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

Bachelor of Engineering in Aerospace Engineering

Scheme and Syllabus
(2025 Scheme)

III Semester

MVJ College of Engineering, Bengaluru (Autonomous)
B.E. in Aerospace 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 Hours /Week					Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self - Learning	#TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	ASC	MVJ25AS31	Transforms and Probability Distributions	42	28	0	50	120	3	50	50	100	4
2	IPCC	MVJ25AS32	Mechanics of Materials	42	0	28	50	120	3	50	50	100	4
3	PCC	MVJ25AS33	Thermodynamics	42	28	0	50	120	3	50	50	100	4
4	PCC	MVJ25AS34	Mechanics of Fluids	42	0	0	48	90	3	50	50	100	3
5	PCC	MVJ25AS35	Aerospace Materials	42	0	0	48	90	3	50	50	100	3
6	PCCL	MVJ25ASL36	Energy Conversion & Fluid Mechanics Lab	0	0	28	2	30	2	50	50	100	1
7	AEC	MVJ25AECK37	Sustainable Engineering and SDGs	0	0	28	2	30	2	50	50	100	1
8	SDL	MVJ25AS38SL	Aeromodelling and Fabrication Lab	0	0	28	2	30	2	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*	42	0	0	48		3	100	---	100	PP
TOTAL													21

*Applicable for Lateral entry students only

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B.E. in Aerospace Engineering - **Scheme 2025**
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Semester – IV

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week					Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self - Learning	#TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	PCC	MVJ25AS41	Complex Analysis and Optimization Techniques	42	0	0	48	90	3	50	50	100	3
2	IPCC	MVJ25AS42	Low speed Aerodynamics	42	0	28	50	120	3	50	50	100	4
3	PCC	MVJ25AS43	Fundamentals of Aerospace Structures	42	28	0	50	120	3	50	50	100	4
4	PCC	MVJ25AS44	Air Breathing Propulsion	42	28	0	50	120	3	50	50	100	4
5	PCCL	MVJ25ASL45	CAAD Lab	0	0	28	2	30	2	50	50	100	1
6	BSC	MVJ25BI46	Biology for Engineers	2	0	0	58	60	2	50	50	100	2
7	AEC	MVJ25AECK47	Scientific Foundation of Health	0	0	28	2	30	2	50	50	100	1
8	SDL	MVJ25AS48SL	UAV Lab	0	0	28	2	30	2	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*	42	0	0	48	90	3	100	--	100	PP
TOTAL													20

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B.E. in Aerospace Engineering - **Scheme 2025**
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Semester – V

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week					Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self - Learning	#TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	HSMC	MVJ25AS51	Aviation and Air Traffic Management	42	0	0	48	90	3	50	50	100	3
2	IPCC	MVJ25AS52	Rocket Propulsion	42	0	28	50	120	3	50	50	100	4
3	PCC	MVJ25AS53	Finite Element Method	42	0	0	48	90	3	50	50	100	3
4	PCC	MVJ25AS54	High speed Aerodynamics	42	0	0	48	90	3	50	50	100	3
5	PEC	MVJ25AS55X	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	3	50	50	100	2
7	AEC	MVJ25AECK57	Ability Enhancement Course	0	0	28	2	30	2	50	50	100	1
8	SDL	MVJ25AS58SL	Aero Power BI Skill Lab	0	0	28	2	30	2	50	50	100	1
9	PCCL	MVJ26ASL59	Mechanical Measurement & Metrology Lab	0	0	28	2	30	2	50	50	100	1
10	SDC	MVJ25HBP510	Hackathon-Based Project	0	0	0	60	60	3	50	50	100	2
TOTAL													23

Professional Elective Course-I

MVJ25AS55A	Control Engineering	MVJ25AS55C	Heat and Mass Transfer
MVJ25AS55B	Introduction to Astrophysics and Space Environment	MVJ25AS55D	UAV Systems and AIML Applications

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B.E. in Aerospace Engineering - **Scheme 2025**
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Semester – VI

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week					Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self - Learning	#TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	IPCC	MVJ25AS61	Aerospace Structural Analysis	42	0	28	50	120	3	50	50	100	4
2	PCC	MVJ25AS62	Vibration and Aero Elasticity	42	0	0	48	90	3	50	50	100	3
3	PCC	MVJ25AS63	Computational Fluid Dynamics	42	0	0	48	90	3	50	50	100	3
4	PCC	MVJ25AS64	Aerospace Vehicle Design	42	28	0	50	120	3	50	50	100	4
5	PEC	MVJ25AS65x	Professional Elective Courses-II	42	0	0	48	90	3	50	50	100	3
6	PCCL	MVJ25ASL66	Modelling and Analysis Lab	0	0	28	2	30	2	50	50	100	1
7	AEC	MVJ25AECK67	Ability Enhancement Course	0	0	28	2	30	2	50	50	100	1
8	SDL	MVJ25AS68SL	Aero Digital Design Studio	0	0	28	2	30	2	50	50	100	1
9	SDC	MVJ25AS69	Capstone Project – Phase 1	0	0	0	90	90	6	100	--	100	3
10	NCMC	MVJ25UHV610	Universal Human Value	0	0	0	28	28	--	100	--	100	PP
TOTAL													23

Professional Elective Course-II

MVJ25AS65A	Atmospheric Flight Mechanics	MVJ25AS65C	Mechanics of Composite Structures
MVJ25AS65B	ML for Aeronautical and Aerospace Engineering	MVJ25AS65D	Fuels and Combustion Thermodynamics

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B.E. in Aerospace Engineering - **Scheme 2025**
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Semester – VII (Swappable VII and VIII SEMESTER) (SCHEME-A)

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week					Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self - Learning	#TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	IPCC	MVJ25AS71	Space Flight Mechanics	42	0	28	50	120	3	50	50	100	4
2	PEC	MVJ25AS72x	Professional Elective Course-III	42	0	0	48	90	3	50	50	100	3
3	PEC	MVJ25AS73x	Professional Elective Course -IV	42	0	0	48	90	3	50	50	100	3
4	OEC	MVJ25AS74x	Open Elective Course-I	42	0	0	48	90	3	50	50	100	3
5	SDC	MVJ25AS75	Capstone Project - Phase II	0	0	0	210	210	3	100	100	200	7
6	NCMC	MVJ25IKS76	Indian Knowledge System	0	0	0	28	28	---	100	--	100	PP
7	AEC	MVJ25AECK77	Ability Enhancement Course	0	0	28	2	2	2	50	50	100	1
8	SDL	MVJ25AS78SL	Rocket Propulsion skill lab	0	0	28	2	2	2	50	50	100	1
TOTAL													22

Professional Elective Course-III			
MVJ25AS72A	Avionics and Systems	MVJ25AS72C	Fatigue and Fracture Mechanics
MVJ25AS72B	Space Mission Planning and Operations	MVJ25AS72D	Design of Buoyant Aerial Vehicles
Professional Elective Course-IV			
MVJ25AS73A	Reusable Launch Vehicles	MVJ25AS73C	Industrial & Experimental Aerodynamics
MVJ25AS73B	Hypersonic Flows	MVJ25AS73D	Guidance Navigation and Control Systems
Open Elective Course-I			
MVJ25AS74A	Avionics	MVJ25AS74C	Basics of Aerospace Engineering
MVJ25AS74B	Introduction to Drone Technologies	MVJ25XX74D	**Foreign Language** (NPTEL/SWAYAM/online VTU)

MVJ College of Engineering, Bengaluru (Autonomous)
B.E. in Aerospace Engineering - **Scheme 2025**
Outcome-Based Education (OBE)and Choice-Based Credit System (CBCS)
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Semester – VIII (Swappable VII and VIII SEMESTER) (SCHEME-A)

Sl. No.	Course	Course Code	Course Title	Teaching Hours /Week					Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self - Learning	#TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	PEC	MVJ25AS81X	Professional Elective-V (NPTEL/VTU Online Course)	--	--	--	90	90	3	50	50	100	3
2	OEC	MVJ25AS82X	Open Elective-II (NPTEL/VTU Online Course)	--	--	--	90	90	3	50	50	100	3
3	SDC	MVJ25INT83X	Internship (15 weeks or 90 working days)	--	--	--	270	270	3	100	100	200	9
TOTAL													15

Professional Elective-V

MVJ25AS81A	NPTEL/VTU Online Course	MVJ25AS81C	NPTEL/VTU Online Course
MVJ25AS81B	NPTEL/VTU Online Course	MVJ25AS81D	NPTEL/VTU Online Course

Open Elective-II

MVJ25AS82A	NPTEL/VTU Online Course	MVJ25AS82C	NPTEL/VTU Online Course
MVJ25AS82B	NPTEL/VTU Online Course	MVJ25AS82D	NPTEL/VTU Online Course

Types of Internships (Course Code: MVJ25INT83X)

Students shall undertake one of the following internship types during the eighth semester, as per academic guidelines:

1. **MVJ25INT83A – Industry Internship**: Shall involve practical exposure and training within an industrial or corporate setting.
2. **MVJ25INT83B – Research Internship**: Shall focus on academic or applied research under the guidance of faculty or research institutions.
3. **MVJ25INT83C – Post-Placement Internship**: Shall be undertaken by students who have secured placement, aligning with their future employment domain.
4. **MVJ25INT83D – Societal Internship**: Shall engage students in community-based or social impact projects with NGOs, government bodies, or civic organizations.
5. **MVJ25INT83E – Online Internship**: Shall be conducted through recognized digital platforms offering structured internship modules.
6. **MVJ25INT83F – Skill Enhancement Internship**: Shall be opted by students unable to secure internships, offering credit equivalence through curated online courses available at http:// www.online.vtu.ac.in

MVJ College of Engineering, Bengaluru (Autonomous)
B.E. in Aerospace Engineering - Scheme 2025
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VII and VIII semesters for the candidates who opt for a two-semesters internship along with Capstone Project (Scheme B)

Sl. No.	Course	Course Code	Course Title	Teaching Hours /Week					Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self - Learning	#TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	SL						
1	IPCC	MVJ25AS71	Space Flight Mechanics	42	0	28	50	120	3	50	50	100	4
2	PEC	MVJ25AS72X	Professional Elective Course-III (NPTEL/VTU Online Course)	42	0	0	48	90	3	50	50	100	3
3	PEC	MVJ25AS73X	Professional Elective Course-IV (NPTEL/VTU Online Course)	42	0	0	48	90	3	50	50	100	3
4	OEC	MVJ25AS74X	Open Elective Course -I (NPTEL/VTU Online course)	42	0	0	48	90	3	50	50	100	3
5	SDC	MVJ25AS75	Capstone Project - Phase-II	0	0	0	210	210	3	100	100	200	7
6	NCMC	MVJ25IKS76	Indian Knowledge System (VTU online)	0	0	0	28	28	---	100	--	100	PP
7	AEC	MVJ25AECK77	Ability Enhancement Course	0	0	28	2	2	2	50	50	100	1
8	SDC	MVJ25AS78SL	Rocket Propulsion skill lab	0	0	28	2	2	2	50	50	100	1
Total													**22**
1	PEC	MVJ25AS81X	Professional Elective-V (NPTEL/VTU Online Course)	--	--	--	90	90	3	50	50	100	3
2	OEC	MVJ25AS82X	Open Elective-II (NPTEL/VTU Online Course)	--	--	--	90	90	3	50	50	100	3
3	SDC	MVJ25INT83X	Internship (Two- semester internship for a minimum Period of 180 working days or -30 weeks)	--	--	--	270	270	3	100	100	200	9
Total													15
7th semester and 8th semester Credits Total													**37**

Professional Elective Course-III			
MVJ25AS72A	NPTEL/VTU Online Course	MVJ25AS72C	NPTEL/VTU Online Course
MVJ25AS72B	NPTEL/VTU Online Course	MVJ25AS72D	NPTEL/VTU Online Course
Professional Elective Course-IV			
MVJ25AS73A	NPTEL/VTU Online Course	MVJ25AS73C	NPTEL/VTU Online Course
MVJ25AS73B	NPTEL/VTU Online Course	MVJ25AS73D	NPTEL/VTU Online Course
Open Elective Course-I			
MVJ25AS74A	NPTEL/VTU Online Course	MVJ25AS74C	NPTEL/VTU Online Course
MVJ25AS74B	NPTEL/VTU Online Course	MVJ25AS74D	NPTEL/VTU Online Course
Professional Elective Course-V			
MVJ25AS81A	NPTEL/VTU Online Course	MVJ25AS81C	NPTEL/VTU Online Course
MVJ25AS81B	NPTEL/VTU Online Course	MVJ25AS81D	NPTEL/VTU Online Course
Open Elective Course-II			
MVJ25AS82A	NPTEL/VTU Online Course	MVJ25AS82C	NPTEL/VTU Online Course
MVJ25AS82B	NPTEL/VTU Online Course	MVJ25AS82D	NPTEL/VTU Online Course

Types of Internships (Course Code: MVJ25INT83X)

Students shall undertake one of the following internship types during the eighth semester, as per academic guidelines:

1. **MVJ25INT83A – Industry Internship**: Shall involve practical exposure and training within an industrial or corporate setting.
2. **MVJ25INT83B – Research Internship**: Shall focus on academic or applied research under the guidance of faculty or research institutions.
3. **MVJ25INT83C – Post-Placement Internship**: Shall be undertaken by students who have secured placement, aligning with their future employment domain.
4. **MVJ25INT83D – Societal Internship**: Shall engage students in community-based or social impact projects with NGOs, government bodies, or civic organizations.
5. **MVJ25INT83E – Online Internship**: Shall be conducted through recognized digital platforms offering structured internship modules.
6. **MVJ25INT83F – Skill Enhancement Courses (SEC):** Shall be opted by students unable to secure internships, offering credit equivalence through curated online courses available at http:// www.online.vtu.ac.in

To ensure uniformity, quality, and transparency in the internship process, **VTU has launched a centralized web portal** that serves as a **single platform** for all internships opportunities. Reputed **industries, Centers of Excellence, Research Laboratories**, and other recognized bodies will be registered on this portal. **Students must choose internships exclusively through this portal. No other mode of internship selection will be permitted**.

Transforms and Probability Distributions			
Course Code:	MVJ25AS31	Scheme	2025
Type of Course	ASC	Semester	III
Teaching Hours/Week (L:T:P)	3:2:0	CIE Marks	50
Total Hours of Pedagogy (L:T:P:SL&TW)	42:28:0:50	SEE Marks	50
Credits:	4	Total Marks	100
Examination type (SEE)	Theory	SEE Duration	3 Hours

Course Objectives:

This course will give ability to:

- Apprehend and apply Laplace and Fourier Series.
- Realize and use of Fourier and Z transforms in engineering field.
- Use of probability distributions in engineering application.

Syllabus

The syllabus on Transforms and statistical methods focuses on the mathematical techniques used to analyze transform equations for easier problem-solving. It covers the Laplace Transform, which is widely used for solving differential equations, and Fourier Series and Fourier and Z Transforms, which are used to represent and analyze periodic and non-periodic signals in the frequency domain. The course also includes the study of probability distribution methods.

Course Plan

Module I

Laplace Transforms

Sl.No	Topics to be covered	Hours Required
1	Laplace transforms: Definition, elementary functions, periodic function-problems.	9
2	Properties of Laplace transform: linearity and shifting - problems.	
3	Inverse Laplace Transforms by method of partial fraction -problems.	
4	Unit step function and Convolution theorem- problems.	
5	Applications of Inverse Laplace transforms: Solving linear differential equations-problems (Initial Value Problems).	

Module II

Fourier Series

Sl.No	Topics to be covered	Hours Required
1	Fourier series: Recapitulation of Series, Periodic functions, Dirichlet's condition.	8
2	Fourier series of periodic functions with period 2π and arbitrary period $2l$ – problems.	
4	Half-range Fourier series –problems.	
5	Practical Harmonic analysis-problems.	

Module III

Fourier transforms

Sl.No	Topics to be covered	Hours Required
1	Infinite Fourier transforms: Definition -Problems	9
2	Fourier sine transform-Problems	
3	Fourier cosine transform-Problems	

4	Properties Fourier transform-Problems	
5	Inverse Fourier transforms – problems.	

Module IV		
Z-transforms		
Sl.No	Topics to be covered	Hours Required
1	Z-transforms: Definition, Standard z-transforms –problems.	8
2	Linearity property, damping rule and applications of damping rule.	
3	Shifting rule property - problems, and initial value and final value theorem (Statements only).	
4	Inverse Z-transform by partial fractions method – problems.	
5	Problems on difference equations.	

Module V		
Probability Distribution		
Sl.No	Topics to be covered	Hours Required
1	Random variables (discrete and continuous), probability mass/density functions.	8
2	Binomial distribution, Poisson distribution.	
3	Exponential distribution.	
4	Normal distributions.	
5	Joint Probability distribution for two discrete random variables.	

Textbooks:

1. R. K, Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Publishing House,2012.
2. B.S. Grewal "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.

Reference Books:

1. Dr. K. S. C, "Engineering Mathematics-II" Sudha Publications, 2016
2. N.P Bali and Dr. Manish Goyal, "Engineering Mathematics", 9th Edition, 2014.

Other References:(NPTEL/SWAYAM. Any Other)

1. NPTEL course: Advanced Engineering Mathematics by Prof. P. N. Agarwal, IIT Roorke. https://nptel.ac.in/courses/111107119
2. NPTEL course: Advanced calculus for Engineer by Prof. Somesh Kumar, IIT Kharagpur. https://nptel.ac.in/courses/111105160

Course Outcomes:

The student will be able to:

CO1: Apply integral transforms (Laplace, Fourier, and Z-transforms) to solve linear differential equations, difference equations, and initial value problems.

CO2: Analyze periodic, non-periodic, discrete, and continuous functions by representing them in frequency, time, and spectral domains

CO3: Evaluate engineering systems and signals using operational properties, inversion methods, and convolution theorems across various transform domains.

CO4: Formulate probabilistic models using discrete and continuous random variables to predict outcomes and analyze data distributions.

CO-PO Mapping:

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

High-3: Medium-2: Low-1

Evaluation Method:

Continuous Internal Evaluation (CIE):

- Three Internal Tests will be conducted for 50marks 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 10marks 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 Borad	1	IA tests
2	PPT and Videos	2	Open Book Assignments (OBA)/ AAT/Quiz/Seminar cum Presentation
		3	Semester End Examination

B.E, Aerospace Engineering

Mechanics of Materials			
Course Code:	MVJ25AS32	Scheme	2025
Type of Course	IPCC	Semester	III
Teaching Hours/Week (L:T:P)	3:0:2	CIE Marks	50
Total Hours of Pedagogy (L:T:P:SL&TW)	42:0:28:50	SEE Marks	50
Credits:	4	Total Marks	100
Examination type (SEE)	Theory + Practical	SEE Duration	3 Hours

Course Objectives:

This course will give ability to:

- Develop a strong foundation in the mechanics of materials by studying the concepts of stress, strain, and material behavior and their influence on structural response under external loads.
- Apply fundamental principles of strength of materials to determine internal forces, stresses, and deformations in structural elements such as bars, beams, trusses, and shafts subjected to different loading conditions.
- Analyze the behavior of structural systems using analytical and graphical methods, including equilibrium concepts, deflection techniques, torsion theory, and Mohr's circle for stress transformation.
- Investigate material and structural performance through experimental methods, including mechanical testing and non-destructive testing, and interpret results to assess failure behavior of engineering materials.

Syllabus Summary

This course introduces the fundamental concepts of stress, strain, and material behavior. It examines the deformation of structural elements such as bars, beams, and shafts under axial, bending, and torsional loads, including the formulation of governing relationships. The course covers shear force and bending moment analysis, beam deflection, torsion and power transmission in shafts, and stresses in thin and thick cylinders. It also includes stress transformation, graphical representation of the state of stress, and applications of virtual work principles and energy methods.

Course Plan

Module I

Basics & Axial Deformation of Bars

Sl.No	Topics to be covered	Hours Required
1	Introduction: concept of equilibrium, stress, strain, Hooke's law, stress-strain diagram for ductile and brittle materials, allowable stress, normal and shear stresses and strains	8
2	Axial deformation of bars: general derivation of stress, strain and displacement equations, numerical on bars with constant cross-sections.	
3	Axial deformation of bars: Principle of superposition, numerical on bars with varying cross-sections, elongation due to self-weight	
4	Axial deformation of bars: numerical on composite bar & temperature stresses	
5	Volumetric strain, Relationship between elastic constants: Numerical problems	

Module II

Shear Force & Bending Moments in Beams

Sl.No	Topics to be covered	Hours Required

1	Introduction: types of beams, loads and reactions, sign conventions, relationship between shear force, bending moment and load intensity, shear force and bending moment diagrams	9
2	Shear force and bending moment diagrams for cantilever and simply supported beams subjected to concentrated loads, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple: Numerical problems	
3	Shear force and bending moment diagrams for cantilever and simply supported beams with combinations of various loads: Numerical problems	
4	Shear stress in rectangular cross section: only explanation of the formula and the distribution of stress	

Module III

Deflection of Beams

Sl.No	Topics to be covered	Hours Required
1	Classical/Euler-Bernoulli Beam Theory: introduction, assumptions and their implications, derivation, differential equation for deflection, slope and bending moment	8
2	Double Integration Method Numerical: cantilever and simply supported beams with point load, UDL, UVL and couple	
3	Macaulay's Method Numerical: simply supported beams with point loads and UDL	

Module IV

Torsion of Shafts & Plane Stress Analysis

Sl.No	Topics to be covered	Hours Required
1	Torsion of circular shafts: introduction to pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity/stiffness of shafts	8
2	Numerical: power transmitted by solid and hollow circular shafts.	
3	Explanation of stress distribution in thin and thick cylinders	
4	Introduction to Plane stress, stresses on inclined sections, principal stresses & strains	
5	Representation of Mohr's Circle	

Module V

Virtual Work & Energy Methods

Sl.No	Topics to be covered	Hours Required
1	Virtual work principles: Introduction, Equilibrium and work fundamentals, Principle of virtual work, Principle of virtual work applied to mechanical systems.	9
2	Virtual work principles: Principle of complementary virtual work, Internal virtual work in beams and solids.	
3	Energy methods: Conservative forces, Internal strain energy in springs, beams and solids, Principle of minimum total potential energy	
4	Energy methods: Betti-Maxwell Reciprocal Theorem, Castigliano's theorem.	
	Laboratory Experiments	

1. Tensile test on mild steel specimen using Universal Testing Machine
2. Single and Double shear test on a mild steel specimen using Universal Testing Machine
3. Compression test on mild steel specimen using Universal Testing Machine
4. Determination of hardness using Brinell Hardness and Rockwell Hardness Testing Machine
5. Flexural test on a wooden specimen under four-point bending using Universal Testing Machine

6. Torsional test on mild steel specimen using Torsion Testing Machine
7. Determination of the impact strength of a mild steel specimen using the Izod Impact Test
8. Determination of the impact strength of a mild steel specimen using the Charpy Impact Test
9. Preparation of specimen for metallographic examination of different engineering materials
10. Dye penetration test to detect the flaws on the surface of a specimen

Textbooks:

1. T.H.G Megson, "Introduction to Aircraft Structural Analysis", Butterworth-Heinemann Publications, 2007, ISBN 13: 9781856179324.
2. Beer F.P. and Johnston.R, "Mechanics of Materials", McGraw Hill Publishers, 2006, ISBN13:978-0073380285.

Reference Books:

1. Gere, Timoshenko, "Mechanics of Materials", McGraw Hill, Reprint 2020. B. C.
2. Russell C. Hibbeler, "Mechanics of Materials", Pearson, 9th Edition, 2014.

Other References:

1. **NPTEL Course: Strength of Materials,** by Prof. K. Ramesh, Dr. Hariprasad M P, **IIT Madras.** https://onlinecourses.nptel.ac.in/noc26_me70/preview
2. **NPTEL Course: Aircraft Structures - I, by Prof. Anup Ghosh, IIT Kharagpur.** https://nptel.ac.in/courses/101105084

Course Outcomes:

The student will be able to:

CO1: Explain the fundamental concepts of stress, strain, and material behavior, and interpret structural responses such as shear force, bending moment, beam deflection, torsion, virtual work, and energy methods under external loading conditions.

CO2: Apply the principles of stress–strain relationships, shear force, bending moment, torsion, and beam deflection to calculate internal forces, stresses, and deformations in structural elements such as bars, beams, trusses, and shafts.

CO3: Analyze mechanical and structural systems using equilibrium principles, energy theorems, deflection techniques, torsion theory, and graphical methods such as Mohr's circle to determine stress states and structural response.

CO4: Evaluate material and structural behavior using results from mechanical testing and non-destructive testing (tensile, compressive, impact, hardness, and NDT tests) for applications considering ductile and brittle failure modes.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2											2
CO2	3	3	2		2								2
CO3	3	3	2	2	2								2
CO4	2	2	1	3	3								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.

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).

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

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

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)		

Thermodynamics			
Course Code:	MVJ25AS33	Scheme	2025
Type of Course	PCC	Semester	III
Teaching Hours/Week (L:T:P)	3:0:2	CIE Marks	50
Total Hours of Pedagogy (L:T:P:SL&TW)	42:28:0:50	SEE Marks	50
Credits:	4	Total Marks	100
Examination type (SEE)	Theory	SEE Duration	3 Hours

Course Objectives:

This course will give ability to:

- Understand fundamentals of thermodynamics using a macroscopic approach to systems, properties, and processes.
- Apply the first and second laws to closed and open systems, heat engines, and cycles.
- Analyze air standard cycles such as Otto, Diesel, and Brayton for performance evaluation.
- Evaluate pure substances and use steam tables in engineering applications.
- Explore heat transfer modes including conduction, convection, radiation, and their applications in heat exchangers and jet engine cooling.

Syllabus Summary

Fundamentals of thermodynamics, macroscopic approach to thermodynamic systems, properties, processes, and the first law of thermodynamics with applications to closed and open systems. second law of thermodynamics, heat engines, Carnot cycle, entropy, and Clausius inequality. Air standard cycles such as Otto, Diesel and Brayton cycle. Pure substance and applications of steam tables. Heat transfer modes—conduction, convection, and radiation—heat exchangers, and radiation properties, with a case study on jet engine cooling techniques.

Course Plan

Module I

Fundamentals of Thermodynamics

Sl.No	Topics to be covered	Hours Required
1	Microscopic and Macroscopic approach to thermodynamic systems	9
2	Types of systems: open, closed, isolated, Properties-state, path, process and cycle, intensive and extensive properties	
3	Thermodynamic equilibrium, Quasi and non-quasi-static process, zeroth of law thermodynamics, concept of temperature	
4	Energy interactions: Work and Heat	
5	Pdv work for the thermodynamic process	
6	Numerical Problems	

Module II

First Law of Thermodynamics

Sl.No	Topics to be covered	Hours Required
1	First law of thermodynamics-internal energy, enthalpy	8
2	Applications of the first law of thermodynamics to closed and open systems	
3	Applications to non-flow processes	
4	Steady flow energy equation	

5	SFEE Applications: Nozzles, Diffusers, Turbines, Compressors, Pumps, Heat exchangers	
6	Limitations of the first law (PMM1)	
7	Numerical Problems	

Module III		
Second Law of Thermodynamics		
Sl.No	Topics to be covered	Hours Required
1	Kelvin–Planck & Clausius statements, PMM2	8
2	Equivalence of Kelvin-Plank and Clausius statements, Heat engines, heat pumps and refrigerators	
3	Reversible and irreversible processes	
4	Carnot cycle and Carnot theorem	
5	Entropy, change of entropy for different processes	
6	Clausius inequality	
7	Numerical Problems	

Module IV		
Pure Substances and Air Standard Cycles		
Sl.No	Topics to be covered	Hours Required
1	Phase-change processes	9
2	Property diagrams: P–V, T–S, h–s charts	
3	Steam tables and Mollier chart	
4	Ideal gas equation and real gas behavior	
5	Thermodynamic analysis of air standard cycles: Otto cycle & Diesel cycle	
6	Thermodynamic analysis of air standard cycles: Brayton cycle	
7	Numerical Problems	

Module V		
Fundamentals of Heat Transfer		
Sl.No	Topics to be covered	Hours Required
1	Introduction to different modes of Heat Transfer: Conduction, convection and radiation heat transfer	8
2	Heat conduction through composite walls	
3	Overview of different types of heat exchangers - heat transfer coefficient for parallel and counter heat exchangers	
4	Radiation properties	
5	Case study: Jet Engine cooling – Effective heat transfer methods/techniques	
6	Numerical Problems	

Textbooks:

1. P K Nag, "Basic and Applied Thermodynamics", 2nd Edition, Tata McGraw Hill Pub. 2002, ISBN 13: 9780070151314

2. Yunus A. Cenegal and Michael A.Boles, "Thermodynamics: An Engineering Approach", Tata McGraw Hill publications, 2002, ISBN 13: 9780071072540
3. Yunus A. Cengel, "Heat Transfer–Apractical approach", 2nd Edition, Tata McGraw-Hill,2002.

Reference Books:

1. J. B. Jones and G. A. Hawkins, "Engineering Thermodynamics", Wiley 1986, ISBN 13: 9780471812029
2. Hill Philip, Peterson Carl, "Mechanics and Thermodynamics of Propulsion", 2ndEdition, Addison Wesly, 2009.

Other References:

1. NPTEL Course: Thermodynamics, by Prof. Anand T. N. C., IIT Palakkad https://onlinecourses.nptel.ac.in/noc23_me76/preview
2. NPTEL Course: Engineering Thermodynamics, by Prof. D.P. Mishra, IIT Kanpur https://onlinecourses.nptel.ac.in/noc22_ae17/preview

Course Outcomes:

The student will be able to:

CO1: Explain thermodynamic principles and demonstrate their application to real engineering systems.
CO2: Apply steam tables to determine properties of pure substances in power and refrigeration systems.
CO3: Evaluate work and efficiency of heat engines, Carnot cycle, and practical cycles.
CO4: Design and analyze heat exchangers and evaluate cooling techniques for jet engines using conduction, convection, and radiation principles.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	3	3	3										2
CO3	3	3	3										2
CO4	2	2	2	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)		

Mechanics of Fluids			
Course Code:	MVJ25AS34	Scheme	2025
Type of Course	PCC	Semester	III
Teaching Hours/Week (L:T:P)	3:0:0	CIE Marks	50
Total Hours of Pedagogy (L:T:P:SL&TW)	42:0:0:48	SEE Marks	50
Credits:	3	Total Marks	100
Examination type (SEE)	Theory	SEE Duration	3 Hours

Course Objectives:

This course will give ability to:

- To introduce fundamental principles of fluid mechanics and understand the physical properties of fluids relevant to aerospace applications.
- To gain knowledge on fluid statics and pressure measurement techniques used in engineering systems.
- To understand fluid kinematics and analyze different types of fluid flow patterns and velocity fields.
- To apply governing equations of fluid dynamics, dimensional analysis, and similarity principles to engineering problems.
- To study boundary layer behavior, internal viscous flows, and energy losses in pipes and aerodynamic systems.

Syllabus Summary

Fluid Mechanics covers the behavior of fluids at rest and in motion, including fluid properties, pressure distribution, buoyancy, and measurement methods. It explains fluid flow through kinematics and dynamics using continuity, momentum, and energy equations, along with flow patterns and visualization. The subject also includes dimensional analysis, boundary layer concepts, and the study of internal and external viscous flows, highlighting Reynolds number effects and energy losses in pipe flow systems.

Course Plan

Module I

Basics of Fluids and Fluid Statics

Sl.No	Topics to be covered	Hours Required
1	Basic Considerations: Introduction to fluid-mechanics, application areas of fluid mechanics, no-slip condition	9
2	Classification of fluids, control volume, continuum, properties of fluids: density and specific gravity, compressibility and bulk modulus, vapor pressure and cavitation, viscosity	
3	Newton's law of viscosity, surface tension and capillary effect.	
4	Pressure and Fluid Statics: Pressure at a point, Pascals Law, Hydrostatic law, Pressure Measurement devices (manometers),	
5	Basic theory of Hydrostatic Forces on Submerged plane and curved surfaces, concept of buoyancy and centre of pressure	

Module II

Fluid Kinematics

Sl.No	Topics to be covered	Hours

		Required
1	Fluid Kinematics: Lagrangian and Eulerian Descriptions, Types of fluid flow, uniform & non-uniform, steady & unsteady	8
2	Compressible & incompressible, one-dimensional, two-dimensional and three-dimensional flows, rotational & irrotational flows, laminar & turbulent flow, ideal & real flows,	
3	Velocity potential function and Stream function	
4	Continuity, Momentum equations, Energy equations (Conservative and Non-Conservative)	
Module III		
Fluid Dynamics and Dimensional Analysis		
Sl.No	Topics to be covered	Hours Required
1	Fluid Dynamics: Equations of motion: Euler's and Bernoulli's equation of motion for ideal and real fluids,	9
2	Fluid flow measurements: Orificemeter, Venturimeter	
3	Pitot tube. Numerical problems.	
4	Dimensional Analysis and Similarity: Dimensional homogeneity, methods of dimensional analysis, Buckingham pi theorem, model analysis	
5	Types of similarity and similitude. Dimensionless numbers. Model laws. Numerical problems.	
Module IV		
Boundary Layer		
Sl.No	Topics to be covered	Hours Required
1	Boundary Layers Theory: Introduction to boundary layer	8
2	Boundary layer thickness, displacement thickness, momentum thickness	
3	Energy thickness, Karman's integral momentum theory	
4	Drag force on flat plate due to boundary layer	
5	Separation of boundary layer	
Module V		
Internal Flows		
Sl.No	Topics to be covered	Hours Required
1	Internal Flows: Reynolds Experiment and Reynolds number regimes,	8
2	Internal and External Viscous Flow, Flow of viscous fluid through a circular pipe (Hagen Poiseuille Formula)	
3	Flow of viscous fluid through parallel plates (Coutte flow)	
4	Losses in pipe Flow: Expression for loss of head due to friction in pipe	
5	Major and minor energy losses.	

Textbooks:

1. Bansal, R.K, "Fluid Mechanics and Hydraulics Machines", Laxmi Publications (P) Ltd., New Delhi 2015.

2. Yunus A. Cengel& John M Cimbala, "Fluid Mechanics and Applications", McGraw Hill Education; 3rd edition, 2013.

Reference Books:

1. Frank M. White, Fluid Mechanics, McGraw-Hill, Seventh Edition, ISBN 978-0-07-352934-9.
2. Kundu P., Cohen I., Fluid Mechanics, Academic Press, Elesvier, 4 th edition.
3. Rathakrishnan. E, "Fluid Mechanics", Prentice-Hall of India Pvt Ltd, 2010.
4. Ramamritham. S, "Hydraulic Fluid Mechanics and Fluid Machines", Dhanpat Rai& Sons, Delhi, 1988.

Other References:

1. NPTEL Course: Fluid Mechanics, by Prof. Gautam Biswas, Prof. Suman Chakraborty, IIT Kanpur https://nptel.ac.in/courses/112104118
2. NPTEL Course: Introduction to Fluid Mechanics, By Prof. Suman Chakraborty, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc25_me41/preview

Course Outcomes:

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

CO1: Explain the fundamental concepts of fluid mechanics and interpret fluid behavior in static and dynamic conditions, including pressure variation and boundary layer concepts.

CO2: Apply fluid mechanics principles such as continuity, momentum, energy equations, and flow measurement techniques to solve engineering problems

CO3: Analyze fluid flow systems by evaluating flow characteristics, boundary layer effects, similarity laws, and energy losses in pipes.

CO4: Evaluate and justify appropriate models, methods, and devices for analyzing and solving complex fluid flow problems.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													2
CO2	3	3		2								2	2
CO3	3	2		2	2							2	3
CO4	3	3	2	2	2	2						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) 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)		

B.E, Aerospace Engineering

Aerospace Materials			
Course Code:	MVJ25AS35	Scheme	2025
Type of Course	PCC	Semester	III
Teaching Hours/Week (L:T:P)	3:0:0	CIE Marks	50
Total Hours of Pedagogy (L:T:P:SL&TW)	42:0:0:48	SEE Marks	50
Credits:	3	Total Marks	100
Examination type (SEE)	Theory	SEE Duration	3 Hours

Course Objectives:

This course will give ability:

- To understand the mechanical behaviour and classification of materials used in aerospace applications.
- To study and explain the properties, processing, and applications of non-ferrous materials in aircraft construction.
- To analyze ferrous materials, maraging steels, and superalloys for high-performance aerospace applications.
- To demonstrate the knowledge of the broad range of Additive manufacturing processes, devices, capabilities and materials that are available.
- To apply the concepts of additive manufacturing to design and create components that satisfy product development/prototyping requirements, using advanced/additive manufacturing devices and processes.

Syllabus Summary

Mechanical behaviour and classification of aerospace materials – non-ferrous materials such as aluminium, magnesium, titanium, composites and their aircraft applications – ferrous materials including steels, maraging steels and superalloys – traditional manufacturing processes like casting, metal forming, machining, and joining techniques – advanced manufacturing processes including superplastic forming and additive manufacturing – corrosion, material testing, and non-destructive inspection methods for aerospace components.

Course Plan

Module I

Mechanical Behaviour of Engineering Materials

Sl.No	Topics to be covered	Hours Required
1	Introduction to aerospace materials and their classification, Linear and non-linear elastic properties	8
2	Stress and Strain Curves-Yielding and strain Hardening	
3	Toughness- Modules of resilience - Bauchinger's effect	
4	Effect of notches-Testing and flaw detection of materials and components	
5	Knowledge of various material testing machines.	

Module II

Non-ferrous materials in aircraft construction

Sl.No	Topics to be covered	Hours Required
1	Aluminium and Its Alloys: Types and identification.	9

2	Properties -Castings-Heat treatment processes —Surface treatments	
3	Magnesium and its alloys: Cast and Wrought Alloys-Aircraft application, features specification, fabrication problems, Special treatments.	
4	Titanium and its alloys: Applications, machining, forming, welding and heat treatment, Copper Alloys.	
5	Wood and fabric in aircraft construction and specifications- Glues Use of glass, plastics & rubber in aircraft, Introduction to glass & carbon composite.	
Module III		
Ferrous materials in aircraft construction		
Sl.No	Topics to be covered	Hours Required
1	Steels: Plain and low carbon steels, various low alloy steels, aircraft steel specifications	8
2	Aircraft steel specifications, corrosion and heat-resistant steels, structural applications	
3	Maraging Steels: Properties and Applications.	
4	Super Alloys: Use -Nickel base-Cobalt base- Iron base -Forging and Casting of Super Alloys-Welding, Heat treatment	
5	High-end materials for aerospace applications.	
Module IV		
Additive manufacturing		
Sl.No	Topics to be covered	Hours Required
1	Introduction and basic principles: Need for Additive Manufacturing,	8
2	Generic AM process, stereo lithography or 3dprinting, rapid prototyping,	
3	The benefits of AM, distinction between AM and CNC machining, other related technologies- reverse engineering technology.	
4	Development of Additive Manufacturing Technology: Introduction, computers, computer-aided design technology, other associated technologies, the use of layers,	
5	Classification of AM processes, metals systems, hybrid systems, milestones in AM development.	
Module V		
Additive Manufacturing Process chain		
Sl.No	Topics to be covered	Hours Required
1	Introduction, the eight steps in additive manufacture, variations from one AM machine to another, metal systems, maintenance of equipment, materials handling issues, design for AM, and application areas.	9
2	Photo polymerization processes: Stereo lithography (SL), Materials, SL resin curing process, Micro- Stereo lithography,	
3	Process Benefits and Drawbacks, Applications of Photo polymerization Processes. Powder bed fusion processes	
4	Introduction, Selective laser Sintering (SLS)Materials, Powder fusion mechanism, SLS Metal and ceramic part creation,	
5	Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of	

	Powder Bed Fusion Processes.	

Textbooks:

1. Titterton GF, "Aircraft Material and Processes", English Book Store, New Delhi, 5th edition, 1998, ISBN-13: 978-8175980136.
2. H Buhl, "Advanced Aerospace Materials", Springer, Berlinl992, ISBN-13: 978-3540558880.
3. Adrian P. Mouritz, "Introduction to Aerospace Materials", Woodhead Publishing, 2012, ISBN 978-1-85573-946-8.
4. Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing I. Gibson l D. W. Rosen l B. Stucker Springer New York Heidelberg Dordrecht, London ISBN: 978-1- 4419-1119-3 e-ISBN: 978- 1-4419- 1120-9 DOI 10.1007/978 -1-4419- 1120-9

Reference Books:

1. Balram Gupta, "Aerospace Materials" (Vols. 1-4), S. Chand & Co. in association with ARDB, 2009.
2. E. R. Parker, Materials for Missiles and Space, McGraw-Hill Inc., 1963.
3. B. Raj, T. Jayakumar, and M. Thavasimuthu, "Practical Non-Destructive Testing", Narosa Publishing House, New Delhi, 2012.
4. King and Butler, "Principles of Engineering Inspection", Clever Humes Press, 2003.
5. Additive Manufacturing Technology Hari Prasad, A.V.Suresh Cengage 2019

Other References:

1. NPTEL Course: Fundamentals of Manufacturing Processes, by Prof. Dheerendra Kumar Dwivedi, IIT Roorkee, https://www.nptel.ac.in/courses/112107219/
2. Coursera Course: Ferrous Technology II, by Sung-Joon Kim, Youn-Bae Kang, Dong Woo Suh, Nack Joon Kim, Pohang University of Science and Technology (POSTECH). https://www.coursera.org/lecture/ferrous-technology-2/introduction-and-classification-mknez

Course Outcomes:

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

CO1: Explain the mechanical behaviour, deformation, and failure characteristics of aerospace materials.
CO2: Identify and compare non-ferrous aerospace materials based on properties, processing, and applications.
CO3: Analyze the suitability of ferrous materials, maraging steels, and superalloys for structural and high-temperature uses.
CO4: Describe and select appropriate manufacturing processes for aerospace materials from traditional to advanced methods.
CO5: Apply the concepts of additive manufacturing to design and create components that satisfy product development/prototyping requirements, using advanced/additive manufacturing devices and processes.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	3	2											2
CO3	3	3										3	2
CO4	2	2	2		1							2	3
CO5	2	3	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) 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)		

B.E, Aerospace Engineering

Energy Conversion & Fluid Mechanics Lab			
Course Code:	MVJ25ASL36	Scheme	2025
Type of Course	PCCL	Semester	III
Teaching Hours/Week (L:T:P)	0:0:2	CIE Marks	50
Total Hours of Pedagogy (L:T:P:SL&TW)	0:0:28:2	SEE Marks	50
Credits:	1	Total Marks	100
Examination type (SEE)	Practical	SEE Duration	3 Hours

Course Objectives:

This course will give ability to:

- Understand various concepts and definitions of thermodynamics.
- Comprehend the first law of thermodynamics.
- Comprehend the Second Law of Thermodynamics
- Acquire the knowledge of Pure Substances & various types of gas cycles
- Acquire knowledge of Heat transfer.

Guidelines/ Specific Requirements, if any:

All consumables are kept ready to conduct the experiment

Expt.No	Experiments List
1.	Determination Flash point and Fire point of lubricating oil using following Apparatus Abel, Pensky Martin, Cleave land and Compare them
2.	Determination of Viscosity of lubricating oil using Torsion viscometers, Red wood viscometer, Saybolt viscometers and compare them.
3.	Valve Timing diagram of a 4-stroke IC Engine.
4.	Performance Test on a four-stroke IC engine and Evaluate Indicated Power, Brake Power, Friction Power, Thermal efficiencies and Specific Fuel Consumption.
5.	Determination of Heat Transfer Coefficients in Parallel and Counter-Flow Heat Exchangers
6	Determination of the convective heat transfer coefficient for the composite materials.
7	Determination of the coefficient of discharge by Venturimeter
8	Determination of the coefficient of discharge using orifice meter
9	Determination of Friction Factor in Pipes (Major Losses)
10	Determination of Minor Losses in Pipe Fittings, Sudden Expansion, Sudden Contraction and Bend
11	Performance Characteristics and Testing of a Centrifugal Pump
12	Performance Test and Evaluation of a Multi-Stage Reciprocating Air Compressor

Course Outcomes:

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

CO1: Apply fundamental principles of fluid mechanics, heat transfer, and thermodynamics to safely operate thermal, fluid, and energy conversion systems.

CO2: Analyze the operational performance and characteristic behavior of IC engines, fluid machinery (pumps, compressors), and heat exchangers through experimental testing

CO3: Evaluate physical properties of fuels/lubricants (viscosity, flash/fire points) and system parameters (friction factors, loss coefficients, discharge rates) using standardized testing apparatus.

CO4: Compare and Validate experimental data derived from varying apparatus, flow geometries, and configurations to draw technically sound engineering conclusions.

CO-PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	3	2								2	3
CO2	3	3	3	2								2	3
CO3	3	3	3	2								2	3
CO4	3	3	3	2								2	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 / Sketch Book for Each exp (15 Marks) + Experiment Conduction/ Execution (15 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:

- Part A: 10 marks
- Part B : 10 marks
- Part C: 30marks
- Total 50 marks

The Final mark for the course is the sum of 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)		

Sustainable Engineering and SDG's			
Course Code:	MVJ25ASCK37	Scheme	2025
Type of Course	AEC	Semester	III
Teaching Hours/Week (L:T:P)	0:0:2	CIE Marks	50
Total Hours of Pedagogy (L:T:P:SL&TW)	14:0:0:16	SEE Marks	50
Credits	1	Total Marks	100
Examination type (SEE)	Practical	SEE Duration	3 Hours

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	Hours Required
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
Module II	**Hours Required**
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 foot print, legal provisions for environmental protection.	3
Module III	**Hours Required**
Environmental management standards: ISO 14001:2015 frame work 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

Module IV	Hours Required
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, bio-fuels, Energy derived from oceans and Geothermal energy.	3
Module V	**Hours Required**
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.	3

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:

3. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
4. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
5. Allenby, B. R., The Sustainability Engineering Handbook, McGraw-Hill.
6. Mihelcic, J. R. and Zimmerman, J. B., Environmental Engineering: Fundamentals, Sustainability, Design, Wiley.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
8. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
9. 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.

Aeromodelling and Fabrication Lab			
Course Code:	MVJ25AS38SL	Scheme	2025
Type of Course	SDL	Semester	III
Teaching Hours/Week (L:T:P)	0:0:2	CIE Marks	50
Total Hours of Pedagogy (L:T:P:SL&TW)	0:0:28:2	SEE Marks	50
Credits:	1	Total Marks	100
Examination type (SEE)	Practical	SEE Duration	3 Hours

Course Objectives:

This course will give ability to:

1: To apply fundamental low-Reynolds-number aerodynamic principles using foundational tools like XFOIL, JavaFoil, and the AirfoilTools database to extract, analyze, and loft airfoils for subscale aircraft.

2: To select lightweight aerospace materials (such as Balsa wood, Depron foam, and carbon fiber), understand structural load paths, and fabricate high-endurance free-flight and elastomeric model aircraft.

3: To integrate electric propulsion systems (BLDC motors, ESCs, and LiPo batteries), digital radio-control avionics, and control linkages according to standard thrust-to-weight and wing loading metrics.

Syllabus

The Aeromodelling and Fabrication Lab bridges undergraduate fluid mechanics, aerodynamics, and structural mechanics with hands-on physical prototyping. In strict adherence to pedagogical guidelines for this curriculum, all aerodynamic analysis, polar extraction, and coordinate generation must be performed exclusively using foundational, low-level aerodynamic tools: AirfoilTools database and XFOIL / JavaFoil.

Course Plan

Module I

Low-Reynolds Aerodynamics, Airfoil Lofting & Hand-Launch Gliders

Sl.No	Topics to be covered	Hours Required
1	**Teaching Content:** Physics of low-Reynolds-number aerodynamics (Re < 100,000); laminar separation bubbles; Clark-Y vs. NACA 4412 vs. cambered plate airfoils. Hands-on extraction of coordinates and polar data using XFOIL and AirfoilTools. Principles of longitudinal static stability, neutral point, center of gravity (CG) location, static margin (8-12%), and decalage angle setting for hand-launched gliders. **Experiment 1: Low-Reynolds Airfoil Analysis & Coordinate Export via XFOIL / JavaFoil** Description & Procedure: Analysis of Clark-Y, NACA 4412, and SG6043 airfoils at Reynolds numbers Re = 50,000 to 150,000 using XFOIL / JavaFoil. Generating pressure distribution (Cp vs x/c), lift-to-drag polars, and extracting 1:1 scale coordinate DAT files for template fabrication. *Raw Materials & Tooling: PC workstation with XFOIL/JavaFoil installed, internet access to AirfoilTools.com, plotting printer, 1:1 scale paper templates, scissors.* **Experiment 2: Depron Glider Fabrication, Ballast Tuning & Static Margin**	9

	Calibration Description & Procedure: Material selection (3mm-5mm Depron), precision cutting using surgical scalpels/hot-wire, leading/trailing edge beveling, dihedral joint bonding, empennage alignment, and lead pellet balancing to achieve 8-12% Static Margin. *Raw Materials & Tooling: Depron sheets (3mm & 5mm), UHU Por / Foam-Tac glue, surgical scalpel set, carbon fiber reinforcement rods (1.5mm), lead balancing pellets, digital gram scale (0.01g precision).* **Project Experiment 3 (Evaluation & Submission): The 'L/D & Endurance Optimization' Micro-Glider Challenge** Practical Execution & Evaluation: Each student team (2 members) designs, lofts, cuts, and balances a custom hand-launched chuck glider targeting maximum glide duration (>10s in still air) and distance (>20m). Students are evaluated on dimensional accuracy, structural symmetry, CG balancing, and official glide test performance. Submission includes pre-flight CG-Neutral Point calculation sheet and post-flight trim analysis log. *Raw Materials, Tooling & Submission Deliverables: Raw Materials & Tooling: Depron sheets (3mm, 5mm), Balsa sheet (C-grain), UHU Por glue, cutting mat, metal ruler, digital weighing scale, stop watch, measuring tape.*	
Module II		
Lightweight Structures, Aeroelasticity & Rubber-Powered Models		
Sl.No	Topics to be covered	Hours Required
1	**Teaching Content:** Structural analysis of subscale aircraft components (ribs, shear webs, spar caps, I-beam and box spars). Mechanics of elastomeric energy storage (Hooke's law in torsion, torque decay curves of wound rubber strips). Techniques of pin-jig framework construction, tissue covering, water-shrinking, and nitrate/Eze dope application to achieve anti-warping structural rigidity. **Experiment 4: Airframe Structural Layout & Elastomeric Energy Storage Mechanics** Description & Procedure: Structural analysis of subscale wing ribs, shear webs, and spar caps. Measuring potential energy storage and torque decay curves of wound FAI Tan Super Sport rubber strips using a custom beam torque meter. *Raw Materials & Tooling: 1/8" FAI Tan II Rubber strips, custom beam torque meter, spring balance, precision stopwatch, graph paper for plotting torque-turns curves.* **Experiment 5: Built-up Balsa Framework Fabrication & Tissue Covering** Description & Procedure: Pin-jig fabrication of fuselage truss and multi-rib wing panels using 1.5mm balsa strips and CA glue. Applying Japanese Esaki tissue / Mylar film with water-shrinking and nitrate dope for anti-warping structural rigidity. *Raw Materials & Tooling: Balsa wood strips (1.5mm × 1.5mm, A/B/C grain), Cyanoacrylate (CA) glue & accelerator, cork pin-board, T-pins, Japanese Esaki*	9

	tissue paper, Nitrate Dope / Eze Dope, artist paint brushes, water spray bottle. **Project Experiment 6 (Evaluation & Submission): Rubber-Powered Model Fabrication & Flight Test** Practical Execution & Evaluation: Teams construct an authentic built-up balsa endurance model (minimum wingspan 500mm, all-up weight < 35g). Students calibrate turns vs. torque curve on a custom torque-meter, execute official timed flights aiming for sustained flight times exceeding 45 seconds, and submit the completed airframe model along with a structural mass-property report. *Raw Materials, Tooling & Submission Deliverables: Raw Materials & Tooling: Balsa strips (assorted grades), Esaki tissue, 1/8" FAI Tan rubber, 5:1 geared winder, beam torque meter, digital scale, 7-9 inch Free-Flight propellers, dope and thinner.*	
Module III		
RC Avionics Integration, Electric Powerplant Sizing & Flight Dynamics		
Sl.No	Topics to be covered	Hours Required
	Teaching Content: Brushless DC (BLDC) motor sizing (Kv ratings, stator dimensions), propeller static thrust computation, Electronic Speed Controller (ESC) safety margins, and 2S/3S LiPo battery C-ratings. Radio control system architecture (2.4GHz FHSS, transmitter channel mapping, elevon/flaperon mixing, failsafe setup). Execution of systematic flight test cards and stability diagnosis (phugoid oscillations, roll damping). **Experiment 7: Brushless Motor, ESC, LiPo Matching & Static Thrust Bench Testing** Description & Procedure: BLDC motor sizing (2212 Kv ratings), propeller static thrust computation, ESC current ratings, and LiPo C-rating calculations. Bench testing static thrust, RPM, and power draw using a digital thrust stand and tachometer. *Raw Materials & Tooling: 2212 1400KV / 2205 2300KV BLDC Motors, 30A ESC with BEC, 3S 1000-1500mAh LiPo batteries, Digital Thrust Stand with optical tachometer and wattmeter, safety goggles, LiPo-safe charging bag.* **Experiment 8: RC Airframe Assembly, Control Linkage Rigging & Transmitter Programming** Description & Procedure: Assembling an EPP/Coroplast RC trainer / Flying Wing airframe. Micro servo (SG90) installation, pushrod geometry, zero-slop clevis connections, and OpenTX transmitter programming (dual rates, expo, failsafe). *Raw Materials & Tooling: EPP/Coroplast airframe kit, 9g Metal Gear micro servos, 6-channel 2.4GHz transmitter/receiver, pushrod wires, control horns, clevises, soldering iron, zip ties, double-sided foam tape.* **Experiment 9: Flight Test Card Execution, Telemetry Data Logging & Stability Diagnosis** Description & Procedure: Executing formal Flight Test Cards (takeoff roll, trim passes, stall recovery, figure-8 maneuvers). Video telemetry review and post-flight analysis of dynamic longitudinal oscillations (phugoid) and roll	10

	damping. *Raw Materials & Tooling: Assembled RC aircraft, flight test cards, optical/video telemetry equipment, stopwatch, runway/flight line safety gear.* Project Experiment 10 (Evaluation & Submission): Subscale RC Fixed-Wing / Flying Wing Flight Envelope Validation Practical Execution & Evaluation: Teams configure and flight-test a 750mm-1000mm electric RC aircraft (Trainer or Delta Wing). Each team performs pre-flight weight-and-balance, static thrust bench testing, transmitter failsafe configuration, and executes a full circuit flight mission recorded via video telemetry / datalogger. Students are evaluated on wiring neatness, static thrust validation, failsafe programming, and successful flight circuit performance. *Raw Materials, Tooling & Submission Deliverables: Raw Materials & Tooling: Assembled RC aircraft, radio transmitter/receiver system, fully charged 3S LiPo batteries, digital balance stand, flight checklist cards, onboard micro-datalogger / action camera for telemetry review.*	

Reference Books:

1. Martin Simons, Model Aircraft Aerodynamics, Special Interest Model Books, 5th Edition (2015)
2. John D. Anderson Jr, Fundamentals of Aerodynamics, McGraw-Hill Education, 6th Edition (2016)
3. Don Ross, Rubber Powered Model Airplanes, Motorbooks International / Independent Published, Revised Edition (1988)
4. Daniel P. Raymer, Simplified Aircraft Design for Homebuilders & UAVs, Design Dimension Press, 1st Edition (2002)

Other References:(NPTEL/SWAYAM. Any Other)

1. NPTEL course: Airplane design (Aerodynamic), IIT Madras https://nptel.ac.in/courses/101106035
2. NPTEL course: Aeromechanics of Unmanned Aerial Vehicles / Drones, IIT Kanpur https://nptel.ac.in/courses/101104807

Course Outcomes:

The student will be able to:

CO1: Apply low-Reynolds-number aerodynamics using XFOIL and AirfoilTools to extract, analyze, and loft airfoils for precision hand-launched gliders.

CO2: Select aero-materials (Balsa, Depron, Carbon Fiber), compute structural load paths, and fabricate high-endurance elastomeric free-flight models.

CO3: Execute systematic flight-test cards, record glide ratio and endurance data, diagnose stability anomalies, and prepare technical flight logs.

CO-PO Mapping:

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

High-3: Medium-2: Low-1

Evaluation Method

Continuous Internal Evaluation (CIE):

The CIE is evaluated for 50 marks, distributed as follows: Regular Laboratory Performance & Conduct (15 Marks) + Module Project Evaluations (3 Projects) (20 Marks) + Laboratory Record / Logbook & Calculations (10 Marks) + Internal Practical Test / Quizzes (5 Marks)

Final CIE Marks of practical should be calculated for 50 marks.

Semester End Examination (SEE):

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

Fabrication & Assembly Task (15 Marks) + XFOIL / Airfoil Analysis & Data Generation (10 Marks) + Model Demonstration / Flight Simulation Check (10 Marks) + Comprehensive Viva-Voce Examination (15 Marks)

The Final mark for the course is the sum of 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)		

Yoga (Common to all Branches)			
Course Code:	MVJ25YO39	Scheme	2025
Type of Course	NCMC	Semester	III
Total Hours of Pedagogy (L:T:P:SL&TW)	0:0:0:28	CIE Marks	100
Credits	1	Total Marks	100

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.

<u>The Health Benefits of Yoga:</u>

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.
- Reduces 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	Hours Required
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. **Sitting**: -Vajrasana, - adasana, Ardhachakrasana, **Prone line**: -Advasana, Bhujangasana **Supine line**: -Shavasana, Supta baddhakonasana, **Balancing posture**: -Vrikshasana, Garudasana	7

MODULE -II	Hours Required
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

MODULE -III	Hours Required
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
MODULE -IV	**Hours Required**
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

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			

Evaluation Method

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"

B.E, Aerospace Engineering

PHYSICAL EDUCATION (SPORTS & ATHLETICS) (Common to all Branches)			
Course Code:	MVJ25PE39	Scheme	2025
Type of Course	NCMC	Semester	III
Total Hours of Pedagogy (L:T:P:SL&TW)	0:0:0:30	CIE Marks	100
Credits	1	Total Marks	100

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.

Module I		
Sr.No	Topics to be covered	Hours required
1	Orientation ➢ Lifestyle ➢ Fitness ➢ Food & Nutrition: Sports diet. ➢ Stress Management	**5**
Module II		
Sl. No	Topics to be covered	Hours required
1	General Fitness & Components of Fitness ➢ Warming up (Free Hand Exercises). ➢ Strength—Push-up/Pull-ups ➢ Speed—30MtrDash. ➢ Agility—Shuttle Run ➢ Flexibility—Sit and Reach	**5**
Module III		
Sl. No	Topics to be covered	Hours required
1	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.	6
Module IV		
Sl. No	Topics to be covered	Hours required
1	Role of Organization and administration	6

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

Module V

Sl. No	Topics to be covered	Hours required
1	Aerobics ➢ Dance Aerobics ➢ Sport Aerobics ➢ Warm up Aerobics ➢ Cardiovascular Aerobics	6

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.

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		

Additional Mathematics-I (Common to all Branches)			
Course Code:	MVJ25MATDIP310	Scheme	2025
Type of Course	NCMC	Semester	III
Teaching Hours/Week (L:T:P)	2:0:0	CIE Marks	50
Total Hours of Pedagogy (L:T:P:SL&TW)	25:0:0:5	SEE Marks	50
Credits:	1	Total Marks	100
Examination type (SEE)	Theory	SEE Duration	3 Hours

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
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
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
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
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
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)

1. https://youtube.com/playlist?list=PL7oBzLzHZ1wXBSiJEgqz_iwVoLiY8qhbv&si=LWY0G3ywwoMbHN9G
2. https://youtu.be/rveuCHNkaC4?si=jIJomstkFZySE0tk
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 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)