MVJ COLLEGE OF ENGINEERING
Since 1982
Engineering A Better Tomorrow
An Autonomous Institution

Bachelor of Engineering in Mechanical Engineering

Scheme and Syllabus
(2025 Scheme)

III Semester

MVJ College of Engineering, Bengaluru (Autonomous)
B.E. in Mechanical Engineering - **Scheme 2025**
Outcome-Based Education (OBE)and Choice-Based Credit System (CBCS)
(Applicable for 2025-26 admitted students)

Semester - III

Sl. No	Course	Course Code	Course Title	Teaching and Learning Scheme					Examination				Credits
				CI		LI	TW& SL	#TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	ASC/PCC	MVJ25ME31	Statistical and Transform techniques	56	0	0	64	120	4	50	50	100	4
2	IPCC	MVJ25ME32	Mechanics of Materials	42	0	28	50	120	3	50	50	100	4
3	PCC	MVJ25ME33	Engineering Thermodynamics	56	0	0	64	120	4	50	50	100	4
4	PCC	MVJ25ME34	Material Science and Engineering	42	0	0	48	90	3	50	50	100	3
5	PCC	MVJ25ME35	Manufacturing Process	42	0	0	48	90	3	50	50	100	3
6	PCCL	MVJ25MEL36	Introduction to Modelling and Design for Manufacturing	0	0	28	2	30	3	50	50	100	1
7	AEC	MVJ25AECK37	Sustainable Engineering and SDGs	14	0	0	16	30	3	50	50	100	1
8	SDC	MVJ25ME38SL	MATLAB for Mechanical Engineering	0	0	28	2	30	3	50	50	100	1
9	NCMC	MVJ25PE39	Physical Education (PE) (Sports and Athletics)	0	0	0	28	28	---	100	---	100	PP
		MVJ25YO39	Yoga										
10	NCMC	MVJ25MATDIP310	Additional Mathematics – I *	14	0	0	14	28	-----	100	---	100	PP
TOTAL													21

*Applicable for Lateral entry students only

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Semester - IV

Sl. No	Course	Course Code	Course Title	Teaching and Learning Scheme					Examination				Credits
				CI		LI	TW& SL	#TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	IPCC	MVJ25ME41	Machining Science	42	0	28	50	120	3	50	50	100	4
2	IPCC	MVJ25ME42	Fluid Mechanics	42	0	28	50	120	3	50	50	100	4
3	PCC	MVJ25ME43	Kinematics of Machines	56	0	0	64	120	3	50	50	100	4
4	PCC	MVJ25ME44	Flexible Manufacturing Systems	42	0	0	48	90	3	50	50	100	4
5	PCCL	MVJ25MEL45	Mechanical Measurements and Metrology lab	42	0	0	48	90	3	50	50	100	1
6	BSC	MVJ25BI46	Biology for Engineers	0	0	28	34	60	2	50	50	100	2
7	AEC	MVJ25AECK47	Scientific Foundation of Health	14	0	0	16	30	2	50	50	100	1
8	SDC	MVJ25ME48SL	CAD/CAM/CAE Skill Lab	0	0	28	2	30	3	50	50	100	1
9	NCMC	MVJ25PE49	Physical Education (PE) (Sports and Athletics)	0	0	0	28	28	---	100	---	100	PP
		MVJ25YO49	Yoga										
10	NCMC	MVJ25MATDIP410	Additional Mathematics – II*	14	0	0	14	28	----	100	---	100	PP
TOTAL													21

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Semester - V

Sl. No	Course	Course Code	Course Title	Teaching and Learning Scheme					Examination				Credits
				CI		LI	TW& SL	#TH/S	Duration in	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	HSMC	MVJ25ME51	Industrial Management & Entrepreneurship	42	0	0	48	90	3	50	50	100	3
2	IPCC	MVJ25ME52	Turbo machines	42	0	28	50	120	3	50	50	100	4
3	PCC	MVJ25ME53	Machine Design -I	42	0	0	48	190	3	50	50	100	3
4	PCC	MVJ25ME54	Dynamics of Machines	42	0	0	48	90	3	50	50	100	3
5	PEC	MVJ25ME55x	Professional Elective Course-I	42	0	0	48	90	3	50	50	100	3
6	BSC	MVJ25RM56	Research Methodology and IPR (**Online**)	0	0	0	60	60	2	50	50	100	2
7	AEC	MVJ25AECK57	Ability Enhancement Course	14	0	0	16	30	2	50	50	100	1
8	SDC	MVJ25ME58SL	LabVIEW for Mechanical Engineering	0	0	28	2	30	3	50	50	100	1
9	PCCL	MVJ25MEL59	CNC Programming and 3-D Printing lab	0	0	28	2	30	3	50	50	100	1
10	SDC	MVJ25HBP510	Hackathon-Based Project	0	0	0	60	60	2	50	50	100	2
TOTAL													21

Professional Elective Course-I

MVJ25ME55A	Operations Management Systems	MVJ25ME55C	Waste to Energy Conversion
MVJ25ME55B	Non-traditional Machining	MVJ25ME55D	Renewable Energy Sources

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Semester - VI

Sl. No	Course	Course Code	Course Title	Teaching and Learning Scheme					Examination				Credits
				CI		LI	TW& SL	#TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	IPCC	MVJ25ME61	Heat Transfer	42	0	28	50	120	3	50	50	100	4
2	PCC	MVJ25ME62	Machine Design-II	56	0	0	64	120	3	50	50	100	4
3	PCC	MVJ25ME63	Hydraulics and Pneumatics	56	0	0	64	120	3	50	50	100	3
4	PCC	MVJ25ME64	Design for Manufacturing and Assembly	42	0	0	48	90	3	50	50	100	3
5	PEC	MVJ25ME65X	Professional Elective Courses-II	42	0	0	48	90	3	50	50	100	3
6	PCCL	MVJ25MEL66	Design lab	0	0	28	2	30	3	50	50	100	1
7	AEC	MVJ25AECK77	Ability Enhancement Course	14	0	0	16	30	2	50	50	100	1
8	SDC	MVJ25ME68SL	EV & Hybrid Vehicle Lab	0	0	28	2	30	3	50	50	100	1
9	SDC	MVJ25ME69	Capstone Project – Phase 1	0	0	0	90	90	3	100	--	100	3
10	NCMC	MVJ25UHV610	Universal Human Value	0	0	0	28	28	---	100	---	100	PP
TOTAL													23

Professional Elective Course-II

MVJ25ME65A	Additive Manufacturing	MVJ25ME65C	Mechanical Vibration
MVJ25ME65B	Automotive Mechatronics	MVJ25ME65D	Digital Manufacturing

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Semester - VII

Sl. No	Course	Course Code	Course Title	Teaching and Learning Scheme					Examination				Credits
				CI		LI	TW& SL	#TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	IPCC	MVJ25ME71	Finite Element Methods	42	0	28	50	120	3	50	50	100	4
2	PEC	MVJ25 ME 72X	Professional Elective Course-III	42	0	0	48	90	3	50	50	100	3
3	PEC	MVJ25ME73X	Professional Elective Course -IV	42	0	0	48	90	3	50	50	100	3
4	OEC	MVJ25ME74X	Open Elective Course-I	42	0	0	48	90	3	50	50	100	3
5	SDC	MVJ25ME75	Capstone Project - Phase-II	0	0	0	210	210	3	100	100	200	7
6	NCMC	MVJ25IKS76	Indian Knowledge System	0	0	28	2	30	---	100	--	100	PP
7	AEC	MVJ25AECK77	Ability Enhancement Course	14	0	0	16	30	2	50	50	100	1
8	SDC	MVJ25ME78SL	Industry 4.0 & Smart Manufacturing Lab	0	0	28	2	30	3	50	50	100	1
TOTAL													22

Professional Elective Course-III

MVJ25ME72A	Fundamentals of Robotics	MVJ25ME72C	Product Design and Manufacturing
MVJ25ME72B	Non-Destructive Testing	MVJ25ME72D	Industrial IOT and Smart Manufacturing

Professional Elective Course-IV

MVJ25ME73A	Total Quality Management	MVJ25ME73C	AI & ML for Mechanical Engineers
MVJ25ME73B	Power Plant Engineering	MVJ25ME73D	Operation Research

Open Elective Course-I

MVJ25ME74A	Project Management	MVJ25ME74C	Material Characterization
MVJ25ME74B	Optimization Techniques	MVJ25ME74D	Foreign Language (NPTEL/SWAYAM/online VTU)

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Semester - VIII

Sl. No	Course	Course Code	Course Title	Teaching and Learning Scheme					Examination				Credits
				CI		LI	TW& SL	#TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	PEC	MVJ25ME81X	Professional Elective-V (NPTEL/VTU Online Course)	-	-	-	-	90	3	50	50	100	3
2	OEC	MVJ25ME82X	Open Elective-II (NPTEL/VTU Online Course)	-	-	-	-	90	3	50	50	100	3
3	SDC	MVJ25INT83X	Internship (15 weeks or 90 working days)	-	-	-	-	90	3	100	100	200	9
TOTAL													15

Professional Elective Course-IV

MVJ25ME81A	NPTEL/VTU Online Course	MVJ25ME81C	NPTEL/VTU Online Course
MVJ25ME81B	NPTEL/VTU Online Course	MVJ25ME81D	NPTEL/VTU Online Course

Open Elective Course-II

MVJ25ME82A	NPTEL/VTU Online Course	MVJ25ME82C	NPTEL/VTU Online Course
MVJ25ME82B	NPTEL/VTU Online Course	MVJ25ME82D	NPTEL/VTU Online Course

Semester: III			
Statistical and Transform techniques			
Course Code:	MVJ25ME31	Scheme	2025
Type of Course	ASC	Semester	III
Teaching Hours /Week (L: T:P)	4:0:0:0	CIE Marks:	50
Teaching Hours of Pedagogy (L: T:P:SL & TW)	56:0:0:64	SEE Marks:	50
Credits	4	Total Marks	100
Examination Type	Theory	Exam hours	3

Course Objectives:

This course will give ability to:

- Use of statistical methods in curve fitting applications.
- Understand the concepts of Complex variables and transformation for solving Engineering Problems.
- Solve the linear differential equations using Laplace transforms.
- Apprehend and apply Fourier Series.
- Demonstrate Fourier Transform as a tool for solving Integral equations.

Syllabus

Statistical methods : correlation, regression, curve fitting using least-squares methods. Complex variables: Analytic function, Cauchy-Riemann equations, Milne-Thomson method, complex potential, velocity potential, potential lines, stream functions and streamlines. Laplace transform: Periodic functions, unit-step function, impulse function, Inverse Laplace Transform and Deconvolution. Fourier series: Periodic functions, Dirichlet's condition, Fourier series of periodic functions with period 2π, period 2C. Fourier series of even and odd functions, Half range Fourier Series and harmonic Analysis. Fourier transform: Infinite Fourier transform, sine and cosine transform, Inverse - Fourier sine and cosine transform, Convolution theorem. Fast Fourier Transform and Inverse Fast Fourier Transform.

Course Plan

Module I

Statistical Methods

Sl. No	Topics to be covered	Hours required
1	Statistical Methods: Introduction, Correlation and Coefficient of Correlation Problems.	11 Hrs
2	Regression, lines of regression and problems.	
3	Curve fitting by the method of least squares. Fitting of the curves of the form $y = ax + b$.	
4	Curve fitting of the form $y = ax^2 + bx + c$.	
5	Curve fitting of the form $y = ae^{bx}$	

Module II		
Complex Variables		
Sl. No	**Topics to be covered**	**Hours required**
1	Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates.	11 Hrs
2	Properties of analytic functions.	
3	Construction of analytic function by Using Milne-Thomson method.	
4	Application to flow problems - complex potential, velocity potential, potential lines, stream functions, streamlines.	
Module III		
Laplace Transforms		
Sl. No	**Topics to be covered**	**Hours required**
1	Definition and Laplace transform elementary functions.	12 Hrs
2	Laplace transforms Periodic functions and unit-step function, impulse function and problems.	
3	Inverse Laplace Transform: Definition and problems, Convolution theorem to find the inverse Laplace transforms by using partial fraction method and problems.	
4	Definition of Deconvolution and Solution of linear differential equations using Laplace transforms.	
Module IV		
Fourier Series		
Sl. No	**Topics to be covered**	**Hours required**
1	Periodic functions, Dirichlet's condition, Fourier series of periodic functions with period 2π.	11 Hrs
2	Fourier series of periodic functions with arbitrary period 2C.	
3	Fourier series of even and odd functions. Half range Fourier Series.	
4	Practical harmonic Analysis and Problems.	
Module V		
Fourier Transforms		
Sl. No	**Topics to be covered**	**Hours required**
1	Infinite Fourier transform.	11 Hrs
2	Infinite Fourier sine and cosine transform.	
3	Inverse Fourier transforms.	
4	Inverse - Fourier sine and cosine transform.	

5	Convolution theorem. Fast Fourier Transform and Inverse Fast Fourier Transform.	

Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 45th Ed., 2024.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 11th Ed., 2025.
3. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 8th Ed., 2022.

Reference Books:

1. Dennis G. Zill, "Advanced Engineering Mathematics", Jones & Bartlett Learning, 7th Edition, 2020.
2. Steven C. Chapra and Raymond P. Canale, "Numerical Methods for Engineers", McGraw-Hill Education, 8th Edition, 2020.
3. Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 1st edition 2006.

Other References:

SWAYAM and NPTEL Courses:

Design and Optimization of Energy systems, Prof. C. Balaji, IIT Madras
https://nptel.ac.in/courses/112106064

Complex Analysis, Prof. P. A. S. Sree Krishna, IIT Guwahati
https://nptel.ac.in/courses/111103070

Transform Calculus and Its Applications In Differential Equations, Prof. Adrijit Goswami, IIT Kharagpur
https://nptel.ac.in/courses/111105123

Introduction to Fourier Analysis, Prof. Parasar Mohanty, IIT Kanpur
https://nptel.ac.in/courses/111104519

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Apply statistical methods and curve-fitting techniques to analyze, model, and interpret experimental data in mechanical engineering systems.

CO2: Apply the concepts of analytic functions and complex potential theory to solve problems in two-dimensional fluid flow, stream functions, and velocity potentials.

CO3: Solve linear differential equations governing mechanical vibrations and dynamic system responses using Laplace transform and convolution techniques.

CO4: Apply Fourier series and practical harmonic analysis to evaluate periodic motions, cyclic thermal variations, and harmonic excitations in rotating machinery

CO5: Utilize Fourier transforms and Fast Fourier Transform (FFT) techniques for frequency-domain signal analysis, condition monitoring, and solving thermal-structural boundary value problems.

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	2	-	-	-	-	-	-	2
CO2	3	3	-	2	-	-	-	-	-	-	2
CO3	3	3	-	2	-	-	-	-	-	-	2

CO4	3	3	-	2	-	-	-	-	-	-	2
CO5	3	3	-	2	-	-	-	-	-	-	2

High-3: Medium-2: Low-1

Evaluation Method:

Continuous Internal Evaluation (CIE):

- Three Internal Tests will be conducted for 50 marks each and average of best two will be taken. The student should score minimum 30% marks of the average test score to avoid NSSR. (A).
- Alternative Assessment Tools (AAT) should be a project / Quiz / Seminar cum Presentation / other suitable alternate assessment methods for 30 marks. Two evaluations will be conducted (B).
- Two Assignments for 10 marks each and the sum of both the assignments will be taken for 20 Marks (C).

Final CIE Marks will be calculated as (A + B + C) / 2 for 50 marks.

Semester End Examination (SEE):

The question paper consists of two parts, A and B.

Part A: Consists of 10 questions (2 questions from each module) of 2 marks each.

Part B: The question paper should have 10 questions. Each question carries 16 marks. There should be 2 questions from each module, with a maximum of 2 subdivisions. Students have to answer any 5 questions choosing one full question from each module.

The SEE Theory marks of 100 will be scaled down to 50.

The Final mark for the course is sum of the CIE and SEE Marks.

Course delivery methods		Assessment methods	
1	Chalk and Talk	1	IA tests
2	PPT and Videos	2	Open Book Assignments (OBA)
3	Flipped Classes	3	AAT(Seminar, quiz, mini projects)
		4	Semester End Examination

Semester: III			
Mechanics of Materials			
Course Code:	MVJ25ME32	Scheme	2025
Type of Course	IPCC	Semester	III
Teaching Hours /Week (L: T:P)	3:2:0	CIE Marks:	50
Teaching Hours of Pedagogy (L: T:P:SL & TW)	42: 0: 28: 50	SEE Marks:	50
Credits	4	Total Marks	100
Examination Type	Theory -CIE & SEE Lab-CIE & SEE	Exam hours	3

Course Objectives:

This course will give ability to:

- To establish the notion of stress and strain in structural elements, and fundamental relation between material constants.
- To evaluate the principal stresses and directions using Mohr's circle.
- To elucidate the shear force, bending moment, deflection and slopes in various types of beams under different loading conditions
- To understand the design aspects of power transmitting shafts.
- To impart knowledge on the buckling of columns.

Syllabus

The syllabus introduces the fundamentals of stress, strain, and material properties, including Hooke's law, Poisson's ratio, and stress-strain behaviour. It covers compound stresses, principal stresses, and Mohr's circle, along with thin and thick cylinder analysis using Lame's equation. Beams are studied through shear forces, bending moments, diagrams, bending and shear stresses, and deflection methods. Torsion of circular shafts is explained with torsional equations, rigidity, and power transmission. Finally, columns and struts are analysed using Euler's and Rankine's formulas for critical loads and their limitations.

Module I		
1	**Simple stress and strain**: Introduction, Properties of Materials, Stress, Strain, Hook's law, Poisson's Ratio.	9 - Hrs
2	Stress- Strain Diagram for structural steel and non- ferrous materials, Principles of superposition	
3	Total elongation of tapering bars of circular and rectangular cross section. Elongation due to self- weight.	
4	**Stresses in Composite sections**: Volumetric strain, expression for volumetric strain,	
5	Elastic constants, relationship among elastic constants,	
6	Thermal stresses including compound bars.	
Module II		
1	**Compound stresses**: Introduction, plane stress, stresses on inclined sections,	9 - Hrs
2	Principal stresses and maximum shear stresses,	
3	Graphical method - Mohr's circle for plane stress.	
4	**Thick and Thin cylinders**: Stresses in thin cylinders, Lame's equation for thick cylinders subjected to internal and external pressures	

5	Changes in dimensions of cylinder (diameter, length and volume), simple numerical.	
	Module III	
1	**Bending moment and Shear forces in beams:** Introduction, Types of beams, Loads and Reactions, Shear forces and bending moments.	**8 Hrs**
2	Rate of loading, Sign conventions, Relationship between shear force and bending moments.	
3	Shear force and bending moment diagrams subjected to concentrated loads.	
4	Shear force and bending moment diagrams subjected to uniform distributed load (UDL), Uniformly varying Load (UVL) for different types of beams.	
	Module IV	
1	**Bending and shear stresses in beams:** Introduction, theory of simple bending, assumptions in simple bending.	**8 Hrs**
2	Relationship between bending stresses, radius of curvature and bending moment.	
3	Moment carrying capacity of a section.	
4	Shearing stresses in beams, shear stress across rectangular, Tee and I- sections.	
5	**Deflection of beams:** Introduction, differential equation for deflection, equations for deflections, slope and moments	
6	Double integration method for cantilever and simply supported beams for point loads, UDL and couple, Macaulay's method.	
	Module V	
1	**Torsion of circular shafts:** Introduction, pure torsion, assumptions, derivation of torsional equations	**8 Hrs**
2	Polar modulus, torsional rigidity / stiffness of shafts	
3	Power transmitted by solid and hollow circular shafts.	
4	**Columns and Struts:** Introduction, Euler's formula for critical load of columns for different end conditions,	
5	limitations of Euler's theory, Rankine's formula. simple numerical.	
	Laboratory Experiments 28 Hours	
1.	To determine the hardness values of different metal specimens by Rockwell/Vickers hardness testing machine.	
2.	To determine the hardness values of different metal specimens by Brinell hardness testing machine.	
3.	To determine the tensile strength, modulus of elasticity, yield stress, % of elongation and % of reduction in area of the metal specimen and to observe the necking.	
4.	To carry out the compression test on universal testing machine and determine the change in length/area and compression strength for the give specimen.	
5.	Carryout the Bending test/Single Shear/Double Shear test on the given specimens and to plot the stress strain graphs.	
6.	Determining the impact strength of a given material using Charpy/IZOD tests.	
7.	Carryout the Torsion test on the given specimen and to tabulate the readings and find the torsion values.	
8.	Demonstration of pin on disc wear test.	
9.	Demonstration of any two non-destructive tests and Demonstration of Fatigue test for the given specimen.	
10.	Preparation of the specimen and micro-structure observation for different metals and alloys.	

Textbooks:

1. Beer, F.P., Johuston, Jr., E.R., Dewolf, J.T. and Mazureu, D.E., "Mechanics of Materials", Fifth

Edition, McGraw Hill, 2009.
2. R. K. Bansal, "A Textbook of Mechanics of Materials", Laxmi Publications, 2010.
3. Popov E.P., "Engineering Mechanics of Solids", Prentice Hall of India Private Limited, 2004.

Reference Books:

1. Hibbeler, R.C., "Mechanics of Materials", Sixth Edition, Pearson, 2005.
2. Timoshenko, S.P. and Gere, J.D., 'Mechanics of Materials", CBS; 2nd edition, 2006 3. Gere, J.M.,
3. S.H. Crandall, N.C. Dahl and S.J. Lardner, "An Introduction to Mechanics of Solids", Tata McGraw-Hill, New Delhi, 1978.

Other References: (NPTEL/SWAYAM. Any Other)

1. NPTEL course: Strength of Materials, by Dr. Satish C Sharma, IIT Roorkee. https://nptel.ac.in/courses/112107146
2. NPTEL course: Mechanics of Materials by Dr. U Saravanan, IIT Madras.
3. https://nptel.ac.in/courses/105106172/
4. Mechanics of Solids by Prof. Priyanka Ghosh, IIT Kanpur. https://onlinecourses.nptel.ac.in/noc22_ce46/preview
5. Statics and Strength of Materials, Shehata, 2nd edition, 1994. (http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/TESTEVAL/PAGES/JTE12637J. htm)

Course Outcomes:

At the end of the course, the student will be able to:

The student will be able to:

CO1: Understand the concepts of stress and strain in simple and compound bars.

CO2: Explain the importance of principal stresses and principal planes & Analyse cylindrical pressure vessels under various loadings.

CO3: Apply the knowledge to understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.

CO4: Evaluate stresses induced in different cross-sectional members subjected to shear loads.

CO5: Apply basic equation of simple torsion in designing of circular shafts & Columns.

Evaluation Method:

Continuous Internal Evaluation (CIE):

- Three Internal Tests will be conducted for 50 marks each and average of best two will be taken. The student should score minimum 30% marks of the average of the three tests to avoid NSSR. **(A)**.
- Alternative Assessment Tools (AAT) are used to complete a project / Quiz/ Seminar cum Presentation / other suitable alternate assessment methods for 30 marks. Two evaluations will be conducted **(B)**.
- Two Assignments for 10 marks each and the sum of both the assignments will be taken for 20 Marks **(C)**.

Final CIE Marks will be calculated as (A+B+ C)/2 for 50 marks.

Continuous Internal Evaluation (CIE) for Practical:

- **Weekly Evaluation for 30 Marks**: Weekly evaluation should be conducted for every experiment. Marks of each evaluation includes Preparedness / Observation (6 Marks) + Experiment Conduction/ Execution (9 Marks) + Viva Voce (9 Marks) + Record Book (6 Marks) for each experiment. All weekly marks are added and scaled to 30 marks **(C)**.
- Two CIE tests for 20 Marks each should be conducted and averaged to 20 Marks. The

student should score minimum 30% in the average test marks (i.e. 6 marks) to avoid NSSR. (D).

Final CIE Marks of practical should be calculated as C+D for 50 marks

For IPCC, Final CIE Marks will be calculated as Sum of Theory CIE and Practical CIE for 100 marks.

Semester End Examination (SEE) for Theory:

The question paper consists of two parts, A and B.

Part A: Consists of 10 questions (2 questions from each module) of 2 marks each.

Part B: The question paper should have 10 questions. Each question carries 16 marks. There should be 2 questions from each module, with a maximum of 2 subdivisions. Students have to answer any 5 questions choosing one full question from each module.

The SEE Theory marks of 100 will be scaled down to 50 (X).

Semester End Examination (SEE) for Practical:

The SEE of practical is evaluated for 50 marks, distributed as follows:

- Experiment Conduction with Results: 40 marks
- Viva Voce: 10 marks
- Total 50 marks (Y)

The Final mark for the SEE is X+Y of total 100 marks.

The Final mark for the course is the sum of CIE and SEE marks, scaled to 100.

CO-PO Mapping

High-3: Medium-2: Low-1

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	1			2				
CO2	3	3	2	2			2				
CO3	3	3	2	1			2				
CO4	3	3	2	1			2				
CO5	3	3	3	1			2				

Semester: III			
Engineering Thermodynamics			
Course Code:	MVJ25ME33	Scheme	2025
Type of Course	PCC	Semester	III
Teaching Hours /Week (L: T:P)	4:0:0:0	CIE Marks:	50
Teaching Hours of Pedagogy (L: T:P:SL & TW)	56:0:0:64	SEE Marks:	50
Credits	4	Total Marks	100
Examination Type	Theory	Exam hours	3

Course Objectives:

The course objective is to:

- To learn thermodynamic systems and familiarize various terminologies associated with the thermodynamic system.
- To acquire knowledge about the fundamentals of thermodynamic laws, concepts and principles.
- To predict the availability and irreversibility associated with the thermodynamic processes.
- To analyze the properties of pure substances, ideal and real gas mixtures.
- To understand the principles of various cycles and to apply the thermodynamic concepts in various applications like IC engines and Air conditioning systems.

Syllabus

This course builds a foundation in the principles governing energy, heat, and work interactions. It covers equilibrium, laws of thermodynamics, enthalpy, and energy equations for closed and open systems. Students study heat engines, refrigerators, reversibility, irreversibility, and the Carnot cycle. Entropy, exergy, and second law efficiency are emphasized alongside pure substances, steam tables, and gas mixtures. Applications include air-standard cycles, Brayton cycle modifications, refrigeration systems, psychrometry, and internal combustion engines, enabling analysis of performance and efficiency in real-world energy systems.

Course Plan

Module 1

S.No	Topics to be covered	Hours Required
1	**Introduction to Thermodynamics**; definitions thermodynamics, concepts of thermodynamics.	8 Hrs
2	Thermodynamic equilibrium: mechanical equilibrium; chemical equilibrium, thermal equilibrium,	
3	Zeroth law of thermodynamics, Temperature; concepts, scales, measurement	
4	Definition of work and its limitations. Thermodynamic definition of work; sign convention. Displacement work; expressions for displacement work in various processes through p-v diagrams.	
5	Shaft work; Electrical work. Other types of work.	
6	Heat: definition, units, and sign convention. Numerical	

Module II

S.No	Topics to be covered	Hours Required
1	**First Law of Thermodynamics:** Joule's experiments, equivalence of heat and	9 hrs.

	work.	
2	Statement of the First law of thermodynamics, PMM1, Consequence of 1st Law.	
3	Enthalpy, Heat Transfer for various processes for closed system, Energy as a property, modes of energy, Specific heat at constant volume, enthalpy, specific heat constant pressure.	
4	Steady state-steady flow energy equation (SFEE) and its applications	
5	General equation for variable flow processes (Unsteady state /Transient State)	
6	Numerical on Steady state-steady flow energy equation (SFEE)	
Module III		
S.No	**Topics to be covered**	**Hours Required**
1	**Second Law of Thermodynamics**: Drawbacks of 1st Law, Concept of thermal energy reservoir. Concept of Heat engine.	8 hrs
2	Kelvin - Planck statement of the Second law of Thermodynamic; PMM I & PMM II. Clausius's statement of Second law of thermodynamic; Equivalence of the two statements;	
3	Thermal energy reservoir, Concept of refrigerator and heat pump and its relationship, COP.	
4	Numerical on Heat engine, Heat Pump and Refrigerator	
5	Reversibility and irreversibility, Causes and condition of irreversibility	
6	Carnot cycle, Carnot theorem.	
7	Numerical on Carnot Cycle	
Module IV		
S.No	**Topics to be covered**	**Hours Required**
1	**Entropy, Available energy**: Clausius inequality, Concept of Entropy - principle of increase in entropy	9 hrs
2	Eentropy as a quantitative measure of irreversibility. Available (Exergy) and Unavailable energy, Exergy analysis, Irreversibility and second law efficiency.	
3	**Pure Substances**: P-T and P-V diagrams. Vapor states of pure substance using water as example. Latent heat. Dryness fraction (quality).	
4	T-S and H-S diagrams, representation of various processes on these diagrams. Steam tables.	
5	Numerical on Pure Substances	
5	**Basic concepts of Gas and gas mixture**: Avogadro's Law, equation for state of a gas, ideal gas, Equation of State	
Module V		
S.No	**Topics to be covered**	**Hours Required**
1	**Air Standard and Gas power cycles**: Carnot cycle, Air standard Otto, Diesel, and Dual cycles, efficiency derivation.	8 hrs
2	Ideal Brayton cycle, effect of reheat, regeneration and Intercooling	
3	Simple numerical problems on Otto, Diesel, Dual and ideal Brayton cycle only.	
4	Vapour compression refrigeration cycle - Psychometric properties of air - Psychometric chart.	
5	**Internal Combustion Engines**: Classification of IC engines, Combustion of SI engine and CI engine, Performance analysis of I.C Engines, heat balance.	

	(Numerical problems on Heat balance sheet only)	

Textbooks:

1. P. K. Nag," Engineering Thermodynamics", Tata McGraw-Hill.
2. Yunus Cengel, "Thermodynamics- An Engineering Approach" ,Tata McGraw-Hill.

Reference Books:

1. Van Wylen, Sonntag, "Engineering Thermodynamics', John Wiley.
2. Y. V. C. Rao, "An introduction to Thermodynamics", Universities Press, Hyderabad

Other Reference s: (NPTEL/SWAYAM. Any Other)

1.Course: NPTEL – *Basic Thermodynamics*
Instructor: Prof. S. K. Som https://nptel.ac.in/courses/112105123
2.Course: NPTEL – *Engineering Thermodynamics*
Instructor: Prof. P. K. Nag https://nptel.ac.in/courses/112105266
3.Course: NPTEL – *Thermodynamics*
Instructor: Prof. R. K. Rajput https://nptel.ac.in/courses/112104113
4.Course: NPTEL – *Advanced Thermodynamics*
Instructor: Prof. K. Muralidhar https://nptel.ac.in/courses/112104220
5.Course: NPTEL – *Applied Thermodynamics*
Instructor: Prof. Ravi Kumar https://nptel.ac.in/courses/112105267

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	0	0	0	0	0	1
CO2	3	3	2	3	0	2	0	0	0	0	0
CO3	2	3	3	3	2	0	0	0	0	0	1
CO4	3	3	2	3	0	0	0	0	0	0	0
CO5	3	3	3	2	0	1	0	0	0	0	0

High-3: Medium-2: Low-1

Evaluation Method

Continuous Internal Evaluation (CIE):

- Three Internal Tests will be conducted for 50 marks each and average of best two will be taken. The student should score minimum 30% marks of the average test score to avoid NSSR. (A).
- Alternative Assessment Tools (AAT) should be a project / Quiz/ Seminar cum Presentation / other suitable alternate assessment methods for 30 marks. Two evaluations will be conducted (B).
- Two Assignments for 10 marks each and the sum of both the assignments will be taken for 20 Marks (C).

Final CIE Marks will be calculated as (A+B+ C)/2 for 50 marks.

Semester End Examination (SEE):

The question paper consists of two parts, A and B.

Part A: Consists of 10 questions (2 questions from each module) of 2 marks each.

Part B: The question paper should have 10 questions. Each question carries 16 marks. There should be 2 questions from each module, with a maximum of 2

subdivisions. Students have to answer any 5 questions choosing one full question from each module.

The SEE Theory marks of 100 will be scaled down to 50.

The Final mark for the course is sum of the CIE and SEE Marks.

Semester: III

Materials Science and Engineering

Course Code:	MVJ25ME34	Scheme	2025
Type of Course	PCC	Semester	III
Teaching Hours /Week (L: T:P)	3:0:0:0	CIE Marks:	50
Teaching Hours of Pedagogy (L: T:P:SL & TW)	48:0:0:42	SEE Marks:	50
Credits	3	Total Marks	100
Examination Type	Theory	Exam hours	3

Course Objectives:

This course will give ability to:

- To understand the fundamental structure of materials, including crystalline and amorphous solids, unit cells, and defects.
- To study and analyze the mechanical properties of materials such as strength, toughness, ductility, hardness, and fatigue.
- To explain phase diagrams and heat treatment processes for controlling and improving material properties.
- To identify and compare different types of engineering materials including metals, polymers, ceramics, and composites.
- To introduce material characterization techniques such as XRD, SEM, TEM, and hardness testing for material evaluation.

Syllabus

This course enables students to understand the structure of materials, including crystalline and amorphous nature, unit cells, and defects. It helps students gain knowledge of mechanical properties such as strength, toughness, ductility, hardness, and fatigue. Students learn the fundamentals of phase diagrams and heat treatment processes to control material behavior. The course introduces various engineering materials such as metals, polymers, ceramics, and composites. It emphasizes the relationship between material properties and engineering applications. Students are exposed to important characterization techniques like XRD, SEM, and TEM. Overall, the course provides a strong foundation for material selection and evaluation in engineering practice.

Course Plan

Module I

Sr. No	Topics to be covered	Hours required
1	Introduction: Basics of Engineering Materials, their Classifications and Application, Basics of Advance Engineering Materials	9 Hrs
2	Engineering requirements of materials, Properties of engineering materials, Criteria for selection of materials for engineering Applications.	
3	Crystal Structure: Crystal Lattice, Unit Cell, Planes and directions in a lattice, Planar Atomic Density, packing of atoms and packing fraction,	
4	Classification and Coordination of voids, Bragg's Law. Imperfections in Solids:	
5	Types of imperfections, Point defects: vacancies, interstitials, line defects, 2-D and 3D-defects, Diffusion-Fick's laws, role of imperfections in diffusion.	

Module II

Sr. No	Topics to be covered	Hours required
1	Solidification and Theory of Alloys: Solidification of metals and an alloy.	8 Hrs
2	Nucleation and Growth during freezing of pure metal and alloy ingot/a casting Resultant macrostructures; Effects of Structure on Mechanical Properties.	2 - Hrs
3	Phase and Phase equilibrium: Uniary and Binary equilibrium phase diagrams,	1 - Hrs
4	Hume- Rothery Rules, Gibbs Phase Rule, Lever Rule, Fe-C equilibrium diagram,	2 - Hrs
5	Different reactions like eutectic, eutectoid, peritectic and peritectoid; non-equilibrium cooling.	2 - Hrs
Module III		
Sr. No	Topics to be covered	Hours required
1	Heat treatment: Annealing, Normalizing, hardening, Tempering,	8 Hrs
2	Nitriding, Cyaniding, Induction Hardening and Flame Hardening,	2 - Hrs
3	Recent advances in heat treatment technology.	1 - Hrs
4	TTT diagram, microstructural effects brought about by these processes.	2 - Hrs
5	microstructural effects and their influence on mechanical properties.	2 - Hrs
Module IV		
Sr. No	Topics to be covered	Hours required
1	Corrosion and surface coating: Introduction to corrosion, types of corrosion, mechanism of corrosion	8 Hrs
2	Corrosion prevention techniques, coating materials, coating technologies, types of coatings, advantages and limitations.	2 - Hrs
3	Failure of Materials: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stresses.	1 - Hrs
4	Mohr-Coulomb and Modified Mohr-Coulomb theories, yield locus plots, fatigue failures.	2 - Hrs
5	SN curve, endurance and fatigue limits, modified goodman diagram, creep failure, fracture mechanics, Griffith criterion.	2 - Hrs
Module V		
Sr. No	Topics to be covered	Hours required
1	Metals and Alloys: Carbon and alloy steels-stainless steel and tool steel, maraging steel,	9 Hrs
2	Cast iron-grey, white, malleable and spheroidal cast iron; Copper and Copper Alloys-Brass	2 - Hrs
3	Bronze and Cupro-Nickel alloys; Aluminium Alloys, Magnesium Alloys, Nickel based super alloys and Titanium alloys.	1 - Hrs
4	Composite Materials: Introduction, Classification, Metal Matrix Composites, Ceramic Matrix Composites, Polymer Matrix Composites, Natural fiber reinforced composites,	2 - Hrs
5	Advantages, Limitations, Properties and Applications.	2 - Hrs
Textbooks:		

1. D. Callister, "Materials Science and Engineering-An Introduction", Wiley India, 6th Edition, 2006.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall India, 4th Edition, 2002.

Reference books:

1. Raghavan, "Material Science and Engineering", Prentice Hall India, 5th Edition, 2004.
2. P. C. Angelo and R. Subramanian, "Powder Metallurgy- Science, Technology and Applications", PHI, New Delhi, 2008.

Other References: (NPTEL/SWAYAM. Any Other)

1. NPTEL course: Materials Science and Engineering by Prof. Vivek Pancholi, IIT Roorkee.
   https://nptel.ac.in/courses/113107078 [nptel.ac.in]
2. NPTEL course: Introduction to Materials Science and Engineering by Prof. Rajesh Prasad, IIT Delhi.
   https://nptel.ac.in/courses/113102080 [nptel.ac.in]
3. NPTEL course: Introduction to Materials Science and Engineering by Dr. Ranjit Bauri, IIT Madras.
   https://nptel.ac.in/courses/113106032 [nptel.ac.in]
4. NPTEL course: Materials Science by Prof. Satish V. Kailas, IISc Bangalore.
   https://nptel.ac.in/courses/112108150 [nptel.ac.in]

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Understand the atomic arrangement in crystalline materials and describe the periodic arrangement of atoms using unit cell parameters.

CO2: Explain the importance of phase diagrams and phase transformations in materials.

CO3: Identify and explain various heat treatment methods used for controlling material microstructure.

CO4: Correlate metals and alloys with material properties for component design and identify different failure mechanisms.

CO5: Understand and explain the applications of different types of composite materials.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3										
CO2	3	2	2	2			1		2	1	2
CO3	3								2		2
CO4	3	2	2			2			2		
CO5	2										2

High-3: Medium-2: Low-1

Evaluation Method

Continuous Internal Evaluation (CIE):

- Three Internal Tests will be conducted for 50 marks each and average of best two will be taken. The student should score minimum 30% marks of the average test score to avoid NSSR. (A).
- Alternative Assessment Tools (AAT) should be a project / Quiz/ Seminar cum Presentation / other suitable alternate assessment methods for 30 marks. Two evaluations will be conducted (B).
- Two Assignments for 10 marks each and the sum of both the assignments will be taken for 20 Marks (C).

Final CIE Marks will be calculated as (A+B+ C)/2 for 50 marks.

Semester End Examination (SEE):

The question paper consists of two parts, A and B.

Part A: Consists of 10 questions (2 questions from each module) of 2 marks each.
Part B: The question paper should have 10 questions. Each question carries 16 marks. There should be 2 questions from each module, with a maximum of 2 subdivisions. Students have to answer any 5 questions choosing one full question from each module.

The SEE Theory marks of 100 will be scaled down to 50.

The Final mark for the course is sum of the CIE and SEE Marks.

Course delivery methods		Assessment methods	
1	Chalk and Talk	1	IA tests
2	PPT and Videos	2	Open Book Assignments (OBA)/ Lab Project
3	Flipped Classes	3	Lab Test
4	Practice session/Demonstrations in Labs	4	Semester End Examination
5	Virtual Labs (if present)		

Semester: III

Manufacturing Process

Course Code:	MVJ25ME35	Scheme	2025
Type of Course	PCC	Semester	III
Teaching Hours /Week (L: T:P)	3:0:0:0	CIE Marks:	50
Teaching Hours of Pedagogy (L: T:P:SL & TW)	42:0:0:48	SEE Marks:	50
Credits	3	Total Marks	100
Examination Type	Theory	Exam hours	3

Course Objectives:

This course will give ability to:

- Recognize the various manufacturing principles and techniques, moulding, patterns, and moulding furnaces
- Enable the students to acquire a fundamental knowledge of welding technology
- Understand the rolling and forging processes.
- Apply the processing and powder metallurgy techniques
- Evaluate the special forming and high-energy rate forming process

Syllabus

The fundamental principles, methods, and applications of manufacturing technologies used in modern industries. It builds conceptual clarity on casting, welding, metal forming, powder metallurgy, plastics processing, sheet metal operations, and high-energy rate forming processes, supported by laboratory demonstrations and industrial examples.

Course Plan

Module I

Sr. No	Topics to be covered	Hours required
1	**Manufacturing Process**: Introduction to manufacturing & classification	**9 - Hrs**
2	Primary manufacturing of iron and aluminium	
3	**Pattern**: functions, types, materials	
4	Pattern allowances	
5	**Moulding sand**: composition & properties	
6	Riser design principles, Gating system – types and design	
7	Casting processes & applications, Types of moulds and cores	
8	Casting defects	

Module II

Sr. No	Topics to be covered	Hours required
1	**Introduction to welding**: gas welding	**8 - Hrs**
2	Oxy-acetylene flames, equipment	
3	Resistance welding (spot, seam, projection)	
4	Advanced welding (LBW, EBW, FSW, USW)	
5	Thermal cycles & weld metallurgy	
6	HAZ and solidification of weld	
7	Welding defects	
8	Inspection & NDT methods	

Module III

Sr. No	Topics to be covered	Hours required
1	**Metal Forming Processes**: Mechanical working – hot vs cold working	**8 - Hrs**
2	Classification of forming processes	
3	Forging – principles and types	
4	Open & closed die forging, defects	
5	Rolling theory and mechanics	
6	Rolling mills & roll pass design	
7	Ring rolling & cold rolling	
8	Lab demonstration & numericals	
Module IV		
Sr. No	Topics to be covered	Hours required
1	**Powder Metallurgy**: Introduction to powder metallurgy	**8 - Hrs**
2	Powder production methods	
3	Blending, compaction & sintering	
4	Finishing operations, applications	
5	**Plastic Products Manufacturing Process**: Injection moulding process	
6	Extrusion & blow moulding	
7	Galvanizing, electroplating	
8	Micro/nano machining	
Module V		
Sr. No	Topics to be covered	Hours required
1	**Extrusion, Wire Drawing, Tube Drawing**: Introduction to Extrusion, wire drawing	**9 - Hrs**
2	Press work & die–punch assembly	
3	**Introduction to Sheet metal forming**: Sheet metal operations	
4	Shearing, blanking, piercing, punching, nibbling, lancing, notching and non – shearing, bending, stretching, spinning, embossing, coining, drawing, operation & applications of stretch forming	
5	Deep drawing, defects in sheet metal formed components	
6	**High Energy Rate Forming**: High-energy rate forming processes	
7	Applications, revision & internal assessment support	
8	Tube drawing	

Textbooks:

1. P N Rao, "Manufacturing Technology: Foundry, Forming and Welding", 2nd Edition TataMc Graw-Hill Publication.
2. O.P Khanna, "Foundry Technology", Dhanpat rai publications-2003 reprint.

Reference Books:

1. Degarmo, Black & Kohser, "Materials and Processes in Manufacturing"

Other References:

https://youtu.be/1x3uJ-KSyjY
https://www.youtube.com/watch?v=g7MkIBdl06c&list=PLwdnzlV3ogoUQnGO8eFFygVBTjF0xyYMq
http://web.mit.edu/2.810/www/files/lectures/2015_lectures/lec6-sheet-metal-forming-2015.pdf
https://www.epma.com/powder-metallurgy-process

Course Outcomes:
At the end of the course, the student will be able to:

CO1: Identify and explain all the steps involved in basic casting processes.
CO2: Express the concepts of welding and its types
CO3: Explain the principle behind metal forming process and detail all the forging and rolling process.
CO4: Understand the process of Powder Metallurgy and product manufacturing process along with micro and Nano machining.
CO5: Apply special forming and high-energy rate forming process

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2				2	1	2
CO2	3	3	1	2	2	3	2		2	2	1
CO3	3	2	2	3	3	1			2	1	2
CO4	3	3	2	3	3	2	1		2	2	2
CO5	3	3	3	3	2	2	2		3	2	3

High-3: Medium-2: Low-1

Evaluation Method

Continuous Internal Evaluation (CIE):

- Three Internal Tests will be conducted for 50 marks each and average of best two will be taken. The student should score minimum 30% marks of the average test score to avoid NSSR. (A).
- Alternative Assessment Tools (AAT) are used to complete a project / Quiz/ Seminar cum Presentation / other suitable alternate assessment methods for 30 marks. Two evaluations will be conducted **(B)**.
- Two Assignments for 10 marks each and the sum of both the assignments will be taken for 20 Marks **(C)**.

Final CIE Marks will be calculated as (A+B+ C)/2 for 50 marks.

Semester End Examination (SEE):

The question paper consists of two parts, A and B.

Part A: Consists of 10 questions (2 questions from each module) of 2 marks each.
Part B: The question paper should have 10 questions. Each question carries 16 marks. There should be 2 questions from each module, with a maximum of 2 subdivisions. Students have to answer any 5 questions choosing one full question from each module.

The SEE Theory marks of 100 will be scaled down to 50.

Final mark for the course is sum of the CIE and SEE Marks.

Semester: III

Introduction to Modelling and Design for Manufacturing

Course Code:	MVJ25MEL36	Scheme	2025
Type of Course	PCCL	Semester	III
Teaching Hours /Week (L: T:P)	0:0:2:0	CIE Marks:	50
Teaching Hours of Pedagogy (L: T:P:SL & TW)	0:0:28:2	SEE Marks:	50
Credits	1	Total Marks	100
Examination Type	Practical	Exam hours	3

Course Objectives:

This course will give ability to:

- To acquire the knowledge of CAD software and its features. Make the students to understand of the devices, instruments.
- To inculcate understanding of the theory of projection and make drawings using orthographic projections and sectional views.
- To impart knowledge of thread forms, fasteners, keys, joints, couplings
- To acquire the knowledge of Assembly Drawings.

Guidelines/ Specific Requirements, if any:

AUTO-CAD FUSION Software can be used for creating the 3-dimensional views

Sl. No.	Experiments List
1.	**Limits, Fits and Tolerances:** Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, Types of fits with symbols and applications, Geometrical tolerances on drawings, Standards followed in industry.
2.	**Orthographic views:** Conversion of pictorial views into orthographic projections of simple machine parts with and without section. (Bureau of Indian Standards conventions are to be followed for the drawings), Hidden line conventions, Precedence of lines.
3.	**Thread forms:** Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal and External), square, Acme and Sellers thread, American Standard thread.
4.	**Fasteners:** Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut.
5.	**Riveted joints:** Single and double riveted lap joints, Butt joints with single/double cover straps (Chain and zigzag using snap head riveters).
6.	**Joints:** Cotter joint (socket and spigot) for two rods.
7.	**Joints:** Knuckle joint (pin joint) for two rods.
8.	**Assembly Drawings: (Part drawings shall be given):** Plummer block (Pedestal Bearing)
9.	**Assembly Drawings: (Part drawings shall be given):** I.C. Engine connecting rod
10.	**Assembly Drawings: (Part drawings shall be given):** Screw jack
11.	**Assembly Drawings: (Part drawings shall be given):** Tailstock of lathe

12.	**Assembly Drawings: (Part drawings shall be given)**: Machine vice
13	**Assembly Drawings: (Part drawings shall be given)** : Lathe square tool post

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Students will be able to convert Orthographic views of machine parts with and without sectioning in 2D.

CO2: Able to understand design of thread forms and Sectional views for threads in 2D.

CO3: Students able to Draw the Hexagonal and square headed bolt and nut with washer, screw assemblies in 2D.

CO4: Students will be able to draw the single and double riveted joints, in 2D.

CO5: Students will be able to construct assemblies of mechanical component in 3D environment

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	1	2	-	-	-	3	1	3
CO2	3	3	1	1	2	-	-	-	1	1	1
CO3	3	3	1	1	2	-	-	-	1	2	1
CO4	3	3	3	1	2	-	-	-	1	2	1
CO5	3	3	3	2	2	-	-	-	1	3	3

High-3: Medium-2: Low-1

Evaluation Method

Continuous Internal Evaluation (CIE):

- **Weekly Evaluation for 30 Marks**: Weekly evaluation should be conducted for every experiment. Marks of each evaluation includes Preparedness / Observation (6 Marks) + Experiment Conduction/ Execution (9 Marks) + Viva Voce (9 Marks) + Record Book (6 Marks) for each experiment. All weekly marks are added and scaled to 30 marks **(A)**.
- Two CIE tests for 20 Marks each should be conducted and averaged to 20 Marks. The student should score minimum 30% in the average test marks (i.e. 6 marks) to avoid NSSR. **(B)**.

Final CIE Marks of practical should be calculated as A+B for 50 marks.

Semester End Examination (SEE):

The SEE of practical is evaluated for 50 marks, distributed as follows:

- Experiment Conduction with Results: 40 marks
- Viva Voce: 10 marks
- Total 50 marks

The Final mark for the course is the sum of CIE and SEE Marks

Semester: III			
Sustainable Engineering and SDG's			
Course Code:	MVJ25AECK37	Scheme	2025
Type of Course	AEC	Semester	III
Teaching Hours /Week (L: T:P)	1:0:0:0	CIE Marks:	50
Teaching Hours of Pedagogy (L: T:P:SL & TW)	14:0:0:16	SEE Marks:	50
Credits	1	Total Marks	100
Examination Type	Theory	Exam hours	3

Course Objectives:

This course will give ability to:

- Explain the basic concepts of sustainability, sustainable development and the role of engineers.
- Describe the 17 Sustainable Development Goals (SDGs) and relate selected SDGs to engineering disciplines.
- Explain basic sustainable-engineering principles including resource efficiency, systems thinking, life cycle thinking and circular economy.
- Identify environmental, social and economic impacts associated with engineering products, processes and services.
- Apply simple sustainability thinking to propose an improved solution to a real-life engineering problem.

Syllabus	
Objective of this course is to inculcate in students an awareness of environmental issues and the global initiatives towards attaining sustainability. The student should realize the potential of technology in bringing in sustainable practices.	
Module I	
Foundations of Sustainability and Role of Engineers: Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs)-Overview of the 17 SDGs, Clean Development Mechanism (CDM), Introduction to the UN 2030 Agenda.	3 Hrs
Module II	
Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon footprint, legal provisions for environmental protection.	3 Hrs
Module III	
Environmental management standards: ISO 14001:2015 framework and benefits, Scope and goal of Life Cycle Analysis (LCA), Sustainable Engineering Principles and Circular Economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.	3 Hrs
Module IV	

Resources and its utilisation: Basic concepts of Conventional and non-conventional energy, Environmental footprints, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, biofuels, Energy derived from oceans and Geothermal energy.	3 Hrs
Module V	
Sustainable design and practices/Case Studies/Student Activity: Sustainability practices: Basic concept of sustainable habitat, conventional design Vs sustainable design, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.	2 Hrs

Textbooks:

1. Toolseeram Ramjeawon, Introduction to Sustainability for Engineers, CRC Press, 1st Edition, 2020.
2. Rag, R. L. and Ramesh Lakshmi Dinachandran, Introduction to Sustainable Engineering, PHI Learning.
3. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
4. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
5. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.

Reference Books:

1. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
2. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
3. Allenby, B. R., The Sustainability Engineering Handbook, McGraw-Hill.
4. Mihelcic, J. R. and Zimmerman, J. B., Environmental Engineering: Fundamentals, Sustainability, Design, Wiley.
5. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
6. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
7. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Explain sustainability, sustainable development and the role of engineers

CO2: Explain different types of environmental pollution problems, SDGs, relate them to engineering applications, and their sustainable solutions

CO3: Explain life cycle thinking and environmental footprints

CO4: Apply basic principles of sustainable engineering and circular economy

CO5: Propose a basic sustainable engineering solution to a real-life problem

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1					2	3				
CO2	1				1	2	3				
CO3					1	2	3				
CO4					1	2	3				
CO5						2	3				

High-3: Medium-2: Low-1

Evaluation Method

Continuous Internal Evaluation (CIE) – 50 Marks
The CIE for the mandatory credit courses common across all disciplines comprises of two components as follows:

Internal Assessment Tests (30 Marks):
Two Internal Assessment tests will be conducted, each comprising 50 multiple choice questions for a total of 50 marks. The average of the two test scores will be scaled down to 30 marks.
Assignments (20 Marks):
Students are required to complete two assignments, each carrying 10 marks. These assignments may include projects*, poster presentations*, seminars*, or similar academic activities. The marks of the two assignments are added to get 20 marks.
*Each assignment will undergo two rounds of evaluation to assess progress and quality
At the beginning of the semester, the instructor/faculty teaching the course has to announce the methods of Assignment for the course.
Together, these two components are added to get the Final CIE marks of 50.

Semester End Examination (SEE) – 50 Marks
A Semester End Examination is conducted for 50 marks comprising of multiple-choice questions (MCQ) type each of one mark.
The final score for the course out of 100 is the SumTotal of SEE and CIE.

Semester: III			
MAT Lab for Mechanical Engineers			
Course Code:	MVJ25ME38SL	Scheme	2025
Type of Course	SDC	Semester	III
Teaching Hours /Week (L: T:P)	1:0:0:0	CIE Marks:	50
Teaching Hours of Pedagogy (L: T:P:SL & TW)	0:0:28:2	SEE Marks:	50
Credits	1	Total Marks	100
Examination Type	Practical	Exam hours	3

Course Objectives:

This course will give ability to:

- Understand the specified problems for developing a program for problem-solving in mechanical engineering contexts.
- Select the MATLAB environment and its tools for developing innovative programs for problem-solving in Mechanical Engineering.
- Apply numerical methods for solving complex engineering problems and to determine plausible solutions for data analysis.
- Analyse the program results for getting cognitive insights and augmenting visualization as well as analysis capabilities.

Guidelines/ Specific Requirements, if any:

Sl. No.	Programming themes
1.	Introduction & Matrix Operations: Basic MATLAB commands, array/matrix manipulations, and solving systems of linear equations (e.g., static equilibrium of concurrent forces).
2.	Data Visualization: Plotting 2D and 3D graphs, including plotting shear force and bending moment diagrams for simple supported beam.
3.	Numerical Root Finding: Applying the Newton-Raphson method to solve non-linear equations in mechanical component design.
4.	Thermodynamic Processes: Plotting P-V and T-s diagrams for ideal gas processes (isothermal, adiabatic, polytropic) and calculating work done.
5.	Fluid Flow Analysis: Calculating pressure drops, Reynolds number, and friction factor for laminar and turbulent flow of liquids in a pipe.
6.	Kinematics: Position, velocity, and acceleration analysis of a simple slider-crank mechanism over a full crank rotation.
7.	Newton's Laws & Dynamics: Simulating projectile motion with aerodynamic drag using Newton's second law of motion.
8.	Mechanical Vibrations: Solving and plotting the time-response of a single degree of freedom (SDOF) spring-mass-damper system subjected to free vibration.
9	Data Handling & Curve Fitting: Importing experimental data (e.g., stress-strain data from a tensile test), applying curve fitting, and determining the modulus of elasticity.
10	Optimization: Determining the maximum and minimum stress concentrations in a mechanical element under combined loading.

Programming for all problems must be conducted if feasible. Otherwise, minimum of 8 programs must be attempted

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Develop a program for problem-solving in engineering contexts via formal understanding of specified mechanical problems.

CO2: Create innovative programs for problem-solving in Mechanical Engineering by appropriate selection of MATLAB tools and functions.

CO3: Determine plausible solutions for data analysis by applying numerical methods appropriately to solve complex mechanics and thermal problems.

CO4: Augment visualization as well as analysis capabilities by analysing the program results for getting cognitive insights into physical systems.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	--	3	3	--	--	--	1	2	--
CO2	3	2	1	3	3	1	--	--	1	2	--
CO3	3	3	2	3	3	1	--	1	2	2	--
CO4	2	3	2	3	3	1	--	1	3	2	--

High-3: Medium-2: Low-1

Evaluation Method

Continuous Internal Evaluation (CIE):

- **Weekly Evaluation for 30 Marks**: Weekly evaluation should be conducted for every experiment. Marks of each evaluation includes Preparedness / Observation (6 Marks) + Experiment Conduction/ Execution (9 Marks) + Viva Voce (9 Marks) + Record Book (6 Marks) for each experiment. All weekly marks are added and scaled to 30 marks **(A)**.
- Two CIE tests for 20 Marks each should be conducted and averaged to 20 Marks. The student should score minimum 30% in the average test marks (i.e. 6 marks) to avoid NSSR. **(B)**.

Final CIE Marks of practical should be calculated as A+B for 50 marks.

Semester End Examination (SEE):

The SEE of practical is evaluated for 50 marks, distributed as follows:

- Experiment Conduction with Results: 40 marks
- Viva Voce: 10 marks
- Total 50 marks

The Final mark for the course is the sum of CIE and SEE Marks.

SEMESTER III

Physical Education (Sports & Athletics)

Course Code:	MVJ25PE39	Scheme	2025
Type of Course	NCMC	Semester	III
Teaching Hours /Week (L: T:P)	1:0:0:0	CIE Marks:	100
Teaching Hours of Pedagogy (L: T:P:SL & TW)	0:0:0:28	SEE Marks:	----
Credits	0	Total Marks	100
Examination Type	Practical	Exam hours	PP

Course Objectives: the student will be able to

1	Understand the meaning and importance of the fitness and the benefits of fitness
2	Types of fitness and fitness tips.
3	Importance of Sports, and Yoga in a day-to-day life.
4	Understand the importance of aerobics and other activities for healthy lifestyle.
5	Know about the different roles of organization and administration in sports events.

Topics / Activities to be Covered (100Marks)

Module I — 5Hours

Orientation

- Lifestyle
- Fitness
- Food & Nutrition: Sports diet.
- Stress Management

Module II — 5 Hours

General Fitness & Components of Fitness

- Warming up (Free Hand Exercises).
- Strength—Push-up/Pull-ups
- Speed—30MtrDash.
- Agility—Shuttle Run
- Flexibility—Sit and Reach

Module III — 6 Hours

Specific Games (Anyone to be selected by the student)

- Volleyball— Attack, Block, Service, Upper Hand Pass and Lower Hand and Pass.
- Throw ball—Service, Receive, Spin attack, Net Drop & Jump throw.
- Kabaddi— Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus.
- Basketball-dribbling, passing, shooting etc.
- Table Tennis—Service (Fore Hand & Back Hand)
- Receive (Fore Hand & Back Hand)
- Smash, Athletics (Track / Field Events) -Running, Jumping, Throwing.

Module IV	6 Hours

Role of Organization and administration

- Planning.
- Organizing.
- Staffing.
- Directing.
- Coordinating & controlling.
- Reporting & Recording.
- Budgeting.

Module V	6Hours

Aerobics

- Dance Aerobics
- Sport Aerobics
- Warm up Aerobics
- Cardiovascular Aerobics

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness.
CO2	Familiarization of health-related Exercises, Sports for overall growth and development.
CO3	Create a foundation for the professionals in physical Education and Sports.
CO4	Participate in the competition at regional / state / national / international levels.
CO5	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.

Assessment Details for CIE (both CIE and SEE)

Weight age	CIE – 100%	
Participation of student in all the modules	50 Marks	• Implementation strategies of the project (PE work). • The last report should be signed by PED, the HOD and principal. • At last report should be evaluated by the PED of the institute. • Finally, the consolidated marks sheet should be sent to the Controller of Examinations office.
Final presentation / exhibition / Participation In competitions / practical on specific tasks Assigned to the students	50 Marks	
Total marks for the course in eachsemester	100 Marks	

Marks scored for 100 by the students should be Scale to 50 marks in each semester.

Students should present the progress of the activities as per the schedule in the prescribed practical session in the field. There should be positive progress in the vertical order for the benefit of society in general.

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CO/PO Mapping											
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	-	-	-	-	-	-	-	2	2	-	-
CO 2	-	-	-	-	-	-	-	2	2	-	-
CO 3	-	-	-	-	-	-	-	2	2	-	-
CO 4	-	-	-	-	-	-	-	2	2	-	-
CO 5	-	-	-	-	-	-	-	3	3	-	-

Semester: III			
Yoga			
Course Code:	MVJ25YO39	Scheme	2025
Type of Course	NCMC	Semester	III
Teaching Hours /Week (L: T:P)	1:0:0:0	CIE Marks:	100
Teaching Hours of Pedagogy (L: T:P:SL & TW)	0:0:0:28	SEE Marks:	----
Credits	0	Total Marks	100
Examination Type	Practical	Exam hours	PP

Course Learning Objectives: The students will be able to

1	Promote Holistic Wellness Practice in Students.
2	Develop Physical Awareness and Flexibility
3	Improve Focus and Academic Performance
4	Encourage Healthy Lifestyle Habits.
5	Support mental Health and Emotional balance.

The Health Benefits of Yoga:

1)Yoga helps with a person-centered approach to well-being offering **physical, mental(cognitive), and spiritual(emotional) benefits** for students. These benefits can help students cope with the demands of academic journeys, improve their overall health, and promote personal development.

- Key Benefits of Various Yoga Techniques:
- Enhances Physical Well-being.
- Boosts Mental Focus.
- Promotes Emotional Stability.
- Reduce Stress Levels.
- Encourages Inner Growth.

It is also used as an adjunct therapy to support recovery from various physical health conditions such as:

- Chronic Pain.
- Back Pain.
- Arthritis.
- Cardiovascular Diseases.
- Asthma.
- Chronic Fatigue Syndrome.
- Menstrual Disorders.
- Digestive Issues.
- Thyroid Imbalances.
- Migraine and headache.

2) Core observations on how yoga functions as a complementary mind-body intervention to support the psychological, physiological and spiritual healing processes associated with various health conditions.

Psychological Benefits:

- Stress reduction.
- Anxiety relief.
- Trauma healing.
- Cognitive and clarity focus.
- Emotional Regulation.
- Aid in managing depression.

Physiological Benefits:

- Enhance Blood Circulation.
- Boost Cardiovascular Health.
- Supports Overall Gut Function.
- Promotes Thyroid Function.
- Relief from Headaches.
- Increased Energy level.

Spiritual Benefits:

- Cultivating gratitude and Compassion
- Self –realization
- Balance and Harmony
- Inner Peace
- Sense of oneness.
  Mindfulness

MODULE- I	
Discipline and Awareness Reflect Habits s Thoughts: • **Basic theory of Yoga, Yamas s Niyamas** Yoga definition, Aims and Objectives, importance of yoga in students. • Introduction to Yoga asana Yoga asana meaning, principle and health benefits. • Ashtanga yoga Meaning, breathing techniques. • Four paths of yoga Karma yoga, Bhakthi yoga, Raja yoga, Jnana yoga. • Surya namaskar Surya namaskar prayer and its meaning, benefits and importance. • Yoga asanas Asanas it's need, importance, name and technique.	7 Hrs

Sitting: -Vajrasana, - adasana, Ardhachakrasana, Prone line: -Advasana, Bhujangasana Supine line: -Shavasana, Supta baddhakonasana, Balancing posture: -Vrikshasana, Garudasana	
MODULE -II	
Building strength and focus Finding out the obstacle: • Kriya Yoga Tapas, Svadhyaya, Ishwarapranidhana • Five Kleshas Obstacles. • Pranayama Introduction to Pranayama. • Pratyahara Preparing mind for meditation, Breathe focus techniques. • Yoga asanas Standing: -Virabhadrasana, Parshvakona Sitting: -Vajrasana, Paschimottanasana Prone Line: -Dhanurasana, Shalabhasana, Supine Line: -Ananda Balasana, Supta Matsyendrasana , Balancing: -Natarajasana (Dancer Pose	7 Hrs
MODULE -III	
Awareness and inner balance: Finding how focused is the mind • Dharana: Concentration • Dhyana: Meditation • Swasthya, Smrithi, Sankalpa. Tool of academic excellence. • Samyama Patanjali's concept of samyama • Yogasanas Standing: - ArdhaChandrasana, Utkatasana Sitting: - Padmasana (or prep), Gomukhasana Prone Line: - Adho Mukha Svanasana, Naukasana Supine Line: - SuptaBaddhaKonasana, Chakrasana Balancing: - Garudasana (Eagle Pose)	7 Hrs
MODULE -IV	

Integrating Yoga in daily Life: • Yama niyama Acharam: Practice of ethical Discipline (practicing nonviolence, truth, cleanliness) • Ahara- Vihara Samyama: Practice discipline in diet C lifestyle. • Asana- pranayama sadhana: Daily practice of asanas and pranayama • Yogasanas: Standing: -PrasaritaPadottanasana, ParivrttaTrikonasana Sitting: -Baddha Konasana, Marichyasana Prone Line: -Ustrasana (Camel), Makarasana (relaxation) Supine Line: -Sarvangasana, Shavasana Balancing: - Bakasana (Crow – optional or modified)	7 Hrs

Course outcomes	
CO1	Identify and reflect on personal habits and thoughts.
CO2	Explain the basic theory of Yoga, including Yamas C Niyama.
CO3	Understand the definition, aims, objectives, and importance of Yoga, especially for students.
CO4	Enhance physical and mental strength through advanced Yog asanas.

CO/PO Mapping											
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1		2						3	2	2	
CO 2	2						2	2			
CO 3	2					2	2	3			
CO 4					2		3	3			

Weekley assessment will be done by the instructor by giving different poses / Asanas.

The final assessment scaled up to 100 marks.

Text Book

1	Ajitkumar, "Yogapravesha in Kannada"
2	BKS Iyengar "Light on Yoga"

Reference Books

1	M L Gharote & Dr. S K Ganguly, "Teaching Methods for Yogic practices"
2	Yoga Instructor Course hand book published by SVYASA University, Bengaluru
3	Yamini Muthanna," Yoga for Children –step by step"

Semester: III			
Additional Mathematics-I			
Course Code:	MVJ25MATDIP310	Scheme	2025
Type of Course	NCMC	Semester	III
Teaching Hours /Week (L: T:P)	2:0:0:0	CIE Marks:	100
Teaching Hours of Pedagogy (L: T:P:SL & TW)	14:0:0:14	SEE Marks:	----
Credits	0	Total Marks	100
Examination Type	Theory	Exam hours	PP

Course Objectives:

This course will give ability to:

- To familiarize the important and introductory concepts of Differential calculus, Integral calculus, Vector differentiation, Probability, ordinary differential equations of first order, and analyze the engineering problems.

Syllabus

Differential calculus-nth derivative, Leibnitz theorem, Polar curves - angle between the radius vector and tangent, angle between two curves pedal equation, Taylor's and Maclaurin's series expansions, Integral Calculus: Statement of reduction formulae for the integrals of of $\sin^n(x)$, $\cos^n(x), \sin^n x, \cos^m x$,

Evaluation of these integrals with standard limits-problems, Double -Simple examples, Triple integrals, Vector Differentiation: Differentiation of vector functions, Velocity and acceleration of a particle moving on a space curve

Scalar and Vector point functions, Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields, Vector identities - $div(\emptyset\,\vec{A})$, $curl(\emptyset\ \vec{A})$, $curl(grad\ (\emptyset))$, $div(curl\ \vec{A})$, Probability: Basic terminology, Sample space and events, Axioms of probability. Addition and multiplication theorems, Conditional probability, Bayes theorem, Introduction – Formation of differential equation, solutions of first order and first-degree differential equations, Variable separable form, homogeneous Exact, linear differential equations, Clairaut's equation.

Course Plan

Module I

Differential calculus

Sr.No	Topics to be covered	Hours required
1	**Differential calculus**: Recapitulation of successive differentiation -nth derivative	**5 Hrs**
2	Leibnitz theorem (without proof) and Problems	
3	Polar curves - angle between the radius vector and tangent, angle between two curves	
4	pedal equation	
5	Taylor's and Maclaurin's series expansions- Illustrative examples	

Module II

Integral Calculus

Sr. No	Topics to be covered	Hours required
1	**Integral Calculus**: Statement of reduction formulae for the integrals of $\sin^n(x)$, $\cos^n(x), \sin^n x, \cos^m x$	**5 Hr**

2	Evaluation of these integrals with standard limits-problems	
3	Double -Simple examples	
4	Triple integrals-Simple examples	

Module III

Vector Differentiation

Sr. No	Topics to be covered	Hours required
1	Vector Differentiation: Differentiation of vector functions	**5 Hr**
2	Velocity and acceleration of a particle moving on a space curve	
3	Scalar and Vector point functions, Gradient, Divergence, Curl	
4	Solenoidal and Irrotational vector fields	
5	Vector identities - $div(\emptyset\,\vec{A})$, $curl(\emptyset\,\vec{A})$, $curl(grad(\emptyset))$, $div(curl\,\vec{A})$.	

Module IV

Probability

Sr. No	Topics to be covered	Hours required
1	Probability: Basic terminology, Sample space and events	**5 Hr**
2	Axioms of probability. Addition and multiplication theorems	
3	Conditional probability – illustrative examples	
4	Bayes theorem-examples	

Module V

Ordinary Differential Equations of First Order

Sr. No	Topics to be covered	Hours required
1	Introduction – Formation of differential equation, solutions of first order and first degree differential equations	**5 Hr**
2	Variable separable form, homogeneous	
3	Exact, linear differential equations	
4	Some special first order equations: Clairaut's equation	
5	Some special first order equations: Clairaut's equation	

Textbooks:

1. B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2. Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition,2014.
2. G. B. Gururajachar: Calculus and Linear Algebra, Academic Excellent Series Publication, 2018-19

Other References:(NPTEL/SWAYAM. Any Other)

1. https://youtube.com/playlist?list=PL7oBzLzHZ1wXBSiJEgqz_iwVoLiY8qhbv&si=LWY0G3ywwoMbHN9G NPTEL course: Mechanics of Materials by Dr. U Saravanan, IIT Madras.
2. https://youtu.be/rveuCHNkaC4?si=jIJomstkFZySE0tk Mechanics of Solids by Prof. Priyanka Ghosh, IIT Kanpur.
3. https://youtu.be/U-5tA9ZMsno?si=Wcl7W7JN3Wmg3McP
4. https://youtu.be/COI0BUmNHT8?si=77D82b9BAnf-jVT2
5. https://youtu.be/ES741wq3APA?si=iqR2QZ5xreoVGo1v

Course Outcomes:
At the end of the course, the student will be able to:

CO1: Apply the knowledge of calculus to solve problems related to polar curves and its applications
CO2: Apply the concept of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.
CO3: Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors and also exhibit the inter dependence of line, surface and volume integrals.
CO4: Understand the basic Concepts of Probability
CO5: Recognize and solve first-order ordinary differential equations occurring in different branches of engineering

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3		2						1	1
CO2	3	3		2						1	1
CO3	3	3		3							1
CO4	2	2		3						1	1
CO5	2	2		2							1

High-3: Medium-2: Low-1:

Evaluation Method:

Continuous Internal Evaluation (CIE):

- Two CIE Will be conducted for 50 marks each and average of two will be taken (A)
- Alternative Assessment Tools (AAT) should be a project / Quiz/ Seminar cum Presentation / other suitable alternate assessment methods for 30 marks. Two evaluations will be conducted **(B)**
- Two Assignments for 10 marks each and the sum of both the assignments will be taken for 20 Marks (C)

Final CIE Marks will be calculated as (A+B+C) for 100 marks

Course delivery methods		Assessment methods	
1	Chalk and Talk	1	IA tests
2	PPT and Videos	2	Open Book Assignments (OBA)/ Project
3	Flipped Classes	3	AAT(Quiz ,Mini project)