitable sensors based on design requirement and sensor specifications and then program the microcontroller's I/O and timers using its instruction set**. (Applying)**
	CO4	**Analyse** working principles and parameters of various sensors and actuators to choose suitable components. **(Analysing)**
	CO5	**Evaluate** and justify appropriate signal conditioning techniques for sensor-based applications. **(Evaluating)**
	CO6	**Design and develop** a complete embedded application integrating sensors and actuators for a real-world problem. **(Creating)**

Syllabus:

Module No.	Unit No.	Topics	Hours
1		**Fundamentals of Microprocessor and Microcontroller**	04
		After completing this module, students will be able to: • Describe the architecture and key features of microprocessor and embedded systems, ALU, registers, address bus, and data bus operation • Understand the architecture, pin configuration, and working of Arduino boards • Compare Arduino and Raspberry Pi based on functionality and applications	
	1.1	Microprocessor and Microcontroller - Features, functional block diagram, address bus and data bus, ALU and Registers	
	1.2	Arduino: Architecture, pin functions, and applications	
	1.3	Raspberry Pi: Architecture, pin functions, and applications	
		Self -Learning Topics: : Types of Memories RAM, ROM and memory mapping	
2		**8051 Microcontroller**	**07**

	After completing this module, students will be able to: • Explain the organization and functions of internal RAM, ROM, and Special Function Registers (SFRs) • Understand different addressing modes and their usage in programming • Explain the working of I/O ports, timers, and counters		
	2.1	Block diagram, features, Pin diagram, SFRs	
	2.2	Internal RAM and ROM	
	2.3	Addressing modes types, Instruction Set and Programming	
	2.4	Ports, Timers, Counters, Interrupts	
	Self-Learning Topics: Optical sensor and Sound sensor		
3	**Types of Sensors and actuator**		**06**
	After completing this module, students will be able to: • Differentiate between sensors and transducers and explain their working principles • Classify various types of sensors, working based on their applications. • Explain key sensor parameters such as range, sensitivity, accuracy, linearity, resolution, and calibration • Describe the operation of other sensors like IR, motion, pressure, level, and humidity sensors.		
	3.1	Sensors vs transducers: working principles, Types of Sensors,	
	3.2	Parameters/Specifications: range, sensitivity, accuracy, linearity, resolution, calibration	
	3.3	Temperature sensors: RTD, thermocouple, thermistor Proximity sensors: inductive (LVDT), capacitive, photoelectric, ultrasonic Chemical sensors: gas, smoke, conductivity, pH Other sensors: IR, motion, pressure, level, humidity Actuators: motors, relays, drivers for interfacing Display devices: LCD, LED, OLED	
	Self-Learning Topics: Optical, sound, laser, combustible gas sensors		
4	**Interfacing of Sensors and Actuators**		**04**
	After completing this module, students will be able to: • Understand the criteria for selecting appropriate sensors for specific applications. • Explain interfacing techniques of sensors with microcontrollers and microprocessors. • Interface actuators such as motors and relays with embedded systems. • Analyse real-world applications in embedded systems and industrial automation.		
	4.1	Sensor selection and interfacing with microcontrollers/ microprocessors, and control in embedded systems.	
	4.2	Interfacing motors, relays, and display devices, Applications in embedded systems and industrial automation	

	Self-Learning Topics: Simple embedded system projects		
5	**Introduction to Embedded Systems and Embedded C**		**05**
	After completing this module, students will be able to: • Differentiate between Embedded C and standard C programming • Apply knowledge of data types, variables, and storage classes in Embedded C • Perform bitwise operations and understand their significance in embedded programming • Use arrays, strings, and structures effectively in Embedded C programs		
	5.1	Definition, block diagram, characteristics and applications, and quality attributes of Embedded Systems	
	5.2	Embedded C Vs C, Data types, Variables, Storage Classes	
	5.3	Bit operations, Arrays, Strings and Structures	
	Self-Learning Topics: Serial communication basics, clock frequency, timers/counters.		
6	**Peripheral Interfacing**		**04**
	After completing this module, students will be able to: • Explain interfacing and usage of analog and digital peripherals in embedded systems. • Describe communication protocols such as UART, I2C, and SPI • Differentiate between various serial communication interfaces based on speed and applications. • Design and develop a complete embedded application integrating sensors		
	6.1	Basic Peripherals: GPIO, Analog-to-Digital Converters (ADC), Digital-to-Analog Converters (DAC)	
	6.2	Advanced Peripherals: Pulse-width modulation (PWM), Universal Asynchronous Receiver/Transmitter (UART), Inter-Integrated Circuit (I2C) and Serial Peripheral Interface (SPI)	
	Self-Learning Topics: Comparative study of sensors like temperature, pressure, proximity sensors for real-world data acquisition.		
		Total	**30**

List of Experiments:

Experiment No.	List of experiments
1	**Program to perform 8-Bit Arithmetic operations using 8051.** **Objective** To understand various arithmetic instructions of 8051 microcontroller. **Outcome** Students will be able to Perform arithmetic operations to observe status of parity, carry and overflow flags
2	**Program to study various addressing Modes of 8051.** **Objective**

	To understand various addressing modes of 8051 microcontroller. **Outcome** Students will be able to access data stored in various ways and use in the programming and differentiate among the various addressing modes
3	**Program to perform block transfer of 10 data bytes in internal memory.** **Objective** To understand various data transfer instructions of 8051. Microcontroller. **Outcome** Students will be able to perform block transfer within internal memory of 8051 using indirect addressing mode of 8051 microcontroller.
4	**Program to perform exchange a block of 10 bytes from internal memory.** **Objective** To understand various data transfer instructions of 8051. microcontroller. **Outcome** Students will be able to perform block exchange within internal memory of 8051 using indirect addressing mode of 8051 microcontroller.
5	**Program to perform inverted block transfer and subsequently verify if it's a Palindrome or not.** **Objective** To understand various data transfer instructions of 8051. microcontroller. **Outcome** Students will be able to perform inverted block transfer and subsequently verify if it's a Palindrome or not using compare or subtraction.
6	**Program to arrange set of 10 number stored in internal memory in ascending order and finding the highest value number** **Objective** To understand sorting algorithms (such as Bubble Sort or Selection Sort) to arrange a dataset in ascending order **Outcome** Students will be able to apply comparison logic to identify the maximum value within a set of numbers and utilize nested loops to iterate through and process multiple data elements stored in memory
7	**Program to Interface LEDs at Port 1 of 8051 Microcontroller.** **Objective** To understand Assembly instructions to toggle individual LEDs. **Outcome** Students will be able to generate delay by means of the Rx registers and blink the LEDs connected to Port 1
8	**Program for perform Serial Communication using UART.** **Objective**

	To understand concept of serial data transmission the string " via UART. **Outcome** Students will be able to configure serial registers and timer-based baud rates to perform serail data transmission.
9	**To study and obtain the performance characteristics of a Thermistor.** **Objective** To understand the temperature-dependent resistance properties of NTC/PTC thermistors and their calibration. **Outcome** Students will be able to plot the resistance-temperature curve and determine the sensitivity of the thermistor
10	**To measure an unknown resistance using a Wheatstone (Meter) Bridge.** **Objective** To apply the null-deflection principle to accurately measure electrical resistance. **Outcome** Students will be able to balance the bridge circuit and calculate unknown resistance values with high precision.
11	**To study and test the operation of a 4-bit Flash type Analog-to-Digital Converter (ADC).** **Objective** To understand high-speed data conversion using parallel comparators and priority encoders. **Outcome** Students will be able to demonstrate how analog voltages are converted into discrete 4-bit digital signals.
12	**To design and test a Digital-to-Analog Converter (DAC) using an R–2R ladder network.** **Objective** To understand the weighted resistor principle and binary ladder networks for signal conversion. **Outcome:** Students will be able to construct an R-2R network and verify the output voltage levels against theoretical digital inputs.
13	**To interface sensors using the DBIT-EXTC Embedded Systems Trainer Kit.** **Objective** To familiarise themselves with the hardware architecture and peripheral headers of the specific trainer kit. **Outcome** Students will be able to establish successful hardware-software communication between the kit and external sensor modules.
14	**To interface a Temperature or Proximity Sensor with a Microcontroller and display data on LCD/OLED.**

	Objective To implement sensor data acquisition and real-time visual feedback using display protocols (I2C/Parallel). **Outcome** Students will be able to write firmware to process sensor signals and format them for user-readable display outputs.
15	**To develop a simple Embedded System–based application for Industrial or IoT use.** **Objective** To integrate multiple hardware components to solve a practical, real-world monitoring or control problem. **Outcome** Students will be able to design a functional prototype that demonstrates data collection and automated decision-making.

Text Books:

1. D.V.S. Murthy, "Transducers and Instrumentation," PHI Learning, 2nd Edition, 2013.
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Muhammad Ali Mazidi, Pearson Education, 2nd Edition (or newer)
3. Sensors and Signal Conditioning, Ramon Pallas Areny, John G. Webster, 2nd edition, John Wiley and Sons, 2000.
4. Vijay K. Garg, "Wireless Communication and Networking", Morgan -Kaufmann Series in Networking, Elsevier 2010.

Reference Books:

1. Microcontrollers: Architecture, Implementation and Programming Technology, Kenneth Hintz and Daniel Tabak, McGraw Hill Education.
2. 8051 Microcontroller Architecture, Programming and Application, Kenneth J. Ayala and Dhananjay Gadre, Cengage Learning India.
3. A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpatri & Co., 19th Edition, 2011.
4. Nathan Ida, "Sensors, Actuators and their Interfaces: A Multidisciplinary Introduction", Second Edition, IET Control, Robotics and Sensors Series 127, 2020.
5. Jacob Fraden Handbook of Modern Sensors Physics, Designs, and Applications Fourth Edition, Springer, 2010.

Useful Links:

1. https://www.ni.com/en-in/innovations/white-papers/06/sensor-fundamentals.html
2. https://www.youtube.com/watch?v=WwQSfk6SSSo
3. https://www.youtube.com/watch?v=MGC2LWeNKSI
4. https://www.youtube.com/watch?v=vjhp0zTXEsc

Assessment Methodology:

Type of Assessment	Assessment Tools
Continuous Assessment (CA) **(20 Marks)**	Certification: NPTEL (20 Marks) (Approved by instructor) **OR** Any 02 Pedagogies (10 marks each) • MCQ /Class Test • Case study/Assignment • GATE based Assignment • Certification Udemy/Coursera (Approved by instructor) • Open Book Test • Working model / Simulation of a course-based concept.
Mid Semester Examination (MSE) **(30 Marks)**	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • For each question, A and B should be based on the same CO. • MSE should be based on 50% syllabus. • Time: 90 minutes (1 hour 30 minutes) • Total Marks: 30
End Semester Examination (ESE) **(50 Marks)**	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • Q4 A or B - 10 marks • Q5 A or B - 10 marks • For each question, A and B should be based on the same CO. • ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE. • Time: 120 minutes (02 hours) • Total Marks: 50
Term Work (25 Marks)	• Active Participation (Lab) = 05 marks • Laboratory Report = 10 marks • Laboratory performance = 10 marks Based on the performance and satisfactory completion of assigned laboratory work.

Course Code	Course Name	Teaching Scheme (Hrs./ Week)			Credits Assigned			
25ET4MDM02	Sensor Technology	L	P	T	L	P	T	Total
		2	2	-	2	1	-	3
		Examination Scheme						
			CA	MSE	ESE	TW	OR	PR	Total
		Theory	20	30	50	-	-	-	100
		Lab/Tut	-	-	-	25	-	-	25
		Total	125						

Pre-Requisite Courses:	25FE1BSC02 Applied Physics
	25FE1ESC02 Basic Electrical and Digital Electronics

Course and Module Overview:

This course introduces the fundamentals of sensor technology used in modern engineering applications, focusing on sensing principles, transduction mechanisms, and performance characteristics. It covers measurement of physical, chemical, and environmental parameters along with signal conditioning and data acquisition techniques. Students are also exposed to modern technologies such as MEMS, nano-sensors, and wireless sensing systems. Through theory and laboratory practice, the course builds strong foundational knowledge and supports the design, implementation, and testing of sensor-based systems for industrial, IoT, and automation applications.

Module 1 establishes the basic concepts of sensors and transducers, including performance parameters, characteristics, and selection criteria. It develops fundamental understanding and analytical ability required for evaluating sensor performance and selecting appropriate sensors for practical applications.

Module 2 explains the operating principles, characteristics, and calibration of commonly used thermal and proximity sensors. It helps students understand sensor behaviour and apply suitable sensors for measurement and control in real-world systems.

Module 3 introduces chemical, environmental, motion, and pressure sensors along with their working principles. It enhances understanding of diverse sensing techniques and supports the selection and application of sensors in safety, environmental monitoring, and smart systems.

Module 4 covers modern sensing technologies such as MEMS and nano-sensors along with their applications. It provides exposure to advanced, compact, and low-power sensor technologies used in healthcare, consumer electronics, and industrial systems.

Module 5 focuses on wireless communication techniques used in sensor networks. It enables understanding of remote sensing, data transmission, and integration of sensors in IoT-based and intelligent systems.

Module 6 introduces data acquisition systems, signal conditioning, and ADC/DAC concepts. It enables students to acquire, process, and interface sensor signals, and supports the design and implementation of complete sensor-based systems through practical applications.

Overall, this course builds a strong foundation in sensor principles, modern sensing technologies, and data acquisition systems. It enables students to Analyse, select, and integrate sensors into real-world applications. The course prepares learners to design and implement sensor-based solutions for industrial, IoT, and automation systems.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Define** and **classify** sensors and transducers based on physical quantity, transduction principle, and application. **(Remembering)**
	CO2	**Explain** the operating principles and characteristics of different sensors using theoretical concepts and laboratory observations. **(Understanding)**
	CO3	**Implement** and **use** appropriate sensors, interfacing techniques, and data acquisition methods in laboratory experiments and practical systems. **(Applying)**
	CO4	**Analyse** and **compare** sensor and wireless sensing system performance based on accuracy, sensitivity, power consumption, and communication range. **(Analysing)**
	CO5	**Evaluate** and **justify** the selection of sensors and signal conditioning circuits for specific engineering applications using experimental results. **(Evaluating)**
	CO6	**Design**, **integrate**, and **test** a sensor-based system incorporating sensing, signal conditioning, data acquisition, and communication modules. **(Creating)**

Syllabus:

Module No.	Unit No.	Topics	Hours
1		**Introduction to Sensors** After completing this module, students will be able to: • Understand the concepts of sensors and transducers, their roles in engineering systems, and their classification based on physical quantities and materials. • Explain key sensor performance parameters such as accuracy, precision, sensitivity, range, linearity, hysteresis, repeatability, and resolution. • Analyse advanced parameters including stability, noise, dynamic characteristics, response time, recovery time, and drift. • Perform basic numerical calculations related to sensitivity, range, and offset. • Select appropriate sensors based on criteria like environmental conditions, reliability, calibration requirements, and cost.	**05**
	1.1	Overview and Classification of Sensors: Sensor and Transducer, Role of sensors in engineering systems, Classification of sensors based on Physical	

		quantity to be sensed, Classification based on materials, Multidisciplinary aspect of sensors, Evolution of Technologies	
	1.2	Sensor Performance Parameters and Selection Criteria I: Accuracy, Precision, Calibration, Sensitivity, Threshold, Range, Linearity, Hysteresis, Selectivity, Repeatability, Reproducibility, Resolution.	
	1.3	Sensor Performance Parameters and Selection Criteria II: Stability, Noise, Excitation, Dynamic Characteristics, -3db point, Safe Limit, Response time, Recovery Time, Drift. Numerical based on Sensitivity, Range and Offset. Criteria for sensor selection: environmental conditions, reliability, Calibration requirements, and Cost.	
	Self -Learning Topics: Block diagram of sensor, Digital Sensors-Principle and its advantage over Analog Sensor.		
2	**Temperature and Proximity**		**05**
	After completing this module, students will be able to: • Understand the working principles of temperature sensors such as RTD, thermocouple, and thermistors. • Interpret graphs like temperature vs time, voltage vs time, and resistance vs temperature. • Explain the operation of proximity sensors such as LVDT and capacitive sensors. • Describe the working of photoelectric and ultrasonic sensors for non-contact detection. • Compare different types of sensors based on their characteristics and applications.		
	2.1	Temperature Sensors: Resistance Temperature Detector sensor, Graphs of Temp vs Time, Voltage vs Time, and Resistance vs Temperature.	
	2.2	Thermocouple and Thermistors sensors	
	2.3	Proximity Sensors: Linear Variable Differential Transducer (LVDT) and Capacitive type sensors	
	2.4	Proximity Sensors: Photoelectric and Ultrasonic sensors	
	Self-Learning Topics: Optical sensor and Sound sensor		
3	**Chemical and Other types**		**05**
	After completing this module, students will be able to: • Understand the working principles of chemical sensors such as gas, smoke, conductivity, and pH sensors. • Explain the operation and applications of sensors like infrared (IR), motion, and pressure sensors. • Describe the working of level, moisture, and humidity sensors. • Identify different types of sensors and their uses in various real-world applications. • Compare different sensors based on their characteristics and functionality.		
	3.1	Chemical Sensors: Gas sensor and Smoke sensor.	
	3.2	Conductivity sensor and pH sensor.	

	3.3	Other Sensors: Infrared (IR) sensor, Motion sensor, and Pressure sensor	
	3.4	Level sensor, Moisture sensor, and Humidity sensor.	
	Self-Learning Topics: Image sensor and GPS sensor		
4	**MEMS and Nano Sensors**		**05**
	After completing this module, students will be able to: • Understand the basics of MEMS technology, its working principles, advantages, and applications. • Explain the use of MEMS-based sensors such as accelerometers, pressure sensors, and gyroscopes in engineering systems. • Understand the concept and working principles of nano sensors and their unique properties. • Describe applications of MEMS and nano sensors in healthcare, environmental monitoring, and industry. • Explain why nano sensors are highly sensitive and fast in response		
	4.1	MEMS Sensors: Introduction to MEMS technology, basic operating concepts, advantages, and applications of MEMS.	
	4.2	Accelerometers, pressure sensors, and gyroscopes in engineering systems.	
	4.3	Nano Sensors: Introduction to nano-sensor concepts, basic working ideas, and application areas.	
	4.4	Applications in healthcare, environment monitoring, and industry, why nano sensors are sensitive and fast.	
	Self-Learning Topics: Chemical sensors, Combustible Gas sensors		
5	**Wireless Sensing Technologies**		**05**
	After completing this module, students will be able to: • Understand the basics of MEMS technology, its working principles, advantages, and applications. • Explain the use of MEMS-based sensors such as accelerometers, pressure sensors, and gyroscopes in engineering systems. • Understand the concept and working principles of nano sensors and their unique properties. • Describe applications of MEMS and nano sensors in healthcare, environmental monitoring, and industry. • Explain why nano sensors are highly sensitive and fast in response.		
	5.1	Introduction to wireless sensing concepts and the role of wireless communication in sensor-based systems.	
	5.2	Overview of Bluetooth technology including basic concepts of piconet and scatternet, link types, and network establishment (device connection).	

	5.3	Short-range wireless technologies for sensor applications including Ultra-Wide Band (UWB) with emphasis on basic architecture, operating principles, and typical applications.	
	5.4	Radio Frequency Identification (RFID) with emphasis on basic architecture, operating principles, and typical applications.	
	Self-Learning Topics: ZigBee - components, architecture, network topologies; Near Field Communication (NFC) – overview and applications.		
6	**Data Acquisition and Signal Processing**		**05**
	After completing this module, students will be able to: • Understand the concept of data acquisition, including analog and digital data, sampling, and system architecture. • Explain the use of data loggers and the effect of noise and interference on sensor data quality. • Understand signal conditioning techniques and the role of circuits like Wheatstone Bridge, Flash ADC, and R–2R DAC. • Describe how sensor data is processed and converted for practical use in measurement systems. • Identify applications of temperature, pressure, and displacement sensors in industrial, automotive, and environmental systems.		
	6.1	Concept of data acquisition in sensor-based systems. Overview of analog and digital data, sampling concept, and block-level architecture of a data acquisition system used in practical applications.	
	6.2	Introduction to data loggers and data recording systems. Basic understanding of noise and interference in measurement systems and their impact on sensor data quality.	
	6.3	Signal conditioning in sensor-based measurement systems. Wheatstone Bridge, Flash ADC, and R–2R DAC explained using functional block diagrams and their role in sensor data acquisition systems.	
	6.4	Applications of temperature, pressure, and displacement sensors in industrial, automotive, and environmental monitoring systems.	
	Self-Learning Topics: Study of sensor data acquisition using microcontroller-based platforms (conceptual level).		

List of Experiments:

Experiment No.	Title of the Experiment
1	**Sensor Characterization and Datasheet Interpretation.** **Objective** To study the characteristics of sensors and learn how to interpret sensor datasheets. It focuses on understanding key parameters like sensitivity, range, and accuracy. **Outcome**

	Students will be able to read and understand sensor datasheets, identify important parameters, and select suitable sensors for different applications.
2	**Measurement of Displacement Using an LVDT.** **Objective** To study the working principle of an LVDT (Linear Variable Differential Transformer) and to measure displacement using it. It also aims to understand the relationship between displacement and output voltage. **Outcome** Students will be able to measure displacement using an LVDT, understand its linear characteristics, and interpret the output signal for different positions accurately.
3	**Measurement and comparison of temperature using RTD and Thermocouple.** **Objective** To measure temperature using an RTD and a thermocouple and to study their working principles. It also aims to compare their performance in terms of accuracy, sensitivity, and response. **Outcome** Students will be able to measure temperature using both RTD and thermocouple, understand their differences, and compare their performance for various applications.
4	**Measurement of Solution Acidity and Alkalinity Using a pH Sensor and Arduino.** **Objective** To measure the acidity and alkalinity of a solution using a pH sensor interfaced with an Arduino. It also aims to understand the working of the pH sensor and the use of Arduino for data acquisition and display. **Outcome** Students will be able to measure pH values using a pH sensor and Arduino, interpret the results to determine acidity or alkalinity, and gain basic knowledge of sensor interfacing and data monitoring.
5	**Non-Contact Distance Measurement Using an Ultrasonic Sensor and Arduino.** **Objective** To measure distance without physical contact using an ultrasonic sensor interfaced with an Arduino. It also aims to understand the working principle of ultrasonic waves and their use in distance measurement. **Outcome** Students will be able to measure distance using an ultrasonic sensor and Arduino, interpret the sensor output, and understand the basics of non-contact measurement and sensor interfacing.
6	**Touch and Proximity Detection Using a Capacitive Sensor and Arduino.** **Objective** To study touch and proximity detection using a capacitive sensor interfaced with an Arduino. It aims to understand the working principle of capacitive sensing and how changes in capacitance are used to detect touch or nearby objects. **Outcome** Students will be able to detect touch and proximity using a capacitive sensor and Arduino, interpret changes in capacitance, and understand the basics of sensor interfacing and its applications.

7	**Measurement of Applied Pressure Using a Pressure Sensor and Arduino.** **Objective** To measure applied pressure using a pressure sensor interfaced with an Arduino. It also aims to understand the working principle of the pressure sensor and how pressure variations are converted into electrical signals. **Outcome** Students will be able to measure pressure using a pressure sensor and Arduino, interpret the sensor output, and understand the basics of pressure measurement and sensor interfacing.
8	**Measurement of Angular Velocity and Orientation Using a Gyroscope and Arduino.** **Objective** To measure angular velocity and orientation using a gyroscope interfaced with an Arduino. It also aims to understand the working principle of the gyroscope and how rotational motion is detected. **Outcome** Students will be able to measure angular velocity and orientation using a gyroscope and Arduino, interpret the sensor data, and understand the basics of motion sensing and sensor interfacing.
9	**Wireless Sensor Data Transmission Using Zigbee Modules and Arduino.** **Objective** To study wireless data transmission using Zigbee modules interfaced with Arduino. It aims to understand the basic concept of wireless communication and how sensor data can be transmitted without physical connections. **Outcome** Students will be able to transmit sensor data wirelessly using Zigbee and Arduino, understand the fundamentals of wireless communication, and apply it in simple sensor network applications.
10	**Wireless Serial Communication Using Bluetooth and Arduino.** **Objective** To study wireless serial communication using Bluetooth interfaced with Arduino. It aims to understand how data is transmitted and received wirelessly between devices using Bluetooth technology. **Outcome** Students will be able to establish Bluetooth communication with Arduino, transmit and receive data wirelessly, and understand the basics of wireless serial communication for sensor applications.
11	**Measurement and Storage of Environmental Temperature Using an Arduino-Based Data Logger.** **Objective** To measure and store environmental temperature using an Arduino-based data logger. It aims to understand temperature sensing, data acquisition, and how data can be recorded over time.

	Outcome Students will be able to measure environmental temperature, store the data using an Arduino data logger, and understand the basics of data logging and monitoring for real-time applications.
12	**Design and Testing of a 4-Bit Flash ADC Using Comparators.** **Objective** To design and test a 4-bit flash ADC using comparators. It aims to understand the working principle of flash analog-to-digital conversion and how analog signals are converted into digital form. **Outcome** Students will be able to design a basic flash ADC, understand the role of comparators in conversion, and interpret digital output corresponding to analog input signals.
13	**Digital-to-Analog Conversion Using a 4-Bit R–2R Ladder DAC.** **Objective** To study and understand the working principle of a 4-bit R–2R ladder Digital-to-Analog Converter (DAC) and to verify the relationship between the applied digital input and the corresponding analog output voltage **Outcome** Students will be able to convert digital signals into analog form using an R–2R ladder DAC, understand its working principle, and Analyse the relationship between digital input and analog output voltage.
14	**Measurement of Unknown Resistance Using Wheatstone Bridge.** **Objective** To measure an unknown resistance using a Wheatstone bridge. It aims to understand the working principle of the bridge circuit and the condition for balance. **Outcome** Students will be able to determine unknown resistance accurately using a Wheatstone bridge, understand the balance condition, and Analyse its application in measurement systems.
15	**Sensor-Based Mini Project: Integration of Sensor, Data Acquisition, and Communication.** **Objective** To design and implement a sensor-based mini project by integrating a sensor, data acquisition system, and communication module. It aims to understand how different components work together to collect, process, and transmit data. **Outcome** Students will be able to develop a basic sensor-based system, integrate sensing, data acquisition, and communication, and apply their knowledge to real-time monitoring and control applications.

Text Books:

1. D.V.S. Murthy, “Transducers and Instrumentation”, PHI Learning, 2nd Edition, 2013.
2. D. Patranabis – Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003
3. Antti V. Raisanen, Arto Lehto, “Radio Engineering for Wireless Communication and Sensor Applications”, Artech House mobile communications series, USA, 2003.

4. Sensors and Signal Conditioning, Ramon Pallas Areny, John G. Webster, 2nd edition, John Wiley and Sons, 2000.
5. Vijay K. Garg, "Wireless Communication and Networking", Morgan -Kaufmann Series in Networking, Elsevier, 2010.

Reference Books:

1. An Introduction to Microelectromechanical Systems Engineering, Nadim Maluf, Kirt Williams, Artech House, 2004.
2. Micro Electro Mechanical System Design, James J. Allen, Taylor and Francis, 2005
3. Nathan Ida, "Sensors, Actuators and their Interfaces: A Multidisciplinary Introduction", Second Edition, IET Control, Robotics and Sensors Series 127, 2020.

Useful Links:

1. https://www.ni.com/en-in/innovations/white-papers/06/sensor-fundamentals.html
2. https://www.youtube.com/watch?v=WwQSfk6SSSo
3. https://www.youtube.com/watch?v=MGC2LWeNKSI
4. https://www.youtube.com/watch?v=vjhp0zTXEsc

Assessment Methodology:

Type of Assessment	Assessment Tools
Continuous Assessment (CA) **(20 Marks)**	Certification: NPTEL (20 Marks) (Approved by instructor) **OR** Any 02 Pedagogies (10 marks each) • MCQ /Class Test • Case study/Assignment • GATE based Assignment • Certification Udemy/Coursera (Approved by instructor) • Open Book Test • Working model / Simulation of a course-based concept.
Mid Semester Examination (MSE) **(30 Marks)**	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • For each question, A and B should be based on the same CO. • MSE should be based on 50% syllabus. • Time: 90 minutes (1 hour 30 minutes) • Total Marks: 30

End Semester Examination (ESE) **(50 Marks)**	Question Paper Pattern is as follows: All Questions are compulsory. • Q1 A or B - 10 marks • Q2 A or B - 10 marks • Q3 A or B - 10 marks • Q4 A or B - 10 marks • Q5 A or B - 10 marks • For each question, A and B should be based on the same CO. • ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE. • Time: 120 minutes (02 hours) • Total Marks: 50
Term Work (25 Marks)	• Active Participation (Lab) = 05 marks • Laboratory Report = 10 marks • Laboratory performance = 10 marks Based on the performance and satisfactory completion of assigned laboratory work.

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
		L	P	T	L	P	T	Total
		-	2	-	-	1	-	1
25ME4CEP01	Community Engagement Project	Examination Scheme						
			CA	MSE	ESE	TW	OR	PR	Total
		Theory	-	-	-	-	-	-	-
		Lab / Tut	-	-	-	25	25	-	50
		Total	50						

Course Overview:

The Community Engagement Project (CEP) aims to provide students with hands-on experiential learning by applying mechanical engineering knowledge to address real-world problems faced by local communities.

Students will identify, design, and implement small-scale engineering solutions based on concepts learned in lower and current semesters. The course emphasizes social responsibility, sustainability, teamwork, ethical engineering practice, and problem-solving skills.

Course Outcomes	After successful completion of this course the students will be able to	
	CO1	**Recall** basic mechanical engineering principles relevant to community-based problems. **(Remembering)**
	CO2	**Explain** community needs and relate them to appropriate mechanical engineering concepts. **(Understanding)**
	CO3	**Apply** engineering knowledge and tools to develop practical solutions for community issues. **(Applying)**
	CO4	**Analyse** technical, economic, and environmental aspects of proposed community solutions. **(Analysing)**
	CO5	**Evaluate** the effectiveness, feasibility, and sustainability of the implemented solutions. **(Evaluating)**
	CO6	**Design** and implement a community-focused mini-project addressing real-world problems. **(Creating)**

Course Content:

Unit 1: Problem Identification and Need Assessment:

- Interaction with local community / NGOs / institutions
- Problem definition and scope
- Data collection methods (survey, observation, interviews)
- Feasibility analysis
- Mapping problems to mechanical engineering domains

Unit 2: Project Planning and Design:

- Selection of suitable project topics
- Application of engineering fundamentals
- Concept generation and design methodology

- Use of CAD tools for design (if applicable)
- Material selection and cost estimation
- Sustainability and energy efficiency considerations

Unit 3: Implementation and Development:

- Fabrication / simulation / modeling of the solution
- Use of workshop, laboratory, or field resources
- Testing and validation of the system
- Troubleshooting and refinement
- Documentation of design and implementation

Unit 4: Evaluation, Impact Assessment, and Reporting:

- Performance evaluation of the solution
- Social, environmental, and economic impact analysis
- Limitations and scope for improvement
- Project report preparation
- Oral presentation and community feedback

Teaching–Learning Methods:

- Field visits and community interaction
- Faculty mentoring and reviews
- Team-based project work
- Hands-on fabrication / simulation
- Presentations and reflective learning

Assessment Criteria:

Assessment Tool	Marks Distribution
Term Work (25 Marks)	• Active Participation = 05 marks • Project Report = 10 marks • Progress presentations (min 02) & demonstration = 10 marks
Oral (25 Marks)	Oral examination will be based on the presentation slides or demonstrating models by the group

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
25IL4EEM01	Entrepreneurship Essentials	L	P	T	L	P	T	Total
		2	-	-	2	-	-	2
		Examination Scheme						
			CA	MSE	ESE	TW	OR	PR	Total
		Theory	50	-	-	-	-	-	50
		Lab/Tut	-	-	-	-	-	-	-
		Total	50						

Pre-Requisite Courses:	Basic knowledge of management functions, leadership, and organizational behaviour.
	Ability to interpret simple financial data, manage budgets, and understand basic accounting principles & Proficiency in using digital tools line Excel.
	Communication, presentation, and interpersonal skills & critical thinking, creativity, problem-solving skills, and an interest in innovation and real-world business scenarios.

Course and Module Overview:

The course aims to develop an understanding of entrepreneurship and its role in economic development. It focuses on entrepreneurial behaviour, theories, types of entrepreneurs, business idea generation, project planning, venture development, and the impact of external environments including government policies and global challenges. The course also encourages self-learning through case studies and real-world entrepreneurial practices in India.

Module 1: Foundations of Entrepreneurship Development

This module introduces the fundamentals of entrepreneurship and its significance in economic growth. It covers the concept and need for entrepreneurship development, definitions of entrepreneurship and entrepreneurs, and key characteristics required for entrepreneurial success. Case studies of entrepreneurs from small towns in India provide practical insights into grassroots entrepreneurship.

Module 2: Theories of Entrepreneurship & External Influences

This module explores major entrepreneurship theories proposed by Schumpeter, McClelland, Leibenstein, Knight, and Hagen. It examines how sociocultural, political, economic, and personal factors influence entrepreneurial development. The role of entrepreneurial culture in fostering innovation and enterprise creation is emphasized.

Module 3: Types & Classification of Entrepreneurs

This module focuses on different types of entrepreneurs, including intrapreneurs, women entrepreneurs, and social entrepreneurs. It discusses challenges faced by women entrepreneurs and the role of Self-Help Groups (SHGs). The module also highlights social entrepreneurship in India and importance of NGOs in social responsibility and development.

Module 4: Entrepreneur Project Development & Business Plan

This module emphasizes innovation, creativity, and idea generation. Students learn about identifying business opportunities through environmental scanning and change. The entrepreneurship development cycle and SWOT analysis help learners understand how to convert ideas into viable entrepreneurial ventures.

Module 5: Business Plan

This module covers the structure and objectives of a business plan. It includes market analysis, feasibility analysis, and planning for marketing, finance, organization, and management. Case studies on mergers, acquisitions, and takeovers of start-ups provide exposure to strategic business growth and expansion.

Module 6: Venture Development

This module explains the steps involved in starting a venture, institutional support systems, venture funding, and sources of finance. It discusses legal requirements, marketing channels, and challenges in venture setup. The module also Analyses the impact of COVID-19 on MSMEs in India and government relief measures under the Atma Nirbhar Bharat Abhiyan.

Summary:

The course offers a comprehensive blend of theory, practical insights, and self-learning components to equip students with entrepreneurial knowledge and skills. It prepares learners to identify opportunities, develop business plans, and understand the challenges and support mechanisms for successful entrepreneurial ventures.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Recall** fundamental concepts of entrepreneurship, identify types and characteristics of entrepreneurs, and list major entrepreneurship theories and government support initiatives in India. **(Remembering)**
	CO2	**Explain** the role of entrepreneurship in economic and social development and describe the influence of theories, innovation, creativity, and external environmental factors on entrepreneurial growth. **(Understanding)**
	CO3	**Apply** idea generation techniques, SWOT and feasibility analysis, and knowledge of finance, institutional support, and legal requirements to plan entrepreneurial ventures. **(Applying)**
	CO4	**Analyse** market conditions, customer needs, challenges faced by women entrepreneurs, MSMEs and social entrepreneurs, and the impact of policies and external factors on ventures. **(Analysing)**
	CO5	**Evaluate** business plans, government support schemes, and entrepreneurial case studies to assess venture viability and development outcomes. **(Evaluating)**
	CO6	**Design** innovative business ideas, develop comprehensive business plans, and create sustainable entrepreneurial solutions to address socio-economic and environmental challenges. **(Creating)**

Syllabus:

Module No.	Unit No.	Topics	Hours
1		**Foundations of Entrepreneurship Development**	05
		Learning Outcomes: • Explain the concept and need for entrepreneurship development. • Identify the characteristics and qualities of successful entrepreneurs. • Describe the importance of entrepreneurship in economic growth.	
	1.1	Concept and need of entrepreneurship development.	
	1.2	Definition of entrepreneur, entrepreneurship importance and significance of growth of entrepreneurial activities.	
	1.3	Characteristics and qualities of an entrepreneur.	
		Self-Learning Topics: Case studies of entrepreneurs from small towns in India.	
2		**Theories of Entrepreneurship & External Influences on Entrepreneurship Development**	05
		Learning Outcomes: • Explain major theories of entrepreneurship proposed by Schumpeter, McClelland, Leibenstein, Knight, and Hagen. • Examine the influence of sociocultural, political, economic, and personal factors on entrepreneurship development. • Assess the role of entrepreneurial culture in promoting entrepreneurial activities.	
	2.1	Theories by: Schumpeter, McClelland, Leibenstein, Knight & Hagen.	
	2.2	External influences: Sociocultural, Political, Economic, Personal.	
	2.3	Role of entrepreneurial culture in entrepreneurship development.	
		Self-Learning Topics: Factors affecting entrepreneurship development.	
3		**Types & Classification of Entrepreneurs**	05
		Learning Outcomes: • Distinguish between different types of entrepreneurs including intrapreneurs, women entrepreneurs, and social entrepreneurs. • Analyse the challenges faced by women entrepreneurs and the role of Self-Help Groups (SHGs). • Explain the importance of social entrepreneurship and the role of NGOs in social responsibility.	
	3.1	Intrapreneur: Types & classification, concept & development of intrapreneurship.	
	3.2	Women Entrepreneur: concept, development and problems faced by women entrepreneurs, development of women entrepreneurs with reference to the Self-Help Group (SHG).	
	3.3	Social Entrepreneurship: concept, development of social entrepreneurship in India. Importance and Social responsibility of NGOs.	

	Self-Learning Topics: Entrepreneurial Development Program (EDP): concept & factors influencing EDP.		
4	**Entrepreneur Project Development & Business Plan**		**05**
	Learning Outcomes: • Differentiate between innovation, invention, and creativity in the context of entrepreneurship. • Apply idea generation techniques and environmental scanning to identify business opportunities. • Explain the entrepreneurship development cycle and use SWOT analysis for project evaluation.		
	4.1	Innovation, Invention, Creativity, Business idea, opportunities through change.	
	4.2	Idea generation: Sources, development of product or idea, environmental scanning.	
	4.3	Creating entrepreneurial ventures: Entrepreneurship development cycle.	
	Self-Learning Topics: SWOT analysis.		
5	**Business Plan**		**05**
	Learning Outcomes: • Identify the elements and objectives of a business plan. • Analyse market and feasibility aspects of entrepreneurial ventures. • Evaluate marketing, financial, organizational, and ownership structures of business plans.		
	5.1	Elements of business plan, objectives of business plan.	
	5.2	Market analysis and feasibility analysis.	
	5.3	Marketing, Finance, Organization & Management, Ownership.	
	Self-Learning Topics: Case study on takeover, mergers and acquisitions of start-ups in India & global.		
6	**Venture Development**		
	Learning Outcomes: • Identify legal requirements and marketing channels for establishing a new business unit. • Analyse the impact of COVID-19 and government policy responses on MSMEs in India.		
	6.1	Steps involved in starting a venture, institutional support to an entrepreneur, venture funding, requirements of capital (Fixed and working), sources of finance, problem of venture set-up and prospects.	**05**
	6.2	Legal requirements for establishment of a new unit, Marketing: methods and channel.	
	6.3	Impact of COVID-19 on micro, small and medium enterprises in India, pandemic shock of COVID-19 and policy response.	

	Self-Learning Topics: Self Learning topics: Government financing support programme for businesses Covid 19, relief measures to small businesses in India (Atma Nirbhar Bharat Abhiyan).	
		Total **30**

Text Books:

1. Business Planning and Entrepreneurial Management by Michael Vaz & Meeta Seta, Publication: Manan Prakashan (2023 June, 7th edition), ISBN: 978-93-5750-083-8.
2. Business Planning and Entrepreneurial Management by Dr. Rinkesh Chheda & Ms. Falguni Mathews, Publication: Himalaya Publishing House (2019), ISBN: 978-93-5367-613-1.
3. Business Planning and Entrepreneurial Management by Veena Prasad & Deepali Kamle, Publication: Himalaya Publishing House (2018), ISBN: 978-93-5202-078-2.

Reference Books:

1. Corporate Entrepreneurship and Innovation by Paul Burns, Publication: Bloomsbury Academic (2025 June, 5th edition), ISBN (Paperback): 9781350384071, ISBN (eBook EPUB/MOBI): 9781350384095, ISBN (eBook PDF): 9781350384101.
2. Dynamics of Entrepreneurial Development & Management by Dr. Desai Vasant, Publication: Himalaya Publishing House (2019, 6th edition), ISBN: 978-93-5750-083-8.
3. Online Book, Institute of Distance & Open Learning (IDOL) University of Mumbai, https://old.mu.ac.in/wp-content/uploads/2014/04/Management-PAPER-V-ENTREPRENEURSHIP-Management-final-book.pdf
4. Entrepreneurship in the New Millennium by Donald F. Kuratko & Richard M. Hodgetts, Publication: Cengage learning South-Western Cengage Learning India (2008 Jan), ISBN: 978-8131505618 (typical Indian edition).
5. Business Planning: A Guide to Business Start-Up by Butler David, Publication: Taylor & Francis Ltd / Butterworth-Heinemann (2000). ISBN-13: 978-0-7506-4706-9

Useful Links:

1. https://www.ahlawatassociates.com/blog/legal-requirements-for-starting-a-business-in-india
2. https://smallbusiness.chron.com/business-plans-fail-projects-fail-10901.html
3. https://rcic.in/acquisitions/mergers-acquisitions-case-studies-india/
4. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1049

Assessment Methodology:

Assessment Tool	Marks Distribution
Continuous Assessment (CA) (50 Marks)	• Certification NPTEL: 20 Marks (Approved by instructor) ***And / Or*** **Any 05 Pedagogies (10 marks each)** • Assignment • Case Study Analysis (individual / group) • Certification: Udemy / Coursera (Approved by instructor) • Class Test • Discussion & Reflective Learning

	• Idea Generation & Opportunity Identification • MCQ Test • Open Book Test • Project Report: Venture Development Plan • Simulation of a course-based concept.

The Bombay Salesian Society's

Don Bosco Institute of Technology, Mumbai

(An Autonomous Institute affiliated to University of Mumbai)

CURRICULUM STRUCTURE
LIBERAL LEARNING COURSES (LLC)

(As Per NEP 2020)

Scheme: DB25-V1

(w.e.f. AY 2025-2026)

Preface

Don Bosco Institute of Technology (DBIT), Kurla, Mumbai, presents the Liberal Learning Courses (LLC) as part of its academic curriculum under the autonomous framework aligned with the National Education Policy (NEP) 2020. The policy emphasizes holistic and multidisciplinary education that enables students to explore learning beyond the boundaries of their primary discipline. In line with this educational vision, Liberal Learning Courses form an important component of the undergraduate curriculum, providing opportunities for students to engage with diverse areas of knowledge and creativity alongside their engineering studies.

Engineering education today requires more than technical competence alone. It demands creativity, communication skills, adaptability, emotional intelligence, and the ability to appreciate perspectives beyond one's core discipline. Liberal Learning Courses aim to address this broader educational need by encouraging students to engage with creative, cultural, and aesthetic domains that enrich their intellectual and personal development.

The LLC framework provides students with opportunities to explore various forms of artistic expression, cultural practices, and creative activities. Such exposure enables learners to develop imagination, aesthetic sensibility, confidence, and collaborative skills. Participation in these courses encourages students to step beyond conventional classroom learning and discover new interests and abilities that contribute to their overall personality development.

The courses emphasize experiential learning through participative and activity-based approaches. Students learn through hands-on engagement, collaborative practice, creative projects, demonstrations, and peer interaction. These learning experiences foster teamwork, communication, leadership, and self-expression while cultivating respect for diverse cultural traditions and forms of artistic creativity.

In addition to promoting creativity and cultural awareness, Liberal Learning Courses contribute to students' emotional well-being and balance during their academic journey. Engaging in creative pursuits provides an avenue for expression and reflection, helping students develop resilience and maintain a healthy perspective amidst the demands of rigorous technical education.

The following pages present the syllabi and structure of the Liberal Learning Courses offered as part of the academic curriculum at DBIT. This document provides an overview of the course objectives, learning outcomes, and learning activities associated with these courses. It serves as a reference for students and faculty members to understand the scope and implementation of Liberal Learning Courses within the curriculum.

The contents of this document may be reviewed and updated periodically by the Academic Council and other academic bodies of the institute in accordance with evolving educational guidelines and institutional priorities. Feedback from students and faculty will continue to play an important role in strengthening the effectiveness and relevance of these courses.

Through the Liberal Learning Courses, DBIT aims to contribute to the development of engineers who are not only technically competent but also creative, culturally aware, confident, and socially responsible individuals capable of contributing meaningfully to society.

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
		L	P	T	L	P	T	Total
25IL4LLC01	Rhythm & Motion: A Journey Through Dance	-	2	-	-	1	-	1

Assessment Methods				Total Marks
Mentor Assessment	Course Attendance	Cultural Festival Participation	Technical Festival Participation	
30	5	10	5	50

Course Objectives:

- To introduce students to the basic elements and techniques of Indian & contemporary dance forms.
- To foster collaborative learning through peer-led instruction and group choreography.
- To enhance students' body rhythm, coordination, expression, and stage confidence through regular practice and performance.
- To provide a creative platform for self-expression, teamwork, and appreciation of cultural diversity through dance.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Identify** and **describe** the basic elements and cultural context of selected Indian and contemporary dance forms. **(Remembering)**
	CO2	**Perform** foundational movements and rhythm patterns of at least one dance style with correct posture and coordination. **(Understanding)**
	CO3	**Design** and **choreograph** a short group dance performance using acquired skills and creativity. **(Applying)**
	CO4	**Engage in** effective peer collaboration, contributing ideas, giving and receiving feedback, and working towards a shared goal. **(Analysing)**
	CO5	**Document** the learning process, including practice routines, group reflections, and performance insights in a learning log. **(Evaluating)**
	CO6	**Demonstrate** confidence, stage presence, and expressive ability through a final group performance. **(Creating)**

Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours
1	Foundations of Dance and Body Awareness	Understanding the role of dance in culture, Importance of body posture, balance, and rhythm, Warm-up techniques and movement preparation	02
2	Introduction to Indian and Contemporary Dance Forms	Basic steps and hand gestures (mudras) from Indian semi-classical styles Folk and contemporary forms (Garba, Bhangra, Bollywood freestyle, etc.) Practice and demonstration under teacher guidance	02

3	Peer Group Formation and Planning for Choreography	Formation of student groups, Selection of dance form(s) for performance, Setting group goals and distributing roles (lead, scribe, music, etc.)	**02**
4	Choreography, Practice & Feedback	Step-by-step choreography building through peer learning, Weekly practice and feedback loops, Focus on synchronization, formations, and transitions	**12**
5	Performance Rehearsal and Expression Techniques	Integration of expression (bhava), facial movements, and stage presence, Full performance rehearsals, Guidance and critiques from teacher-in-charge and peers	**08**
6	Final Performance and Reflective Practice	Group performances (3–5 minutes per group), Reflective presentations on the learning journey and group collaboration, Submission of group logbooks and performance details	**04**

Suggested activities for Rhythm & Motion: A Journey Through Dance

1. Celebration of Culture
   - Fusion of Indian folk dances from different states
   - Depiction of festivals through dance (e.g., Holi, Navratri, Onam)
2. Unity in Diversity
   - Blend of classical and contemporary forms (e.g., Bharatanatyam + Hip-hop)
   - Represent different states/languages/cultures in a seamless performance
3. Seasons of Life
   - Portray different stages: childhood, youth, maturity
   - Express through changing moods and music tempos
4. Nature and Elements
   - Themes like rain, sun, wind, or forest
   - Use movement to express fluidity, calmness, or energy
5. Women Empowerment / Social Change
   - Portray strength, transformation, or voice of change through expressive dance
   - Depict social messages: education, freedom, equality
6. Friendship and Togetherness
   - Dance to illustrate bonding, celebration, or emotional connection
   - Use duets and group motifs creatively
7. Bollywood through the Decades
   - Mix iconic dance styles and songs from 70s to present
   - Highlight evolution of movement and costume
8. Patriotic Spirit / India through Dance
   - Depict freedom movement, unity, or symbols of national pride
   - Use flag colours, folk styles, or instrumental music
9. Time Travel in Dance
   - Present past, present, and future through costumes, styles, and transitions
   - Explore how dance evolves across time
10. Storytelling Without Words
    - Select a theme like a journey, dream, or emotional arc
    - Tell a story only through expression, posture, and movement

Assessment Methodology:

Assessment Tool	Marks Distribution
Continuous Assessment (CA) (50 Marks)	• Active Participation = 5 marks • Assessment of the Activity carried out by student = 25 marks • Cultural Event Participation = 10 marks • Technical Event Participation = 10 marks

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
		L	P	T	L	P	T	Total
25IL4LLC02	Introduction to Dramatics: Exploring Theatre Arts	-	2	-	-	1	-	1

Assessment Methods				Total Marks
Mentor Assessment	Course Attendance	Cultural Festival Participation	Technical Festival Participation	
30	5	10	5	50

Course Objectives:

- To introduce students to the fundamental elements of drama and theatre performance.
- To build confidence, voice modulation, and body language through theatrical expression.
- To encourage collaborative learning through peer-group script development and dramatization.
- To provide a platform for creativity, empathy, and reflective thinking through stage performance.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Identify** key elements of theatre including character, dialogue, movement, and space. **(Remembering)**
	CO2	**Demonstrate** basic acting techniques such as voice projection, improvisation, and body language. **(Understanding)**
	CO3	**Collaboratively develop** and rehearse a short play or dramatic piece. **(Applying)**
	CO4	**Reflect** on dramatic themes, character motivation, and audience engagement. **(Analysing)**
	CO5	**Engage** in peer learning by giving and receiving feedback during rehearsals. **(Evaluating)**
	CO6	**Perform** a scripted or devised scene on stage as part of a team. **(Creating)**

Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours
1	Stagecraft and Self-Awareness	Theatre basics, warm-ups, body/voice awareness	02
2	Acting Essentials and Theatre Forms	Voice projection, improvisation, intro to theatre styles	04
3	Script to Stage: Forming Dramatic Teams	Peer group formation, script selection/creation	02

4	Rehearse, Reflect, Repeat	Blocking, dialogues, emotions, peer feedback	**12**
5	Character, Costume, and Confidence	Character work, stage elements, rehearsal polishing	**06**
6	Curtains Up: Performance and Reflection	Final performance + reflective presentations	**04**

Suggested Themes/Genres for Performance

Students may choose or create scenes around:

- Social issues (e.g., gender, education, environment)
- Adapted mythology or folk tales
- Short comedies or farces
- Emotional/dramatic scenes (1-act plays, monologues)

Assessment Methodology:

Assessment Tool	Marks Distribution
Continuous Assessment (CA) (50 Marks)	• Active Participation = 5 marks • Assessment of the Activity carried out by student = 25 marks • Cultural Event Participation = 10 marks • Technical Event Participation = 10 marks

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
		L	P	T	L	P	T	Total
25IL4LLC03	Swaranjali: Introduction to Vocal Music (Singing)	-	2	-	-	1	-	1

Assessment Methods				Total Marks
Mentor Assessment	Course Attendance	Cultural Festival Participation	Technical Festival Participation	
30	5	10	5	50

Course Objectives:

- To introduce students to the fundamental elements of drama and theatre performance.
- To build confidence, voice modulation, and body language through theatrical expression.
- To encourage collaborative learning through peer-group script development and dramatization.
- To provide a platform for creativity, empathy, and reflective thinking through stage performance.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Identify** and **explain** basic elements of Indian vocal music such as swaras, taal, and raag. **(Remembering)**
	CO2	**Demonstrate** swara practice, pitch accuracy, and basic vocal exercises. **(Understanding)**
	CO3	Collaboratively **learn** and **rehearse** selected compositions in peer groups. **(Applying)**
	CO4	**Reflect** on personal growth, voice improvement, and peer collaboration. **(Analysing)**
	CO5	**Participate in** a group musical presentation with proper rhythm and expression. **(Evaluating)**
	CO6	**Compose** or creatively **adapt** a short group performance based on learned concepts. **(Creating)**

Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours
1	Basics of Indian Vocal Music	Sound, pitch (swar), rhythm (taal), laya, introduction to saptak (scale), shruti, swaras.	02
2	Voice Culture & Alankars	Breathing, pitch practice, alankars (note patterns), vocal warm-ups, intro to raag-based practice.	04
3	Raag & Taal Practice	Simple raags like Bhupali/Yaman, Teen Taal, Dadra; clapping cycles, rhythm coordination.	02

4	Song Practice in Peer Groups	Group division; learning bhajans, folk songs, patriotic songs, or classical compositions.	**12**
5	Expression, Bhava & Presentation Skills	Understanding meaning, emotion (bhava), and improving stage confidence, posture, and projection.	**06**
6	Group Performance & Reflection	Final group performance (3–5 min); sharing experiences; submission of logbooks/journals.	**04**

Suggested list of activities for Swaranjali: Introduction to Vocal Music (Singing)

- **"Raag Rang: Colors of Melody":** A performance based on a single or combination of simple raags (e.g., Bhupali, Yaman), showcasing how mood and emotion can be conveyed through melody.
- **"Voices of Unity":** Group performance using patriotic or unity-based songs (e.g., Vande Mataram, Desh Mera Rangeela) to represent harmony and national spirit.
- **"Bhakti & Bhava":** Present devotional or bhajan-based compositions that emphasize expression (bhava), simplicity, and spiritual connection.
- **"Folk Fusion":** Blend two or more regional Indian folk songs (e.g., Rajasthani, Marathi, Bengali) with a shared rhythm or melody line to showcase cultural diversity.
- **"Seasons in Song":** A musical expression of seasons (spring, monsoon, winter) through selected compositions or original adaptations, using changes in tempo and pitch to reflect mood.
- **"Swar Se Shanti" (Peace Through Voice):** Soothing compositions or raag-based presentations that focus on calmness, wellness, and introspection—ideal for a soft, expressive performance.
- **"Story Through Song":** A mini musical narrative told through 2–3 linked compositions expressing a journey or message (e.g., struggle to peace, darkness to light).

Assessment Methodology:

Assessment Tool	Marks Distribution
Continuous Assessment (CA) (50 Marks)	• Active Participation = 5 marks • Assessment of the Activity carried out by student = 25 marks • Cultural Event Participation = 10 marks • Technical Event Participation = 10 marks

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
		L	P	T	L	P	T	Total
25IL4LLC04	Strings & Strokes: An Introduction to Musical Instruments	-	2	-	-	1	-	1

Assessment Methods				Total Marks
Mentor Assessment	Course Attendance	Cultural Festival Participation	Technical Festival Participation	
30	5	10	5	50

Course Objectives:

- To introduce students to the fundamentals of rhythm, melody, and musical notation.
- To provide hands-on learning in playing selected basic musical instruments.
- To foster collaborative learning through peer practice, ensemble formation, and group performance.
- To develop listening skills, coordination, and appreciation for different music cultures.
- To build self-confidence through stage performance and group expression.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Identify** the basic components, history, and playing techniques of selected musical instruments. **(Remembering)**
	CO2	**Demonstrate** foundational skills in playing at least one melodic or rhythmic instrument. **(Understanding)**
	CO3	**Interpret** simple musical patterns and rhythms using basic notation or auditory learning. **(Applying)**
	CO4	Collaboratively **compose** or **practice** a short ensemble performance in a peer-learning group. **(Analysing)**
	CO5	**Reflect** on their own learning journey and peer group experiences through documentation. **(Evaluating)**
	CO6	**Participate** confidently in a group musical performance. **(Creating)**

Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours
1	Musical Foundations: Sound, Rhythm & Melody	Introduction to sound, rhythm, pitch; clapping exercises, ear training	02
2	Instrument Basics: Form, Function & Playing Technique	Introduction to Instruments: tabla, djembe, harmonium, keyboard, flute, ukulele, etc. (Instruments will vary based on student's choice)	04
3	Group Formation & Instrument Selection	Peer grouping, instrument choice, practice plan	02

4	Practice, Play & Peer Learning	Guided group practice, simple compositions, internal peer reviews	**12**
5	Building an Ensemble: Sound & Synchrony	Coordination of parts, ensemble play, polishing performance	**06**
6	The Final Note: Performance & Reflection	Final group performance, presentation, peer feedback	**04**

Suggested Performance Themes

- "Rhythms of India" - A medley combining classical (e.g., tabla, harmonium), folk, or regional musical patterns from different parts of India.
- "Sounds Without Borders" - A fusion of instruments or rhythms inspired by global cultures—e.g., African djembe + Indian flute + Western ukulele.
- "Nature's Symphony" - Use instruments and sounds to depict elements of nature—rain, breeze, thunder, sunrise, birdsong.
- "Music & Mood" - A performance that explores different emotions—joy, calm, sadness, excitement—through changes in melody, rhythm, and tempo.
- "India in Harmony" - Celebrate unity in diversity through a piece that includes instruments and musical motifs representing India's multilingual, multicultural richness.
- "Cinematic Soundtrack" - Create a simple instrumental piece based on popular Indian or world cinema themes (e.g., folk version of a Bollywood classic or instrumental theme from a famous film).
- "Soulful Strings: Music for Peace" - A meditative or soft instrumental piece designed to calm, soothe, and create emotional connection.
- "Journey Through Time" - Showcase evolution in music—from folk to contemporary—by starting with traditional sounds and gradually shifting to modern ones.

Assessment Methodology:

Assessment Tool	Marks Distribution
Continuous Assessment (CA) (50 Marks)	• Active Participation = 5 marks • Assessment of the Activity carried out by student = 25 marks • Cultural Event Participation = 10 marks • Technical Event Participation = 10 marks

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
		L	P	T	L	P	T	Total
25IL4LLC05	Traditional Rangolis of India	-	2	-	-	1	-	1

Assessment Methods				Total Marks
Mentor Assessment	Course Attendance	Cultural Festival Participation	Technical Festival Participation	
30	5	10	5	50

Course Objectives:

- To introduce students to the traditional art of Kolams and Rangolis from Tamil Nadu and other states of India.
- To understand the cultural, spiritual, and social significance of Rangolis.
- To develop skills in creating various types of Rangoli patterns.
- To appreciate the geometrical symmetry and aesthetic value of Rangoli designs.
- To encourage creativity and imagination in designing new Rangoli patterns.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Recall** different types of Rangolis and the materials used to create them. **(Remembering)**
	CO2	**Explain** the traditions and cultural significance behind Rangolis and Kolams. **(Understanding)**
	CO3	**Apply** basic Rangoli techniques to create structured and larger designs. **(Applying)**
	CO4	**Analyse** the geometric patterns and symmetries present in various Rangoli forms. **(Analysing)**
	CO5	**Evaluate** different Rangoli styles based on creativity, symmetry, and theme relevance. **(Evaluating)**
	CO6	**Create** original Rangoli designs integrating traditional elements with innovative themes. **(Creating)**

Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours
1	Introduction to Kolams	What are Kolams or Rangolis and their traditions, Kolams during festivals and religious functions, Kolams inside the puja room (Hridaya Kamalam, Aishwaryam), Health benefits of early morning Rangoli during Margasheersha.	04
2	Dot-Based Kolams	Basic square Kolams (3 dots to 10 dots), Dot Kolams with straight dots, Dot Kolams with interspread dots, Practice and creation of self-designed dot Kolam pattern	06

3	Sikku Kolam (Twisted Loops)	Basic Sikku Kolams (3 dots to 7 dots), Sikku Kolams with straight dots, Sikku Kolams with interspread dots, Creation of self-designed Sikku Kolam pattern.	**06**
4	Kambi Kolam (Line Patterns)	Basic Kambi Kolam with 2–3 layers, Kambi Kolam with 4–6 layers, Kambi Kolam with more than 6 layers, Creation of self-designed Kambi Kolam pattern.	**04**
5	Flower Rangoli and Thematic Designs	Basic Rangoli patterns with flowers, Rangoli with themes, Rangoli during festivals, Creation of theme-based Rangoli design.	**03**
6	Kolams and Society	Community Kolams, Kolams during marriages, Kolams during Margasheersha month, Social and cultural relevance of Rangolis.	**03**

Suggested Activities for Traditional Rangolis of India Course

- Create Hridaya Kamalam or Aishwaryam Kolam.
- Design a 5-dot to 5-dot Kolam pattern.
- Create a Sikku Kolam using 7 dots.
- Design a Kambi Kolam with 6 layers.
- Create a sustainability-themed Rangoli.
- Design decorative border Kolams for community display.

Assessment Methodology:

Assessment Tool	Marks Distribution
Continuous Assessment (CA) (50 Marks)	• Active Participation = 5 marks • Assessment of the Activity carried out by student = 25 marks • Cultural Event Participation = 10 marks • Technical Event Participation = 10 marks

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
		L	P	T	L	P	T	Total
25IL4LLC05	Foundations of Photography	-	2	-	-	1	-	1

Assessment Methods				Total Marks
Mentor Assessment	Course Attendance	Cultural Festival Participation	Technical Festival Participation	
30	5	10	5	50

Course Objectives:

- To introduce students to the evolution and foundational concepts of digital photography.
- To develop proficiency in camera operations, exposure settings, and essential photographic gear.
- To enable students to understand and apply exposure principles using the exposure triangle (ISO, aperture, shutter speed).
- To provide hands-on experience in post-processing using Photoshop and Lightroom.
- To cultivate technical skills and creative vision in digital image-making.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Recall** the evolution of photography, types of cameras, photographic styles, and basic digital photography concepts. **(Remembering)**
	CO2	**Explain** camera components, lens types, sensors, and exposure settings used in photography. **(Understanding)**
	CO3	**Apply** composition rules and exposure triangle principles to capture well-composed photographs. **(Applying)**
	CO4	**Analyze** lighting conditions, exposure settings, and subject positioning to make informed shooting decisions. **(Analysing)**
	CO5	**Evaluate** and **refine** photographs using Photoshop and Lightroom tools. **(Evaluating)**
	CO6	**Create** compelling photo compositions and digital stories integrating technical skills and creativity. **(Creating)**

Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours
1	Introduction to Digital Photography	History of photography, Photographic styles, Rule of thirds, Basic DSLR settings, Necessary gears, Sensors and mirrors in cameras, Full frame vs crop sensor.	05
2	Working with Your Camera	Commanding the mode dial, Lens structure and types, Prime lenses, cleaning lenses, Introduction to shutter speed, aperture and ISO, White balance, Introduction to light.	05

3	Balancing Light: The Exposure Triangle	Detailed understanding of shutter speed, ISO, and aperture, Practical application of exposure triangle, Managing lighting conditions for better image capture.	**05**
4	Photoshop – Interface and Post-Production	Opening files in Photoshop, Understanding the Photoshop interface, Basic post-production techniques, Color correction and exposure adjustments.	**05**
5	Photoshop – Tools and Editing Techniques	Different tools used in Photoshop, Image enhancement techniques, Cropping, retouching, layering basics.	**05**
6	Lightroom – Editing and Enhancement	Lightroom interface overview, Using filters to enhance photographs, Basic workflow for organizing and refining images.	**05**

Suggested Activities for Photography Course

- Rule of Thirds Challenge – Take 3 photos applying the rule of thirds; peer review and discuss composition.
- Photography challenge - Take photos in different types of photography explained.
- Sensor Showdown – Comparative presentation or discussion on full-frame vs. crop sensor
- DSLR Demo Day – Hands-on exploration of camera settings
- Clean It Right – video on safe lens cleaning
- Before & After Edits – Edit an image using subtle adjustments (brightness, contrast, hue) and present a before/after comparison.
- Mini Retouch Project – Use crop, clone, healing brush, and selection tools to improve an image.
- Creative Edits – Use various tools to apply a creative twist (like turning a daytime photo into night).
- Filter Fun – Apply 3 different Lightroom filters to one image and explain the effects.
- Mood Edit Challenge – Choose a photo and use Lightroom adjustments to convey a specific emotion (e.g., warmth, mystery)

Assessment Methodology:

Assessment Tool	Marks Distribution
Continuous Assessment (CA) (50 Marks)	• Active Participation = 5 marks • Assessment of the Activity carried out by student = 25 marks • Cultural Event Participation = 10 marks • Technical Event Participation = 10 marks

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
		L	P	T	L	P	T	Total
25IL4LLC05	Tradition & Craft: Hands-On Indian Art	-	2	-	-	1	-	1

Assessment Methods				Total Marks
Mentor Assessment	Course Attendance	Cultural Festival Participation	Technical Festival Participation	
30	5	10	5	50

Course Objectives:

- To introduce students to diverse Indian traditional and contemporary art forms.
- To develop hands-on skills in craft techniques such as Tanjore, Lipan, Quilling, Clay Modeling, and DIY décor.
- To cultivate design thinking, creativity, and aesthetic sensibility among students.
- To promote sustainable and mindful crafting as a stress-relieving and enriching activity.
- To encourage integration of traditional craftsmanship with contemporary applications.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Recall** the historical and cultural origins of traditional Indian art forms such as Tanjore and Lipan art. **(Remembering)**
	CO2	**Explain** the tools, materials, and techniques used in Tanjore, Lipan, Quilling, and Clay Modeling crafts. **(Understanding)**
	CO3	**Apply** techniques to create basic forms in clay modelling, quilling, mirror work, and Tanjore relief work. **(Applying)**
	CO4	**Analyse** differences between traditional and contemporary art styles and their contribution to modern décor. **(Analysing)**
	CO5	**Evaluate** the aesthetic and functional aspects of handmade art pieces for home décor. **(Evaluating)**
	CO6	**Create** a unique DIY home décor project by integrating multiple art forms learned in the course. **(Creating)**

Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours
1	Introduction to Tanjore art	History and origin (Thanjavur, Tamil Nadu), Traditional themes and subjects, Tools and materials: MDF board/wooden board, chalk powder and gum mixture, gold foil, stones, brushes, Sketching and layout transfer techniques, Gesso (relief) work, Stone and gold foil application, Painting and finishing techniques.	06

2	Lipan Art (Mud & Mirror Work)	Origin and cultural significance of Lipan art (Kutch, Gujarat), Tools and materials: clay/M-seal, mirrors, MDF/canvas base, adhesives, Basic motifs and symmetry patterns, Clay application techniques, Mirror embedding techniques, Painting and finishing methods.	**06**
3	Quilling Art – Paper Filigree	Introduction to quilling art and its applications, Tools and materials: quilling strips, slotted tool, board, glue, Basic coil techniques: tight coil, loose coil, teardrop, marquise, scrolls, Practice of shapes and patterns, Jewelry or decorative craft creation.	**06**
4	Creative Clay Modeling	Introduction to clay art and types of clay (natural, air-dry, polymer), Tools and safety practices, Basic clay techniques: rolling, pinching, coiling, slab method, joining techniques (scoring and slip), Creating miniature objects, Painting and surface finishing.	**04**
5	DIY Home Décor	Basics of home décor and design principles, Traditional vs modern décor elements, Wall art and hangings, Decorative lighting concepts, Tabletop and shelf décor ideas, Sustainable and recycled craft applications.	**04**
6	Creative Hands: Traditional Meets Contemporary	Integration of traditional crafts with modern aesthetics, Mixed-media approach combining Tanjore-style elements, Lipan patterns, Quilling, and Clay modelling, Design planning and execution of final DIY project, Peer feedback and refinement.	**04**

Suggested Activities for Tradition & Craft: Hands-On Indian Art Course

- Create a small Tanjore-style relief artwork on MDF board using gesso work and gold foil application.
- Design and execute a decorative Lipan art wall plaque incorporating clay work and mirror embedding.
- Craft a quilled jewellery set (earrings and pendant) using basic quilling shapes and proper finishing techniques.
- Create a clay nameplate or wall hanging using basic techniques like rolling, pinching, and coiling.
- Design a functional decorative item (wall art or tabletop décor) using recycled or sustainable materials.
- Develop a mixed-media DIY décor project integrating at least three techniques learned in the course.

Assessment Methodology:

Assessment Tool	Marks Distribution
Continuous Assessment (CA) (50 Marks)	• Active Participation = 5 marks • Assessment of the Activity carried out by student = 25 marks • Cultural Event Participation = 10 marks • Technical Event Participation = 10 marks

Course Code	Course Name	Teaching Scheme (Hrs. / Week)			Credits Assigned			
		L	P	T	L	P	T	Total
25IL4LLC05	Sports & Fitness	-	2	-	-	1	-	1

Assessment Methods				Total Marks
Mentor Assessment	Course Attendance	Cultural Festival Participation	Technical Festival Participation	
30	5	10	5	50

Course Objectives:

- To encourage active participation in indoor and outdoor sports for physical and mental well-being.
- To develop teamwork, leadership, and sportsmanship through group sports activities.
- To promote a healthy and stress-free lifestyle through regular physical activity.
- To create awareness about basic fitness practices and recreational sports.

Course Outcomes	After successful completion of the course, the students will be able to	
	CO1	**Recall** the importance of physical fitness and healthy lifestyle habits. **(Remembering)**
	CO2	**Explain** basic rules of selected indoor and outdoor games. **(Understanding)**
	CO3	**Apply** basic fitness exercises and warm-up routines. **(Applying)**
	CO4	**Demonstrate** teamwork and active participation in sports activities. **(Analysing)**
	CO5	**Evaluate** personal fitness through continuous participation. **(Evaluating)**
	CO6	**Develop** lifelong interest in sports and fitness. **(Creating)**

Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours
1	Foundations of Physical Fitness & Team Formation	Introduction to Sports & Physical Fitness – Importance of sports, fitness components, warm-up and team formation.	05
2	Basic Fitness Conditioning & Injury Prevention	Basic Fitness & Conditioning – Stretching, endurance activities, light strength exercises, safety measures.	04
3	Skill Development in Indoor Sports	Indoor Sports Participation – Practice of badminton, table tennis, chess, carrom and basic rules.	06
4	Skill Development in Outdoor Sports	Outdoor Sports Participation – Practice of cricket, football, volleyball, basketball, kho-kho and kabaddi.	06
5	Team Dynamics, Leadership & Sports Ethics	Teamwork, Leadership & Sports Ethics – Role of captain, discipline, fair play, managing wins and losses.	05

6	Recreational Sports, Wellness & Lifelong Fitness	Recreational Sports & Wellness – Sports for stress management and semester-end sports activity.	**05**

Suggested Activities for the Course

- Weekly sports participation
- Team practice matches
- Basic fitness routine before games
- Inter-team matches
- Semester-end sports event

Assessment Methodology:

Assessment Tool	Marks Distribution
Continuous Assessment (CA) (50 Marks)	• Active Participation = 5 marks • Assessment of the Activity carried out by student = 25 marks • Cultural Event Participation = 10 marks • Technical Event Participation = 10 marks