Course Title	TECHNICALMANAGEMENT &ENTREPRENEURSHIP	Semester	V
Course Code	MVJ19TEM51	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 1 :0	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Introduce the field of management, task of the manager, importance of planning and types of planning, staff recruitment and selection process.
- Explain need of coordination between the manager and staff, the social responsibility of business and leadership.
- Explain the role and importance of the entrepreneur in economic development and the concepts of entrepreneurship.
- Discuss the importance of Small Scale Industries and the related terms and problems involved.
- Explain project feasibility study and project appraisal and discuss project financing.

Module-1	L1., L2	8Hours

Management: Definition, Importance – Nature and Characteristics of Management, Management Functions, Roles of Manager, Levels of Management, Managerial Skills, Management & Administration, Management as a Science, Art &Profession.

Planning: Nature, Importance and Purpose Of Planning, Types of Plans, Steps in Planning, Limitations of Planning, Decision Making – Meaning, Types of Decisions- Steps in Decision Making.

Laboratory Sessions/ Experimental learning: Case study on decision making process in a corporate.

Applications: Planning in engineering field.

Web Link and Video Lectures

https://nptel.ac.in/courses/110/105/110105146/

https://nptel.ac.in/courses/122/108/122108038/

Module-2	L1., L2	8Hours

Organizing and Staffing: Meaning, Nature and Characteristics of Organization – Process of Organization, Principles of Organization, Departmentalization, Committees – meaning, Types of

Committees, Centralization Vs Decentralization of Authority and Responsibility, Span of Control, Nature and Importance of Staffing, Process of Selection and Recruitment.

Directing and Controlling: Meaning and Nature of Directing-Leadership Styles, Motivation Theories,

Communication – Meaning and Importance, Coordination- Meaning and Importance, Techniques of Coordination. Controlling – Meaning, Steps in Controlling.

Laboratory Sessions/ Experimental learning

Case study of steel plant departmentalization.

Applications: Effective communication in a corporate.

Web Link and Video Lectures

https://nptel.ac.in/content/storage2/courses/122106031/slides/3_2s.pdf

https://www.slideshare.net/100005130728571/27-nature-of-directing

Module-3	L1., L2	8Hours

Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance.

Entrepreneurship: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Intrapreneur – An Emerging Class, Comparison between Entrepreneur and Intrapreneur, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship.

Laboratory Sessions/ Experimental learning

Case study of a startup.

Application: Social auditing in a software company Web Link and Video Lectures

https://nptel.ac.in/courses/110/106/110106141/

https://nptel.ac.in/courses/127/105/127105007/

Module-4	L1., L2	8Hours

Modern Small Business Enterprises: Role of Small Scale Industries, Concepts and definitions of SSIEnterprises, Government policy and development of the Small Scale sector in India, Growth and Performance of Small Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Impact of Globalization on SSI, Impact of WTO/GATT on SSIs, Ancillary Industry and Tiny Industry (Definition only).

Institutional Support for Business Enterprises: Introduction, Policies & Schemes of Central–Level Institutions, State-Level Institutions.

Laboratory Sessions/ Experimental learning

Case study on the growth of small scale industries. Application: Small Scale Industries Web Link and Video Lectures https://www.slideshare.net/syedmubarak15/institutional-support-for-business-enterprises		
Module-5	**L1., L2**	**8Hours**
Project Management: Meaning of Project, Project Objectives & Characteristics, Project Identification- Meaning & Importance; Project Life Cycle, Project Scheduling, Capital Budgeting, Generating an Investment Project Proposal, Project Report-Need and Significance of Report, Contents, Formulation, Project Analysis-Market, Technical, Financial, Economic, Ecological, Project Evaluation and Selection, Project Financing, Project Implementation Phase, Human & Administrative aspects of Project Management, Prerequisites for Successful Project Implementation. New Control Techniques- PERT and CPM, Steps involved in developing the network, Uses and Limitations of PERT and CPM. Laboratory Sessions/ Experimental learning Investigation on the market in correspondence to project. Application Preparations of project report. Web Link and Video Lectures ttps://www.projectmanager.com/project-scheduling https://kissflow.com/project/basics-of-project-scheduling/		

Course outcomes:	
CO1	UnderstandtheconceptofManagement
CO2	Understandthestaffingprocess
CO3	ExplainthesocialresponsibilitiesofbusinesstowardsDifferentGroups
CO4	ExplaintheRoleofSmallScale Industries
CO5	InterpretttheProjectObjectives

Reference Books:	
1	StephenP.Robbins&MaryCoulter,Management‖,PrenticeHall(India)Pvt.Ltd.,10th Edition, 2009
2	JAF Stoner, FreemanR .E and Daniel R Gilbert, Management, Pearson Education, Edition, 2004.
3	StephenA. Robbins&DavidA. Decenzo&Mary Coulter,Fundamentals ofManagement‖PearsonEducation,7thEdition,2011.

4	RobertKreitner&MamataMohapatra,Management‖,Biztantra,2008.

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
xli. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. xlii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. xliii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	2				1	1		1	1
CO2	2	2	1	2	2			1	1	1	1	1
CO3	2	2	1	2	2		1	1	1		1	1
CO4	2	2	1	1							1	1
CO5	3	3	2	2	2			1	1	1	1	1

High-3, Medium-2, Low-1

Course Title	COMPRESSIBLE AERODYNAMICS	Semester	V
Course Code	MVJ19AS52	CIE	50
Total No. of Contact Hours	50 L: T : P :: 3:2:0	SEE	50
No. of Contact Hours/week	5	Total	100
Credits	4	Exam. Duration	3 Hrs.

The course objective is to:

1. Understand the concepts of compressible flow
2. Acquire knowledge of normal shock waves
3. Comprehend the phenomenon of oblique shocks and expansion waves
4. Understand the concepts of Differential Equations of Motion for Steady Compressible Flows
5. Gain knowledge of flow measurement techniques

Module 1	L1,L2	10 Hrs.

One Dimensional Compressible Flow: Energy, Momentum, continuity and state equations, velocity of sound, Adiabatic steady state flow equations, Flow through converging, diverging passages, Performance under various back pressures. Numerical

Laboratory Sessions/ Experimental learning:Visualization of Flow analysis in Ansys Lab

Applications: Understanding the close coupling of thermodynamics and fluid dynamics and analyse typical aircraft systems like nozzles, diffusers, intakes

Video link / Additional online information (related to module if any):

1. https://www.youtube.com/watch?v=mS3ZVuOn_lU&list=PLwdnzlV3ogoWb_iTQza6Z8dYHR-_1qhh0&index=2
2. https://youtu.be/mS3ZVuOn_lU?list=PLwdnzlV3ogoWb_iTQza6Z8dYHR-_1qhh0
3. https://youtu.be/HfZ5gfybJK4?list=PLwdnzlV3ogoWb_iTQza6Z8dYHR-_1qhh0

Module 2	L1,L2,	10 Hrs.

Normal Shock: Prandtl Meyer equation and Rankine – Hugonoit relation, Normal shock equations: Property ratios in terms of upstream Mach number, Numericals, Moving Normal Shock wave. Shock tube.

Laboratory Sessions/ Experimental learning:Visualization of airfoil cross-section in Aerodynamics Lab

Applications: Analyzing the supersonic flow problems involving normal shock waves to design and analyze aircraft systems like nozzles, diffusers, intakes, shock tubes, wind tunnels, pipe flows.

Video link / Additional online information (related to module if any):

1. https://nptel.ac.in/courses/112/106/112106166/
2. https://nptel.ac.in/courses/101/108/101108086/#

Module 3	L1,L2	10 Hrs.

Oblique shocks and Expansion waves: Prandtl equation and Rankine – Hugonoit relation, Normal shock equations, Pitot static tube, corrections for subsonic and supersonic flows, Oblique shocks and corresponding equations, Hodograph and pressure turning angle, shock polars, flow past wedges and concave corners, strong, weak and detached shocks, Flow past convex corners, Prandtl –Meyer expansion function, Reflection and interaction of shocks and expansion waves.

Laboratory Sessions/ Experimental learning: Visualization of airfoil cross-section in Aerodynamics Lab

Applications: Analyzing the supersonic flow problems involving oblique shock waves to design and analyze aircraft systems like nozzles, diffusers, intakes, shock tubes, wind tunnels, pipe flows

Video link / Additional online information (related to module if any):

1. https://nptel.ac.in/courses/112/106/112106056/
2. https://nptel.ac.in/courses/112/106/112106056/
3. https://nptel.ac.in/courses/112/106/112106056/

Module 4	L1,L2	10 Hrs.

Differential Equations of Motion for Steady Compressible Flows: Basic potential equations for compressible flow. Linearisation of potential equation-small perturbation theory. Methods for solution of nonlinear potential equation –Introduction, Method of characteristics, Boundary conditions, Pressure coefficient expression, small perturbation equation for compressible flow - Prandtl, Glauret and Geothert's rules - Ackert's supersonic airfoil theory, Von-Karman rule for transonic flow, Lift, drag pitching moment and center of pressure of supersonic profiles

Laboratory Sessions/ Experimental learning:Flow Problems using Ansys Lab

Applications: Analyze and interpret the flow behavior

Video link / Additional online information (related to module if any):

1. https://nptel.ac.in/courses/101/106/101106044/
2. https://nptel.ac.in/courses/112/106/112106056/

Module 5	L1,L2	10Hrs.

Measurements in High-speed Flow: Types of subsonic wind tunnels Balances and measurements - Interference effects transonic, Supersonic and hypersonic wind tunnels and characteristic features, their operation and performance – Shock tubes and shock tunnels - Free flight testing - Measurements of pressure, velocity and Mach number -Flow visualization methods of subsonic and supersonic flows.

Laboratory Sessions/ Experimental learning:Wind Tunnel model force measurements

Applications: Understand the significance of wind tunnels in Aeronautics/Aerospace and perform experiments on appropriate model's wind tunnel

Video link / Additional online information (related to module if any):

1. https://nptel.ac.in/courses/101/106/101106040/
2. https://nptel.ac.in/courses/101/106/101106044/

Course outcomes:

Upon completion of the course, students will be able to:

CO302.1	Apply the basic concepts of compressible flow
CO302.2	Evaluate the concepts of normal shock phenomenon
CO302.3	Apply the concepts of oblique shock and expansion wave formation.
CO302.4	Utilize the concepts of Differential Equations of Motion for Steady Compressible Flows
CO302.5	Investigate the parameters of high-speed flow.

Reference Books:

1.	John D Anderson, Modern Compressible Flow, McGraw Hill,3rd edition,2012,ISBN-13: 978-1259027420.
2.	Radhakrishnan, E., Gas Dynamics, Prentice Hall of India,5th edition,2014,ISBN-13: 978-8120348394
3.	Ascher.H. Saphiro, Dynamics and Thermodynamics of Compressible fluid flow, John Wiley& Sons,1st edition,1977, ISBN-13: 978-0471066910.
4.	Yahya, S.M., Fundamentals of Compressible flow, NEW AGE, 2009, ISBN-13: 978-8122426687.
5.	H.W. Liepmann and A. Roshko, Elements of Gas Dynamics, Dover Publications Inc,2003,ISBN-13: 978-0486419633.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

xliv. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

xlv. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

xlvi. One question must be set from each unit. The duration of examination is 3 hours.

CO,PO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	0	0	0	0	0	0	0	0	0	0	3	1
CO2	3	3	2	2	0	0	0	0	0	0	0	0	3	1
CO3	3	3	0	2	0	0	0	0	0	0	0	0	3	1
CO4	3	3	3	2	0	0	0	0	0	0	0	0	3	1
CO5	3	3	2	2	0	0	0	0	0	0	0	0	2	1

High,3, Medium,2, Low,1

Course Title	AEROSPACE SRUCTURAL ANALYSIS	Semester	V
Course Code	MVJ19AS53	CIE	50
Total No. of Contact Hours	50 L: T : P :: 3:2:0	SEE	50
No. of Contact Hours/week	5	Total	100
Credits	4	Exam. Duration	3 Hrs.

Course objective is to:

1. To describe about symmetrical and unsymmetrical sections
2. To Acquire the knowledge of Structural Idealization on open section tubes
3. To Acquire the knowledge of Structural Idealization on closed section tubes
4. To illustrate the different types of Buckling of Plates, Joints and Fitting
5. To Comprehend the stress analysis on Launch Vehicle and Spacecraft Structure

Module 1	L1,L2, L3	10 Hrs.

Introduction: Elementary theory of bending – Introduction to semi-Monocoque structures - Stresses in beams of symmetrical and unsymmetrical sections -Box beams – General formula for bending stresses- principal axes method – Neutral axis method.

Laboratory Sessions/ Experimental learning: Stress analysis on a flat plate using Ansys.

Applications: To differentiate and analyze the components of aircraft components.

Video link / Additional online information (related to module if any):

4. https://swayam.gov.in/nd1_noc19_ae05/previewhttps://youtu.be/bQQMIy7Dlt0
5. https://nptel.ac.in/courses/101/101/101101079/

https:52/2013/AAE%20352%20Course%20Text%20Weisshaar%202011.pdf

Module 2	L1,L2,L3	10 Hrs.

Shear Flow: Shear stresses in beams – Shear flow in stiffened panels - Shear flow in thin-walled open tubes –Shear center – Shear flow in open sections with stiffeners.

Laboratory Sessions/ Experimental learning: Shear center and angle of twist in Aerospace Structures laboratory

Applications: To analyze shear flow in aircraft/spacecraft skin panels.

Video link / Additional online information (related to module if any):

4. https://cosmolearning.org/courses/introduction-aerospace-structures/video-lectures/
5. https://ocw.tudelft.nl/course-lectures/shear-flow-thin-walled-section-2/

https://www.ae.msstate.edu/tupas/SA2/chA14.7_text.html

Module 3	L1,L2,L3	10 Hrs.
Shear Flow Analyses: Shear flow in closed sections with stiffeners– Angle of twist - Shear flow in two flange and three flange box beams – Shear center - Shear flow in thin-walled closed tubes - Bredt-Batho theory - Torsional shear flow in multi cell tubes - Flexural shear flow in multi cell stiffened structures. **Laboratory Sessions/ Experimental learning**: Shear flow analyses for closed section in Ansys workbench. **Applications**: To analyze the shear flow in closed thin-walled section of the aircraft/spacecraft. **Video link / Additional online information (related to module if any)**: 1. https://swayam.gov.in/nd1_noc19_ae05/previewhttps://youtu.be/bQQMIy7Dlt0 2. https://www.popsci.com/story/technology/best-aerospace-innovations-2019/ https://nptel.ac.in/courses/101/101/101101079/		
Module 4	**L1,L2,L3**	10 Hrs.
Failure concepts: Stability problems of thin-walled structures– Buckling of sheets under compression, shear, bending and combined loads - Crippling stresses by Needham's and Gerard's methods–Sheet stiffener panels- Effective width, Inter rivet and sheet wrinkling failures-Tension field web beams (Wagner's). **Laboratory Sessions/ Experimental learning**: Fatigue analysis can be analyzed using Ansys workbench. **Applications**: Used to predict the product life cycle management of aerospace components. **Video link / Additional online information (related to module if any)**: 1. https://www.youtube.com/watch?v=3HE3A_vUZnw 2. https://www.youtube.com/watch?v=aivDhiLwu8E https://www.youtube.com/results?search_query=unsw+aerospace+structures		
Module 5	**L1,L2**	10Hrs.
Launch Vehicle and Spacecraft Structures: Launch vehicle structures – Loads and stresses, thin-walled pressure vessels, Buckling of beams, thin wall assumption. spacecraft - mini, microstructures, inflatable structures, flying effector, Nano tubing **Laboratory Sessions/ Experimental learning**: Fuselage Pressure Vessel experiment can be conducted using Ansys Workbench. **Applications**: Helps to analyze the stress in Aircraft components. **Video link / Additional online information (related to module if any)**: 1. https://youtu.be/bQQMIy7Dlt0 2. https://nptel.ac.in/courses/101/101/101101079/		
Course outcomes:		

Upon completion of the course, students will be able to:	
CO303.1	Classify various types of load acting on an aircraft and Draw normal stress distribution.
CO303.2	Identify the shear flow distribution for open section structural member under torsion.
CO303.3	Investigate shear flow distribution for closed section structural member under torsion.
CO303.4	Solve different methods to find out buckling load for a given structural panel, Joints and Fittings
CO303.5	Examinethe stress distribution in Pressure Vessels and Spacecraft Structures

Reference Books:	
1.	Megson, T.H.G., AircraftStructures for Engineering Students, Edward Arnold,1995
2.	Perry D J & Azar J J , Aircraft Structures, 2nd edition, McGraw Hill N.Y.,1993
3.	BruhnE.F., Analysis and Design of Flight Vehicles Structures, Tri-Stateoffset Co.USA,1985
4.	T.H.G Megson Introduction to Aircraft Structural Analysis, Elsevier,2nd Edition,2014

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

xlvii. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

xlviii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

xlix. One question must be set from each unit. The duration of examination is 3 hours.

CO,PO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	3	2.6	2.2	1.6	2.4	1	0	0	0.6	1.4	0.2	3	1	1
CO2	3	2.6	2.2	1.6	2.4	1	0	0	0.6	1.4	0.2	3	1	1
CO3	3	2.6	2.2	1.6	2.4	1	0	0	0.6	1.4	0.2	3	1	1
CO4	3	2.6	2.2	1.6	2.4	1	0	0	0.6	1.4	0.2	3	1	1
CO5	3	2.6	2.2	1.6	2.4	1	0	0	0.6	1.4	0.2	3	1	1

High,3, Medium,2, Low,1

Course Title	THOERY OF VIBRATIONS	Semester	V
Course Code	MVJ19AS54/AE54	CIE	50
Total No. of Contact Hours	40 L: T: P :: 3 :1: 0	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	3	Exam. Duration	3 Hrs.

Course objective is to:

1.Understand the basic concepts of vibrations

2.Gain the knowledge of the undamped free vibration and damped free vibrations

3. Learn the vibration measuring instrumentation

4. Acquire knowledge of two degrees of freedom systems

5. Understand numerical methods for Multi-Degree Freedom Systems

Module 1	L1,L2,L3	8 Hrs.

Types of vibrations, S.H.M, principle of super position applied to Simple Harmonic Motions.Beats, Fourier theorem and simple problems.

Laboratory Sessions/ Experimental learning:

Simple pendulum experiment to understand concept of wave motion

Applications: Various types of vibrations and its real time applications

Concept of wave and its characteristics.

Video link / Additional online information (related to module if any): (NPTEL,IIT ROORKEE)

https://www.youtube.com/watch?v=9r630K5HmJc&list=PLSGws_74K01_pG3R7rgtDtrDZBjcTgPdR

Module 2	L1,L2,L3	8 Hrs.

Undamped Free Vibrations: Single degree of freedom systems. Undamped free vibration, natural frequency of free vibration, Spring and Mass elements, effect of mass of spring, Compound Pendulum.

Damped Free Vibrations: Single degree of freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, criticaland over damping, Logarithmic decrement

Laboratory Sessions/ Experimental learning:

Identifying Damping ration experiment allows students to understand behavior of vicious damper. [Design lab]

Applications: Various types of dampers and its real time applications.

Video link / Additional online information (related to module if any) (NPTEL,IIT MADRAS)

https://www.youtube.com/watch?v=tJNaPt5aPmg		
Module 3	**L1,L2.L3**	8 Hrs.
Forced Vibration: Single degree of freedom systems, steady state solution with viscous damping due toharmonic force. Solution by Complex algebra, reciprocating and rotating unbalance, vibration isolation,transmissibility ratio due to harmonic excitation and support motion. **Vibration Measuring Instruments & Whirling of Shafts**: Vibration of elastic bodies – Vibration of strings –Longitudinal, lateral and torsional Vibrations. **Laboratory Sessions/ Experimental learning**: Whirling of shaft experiment [Design Lab] **Applications**: Isolators and its Application. **Video link / Additional online information (related to module if any): (NPTEL,IIT KANPUR)** https://www.youtube.com/watch?v=XGQr1uEX-Dc		
Module 4	**L1,L2,L3**	8 Hrs.
Systems with Two Degrees of Freedom: Introduction, principle modes and Normal modes of vibration, coordinatecoupling, generalized and principal co-ordinates, Free vibration in terms of initial conditions. Gearedsystems. Forced Oscillations-Harmonic excitation. Applications: Vehicle suspension, Dynamic vibrationabsorber and Dynamics of reciprocating Engines. **Continuous Systems**: Introduction, vibration of string, longitudinal vibration of rods, Torsional vibration ofrods, Euler's equation for beams. **Laboratory Sessions/ Experimental learning**:Determination of two natural frequencies, or modes, for the system Applications: **Dynamic vibration absorber and its application in reciprocating engine.** **Video link / Additional online information (related to module if any): (NPTEL,IIT MADRAS)** https://www.youtube.com/watch?v=V_Lj4Pun_WM		
Module 5	**L1,L2**	8 Hrs.
Numerical Methods for Multi-Degree Freedom Systems: Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation. Orthogonalityofprincipal modes, Method of matrix iteration-Method of determination of all the natural frequencies usingsweeping matrix and Orthogonality principle. Holzer's method, Stodola method. **Non-Linear Vibration** : (Advance theory of vibration by ssrao) **Laboratory Sessions/ Experimental learning**: Plotting displacement curve using Analytical Approach. **Applications**:		

Understanding non linear behavior of waves or vibration.

Video link / Additional online information (related to module if any): (NPTEL,IIT MADRAS)

https://www.youtube.com/watch?v=V_Lj4Pun_WM

Course outcomes:

Upon completion of the course, students will be able to:

CO304.1	Apply the principle of super position to Simple Harmonic Motions.
CO304.2	Analyse undamped free and damped free vibration
CO304.3	Perform measurements of vibrations
CO304.4	Evaluate the equations of two degrees of freedom systems.
CO304.5	Evaluate the multi -degree of freedom system.

Reference Books:

1.	W.T. Thomson and MarieDillon Dahleh, Theory of Vibration with Applications, Pearson Education, 2008
2.	V.P. Singh, Mechanical Vibrations, DhanpatRai & Company Pvt. Ltd, 2016
3.	S.S. Rao, Mechanical Vibrations, Pearson Education Inc, 2003
4.	S. Graham Kelly, Mechanical Vibrations, Tata McGraw Hill, 2007

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

lii. One question must be set from each unit. The duration of examination is 3 hours.

CO,PO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	1	1	1	1	1	1	0	2	3	1	1
CO2	3	3	1	3	1	1	0	1	1	0	1	3	1	1
CO3	3	3	2	3	2	1	0	0	1	0	1	3	1	1
CO4	3	3	2	3	3	2	0	0	1	0	01	3	1	1
CO5	2	2	2	2	1	1	0	1	1	0	0	3	1	1

High,3, Medium,2, Low,1

Course Title	THEORY OF PLATES AND SHELLS	Semester	V
Course Code	MVJ19AS551	CIE	50
Total No. of Contact Hours	40 L: T: P :: 3 :1: 0	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	3	Exam. Duration	3 Hrs.

Course objective is to:

This course will enable students to

1. Gain knowledge of various types of plates and study the isotropic and anisotropic plate theories.
2. Study the various types of solutions for the plates and their boundary conditions.
3. Study the buckling and deflection of the different types of the plates under compressive and shearing loads.
4. Comprehend the shell surfaces and their characteristics.
5. Learn the performance of shells under different loading conditions.

Module 1	L1,L2,L3	8 Hrs.

Introduction to thin plates, plate equation. Small deflection theory, isotropic and anisotropic plate theories, bending and twisting of the plates.

Laboratory Sessions/ Experimental learning:Computer Simulation Lab using ANSYS Software

Applications: In mathematical descriptions of mechanics of flat plates and plate theories.

Video link / Additional online information (related to module if any):

1. https://www.youtube.com/watch?v=_2d8YsXwm7M(NPTEL-IITB)
2. https://www.youtube.com/watch?v=q_yiBXCBL8w (NPTEL-IITB)
3. https://www.youtube.com/watch?v=E0opXSYGEiA (NPTEL-IITB)

Module 2	L1,L2,L3,	8 Hrs.

Kirchhoff plate theory, index notation, strain-displacement relation for continuum and plates, Derivation of plate equilibrium equation and boundary conditions. Classical solution of plate equations: the Navier solution, The Levy solution. Bending solutions for circular plates.

Laboratory Sessions/ Experimental learning:Computer Simulation Lab using ANSYS Software

Applications: In the design and analysis of the aircraft skin

Video link / Additional online information (related to module if any):

1. https://www.youtube.com/watch?v=WZN8SDXOX5Q(NPTEL, IIT-Guwahati)
2. https://www.youtube.com/watch?v=q_yiBXCBL8w (NPTEL, IIT-Guwahati)

Module 3	L1,L2,L3	10Hrs.

Theory of moderately large deflection of elastic plates. Example problem with axisymmetric plates/membrane, buckling of plates, general formulation, buckling of rectangular plates. Ultimate strength of plates and elastic/plastic buckling under compressive and shear loadings. Solutions for circular plates under symmetric and unsymmetrical loading.

Laboratory Sessions/ Experimental learning:Computer Simulation Lab using ANSYS Software

Applications:Analysing the effect of various loading over the circular plates.

Video link / Additional online information (related to module if any):

6. https://ocw.mit.edu/courses/mechanical-engineering/2-081j-plates-and-shells-spring-2007/readings/analysis.pdf (MIT Notes)

Module 4	L1,L2,L3	8 Hrs.

Introduction of shell and its behaviour under various loading, shell surfaces and characteristics, classification of shells equilibrium equations in curvilinear co-ordinates. Stress strain & force displacement relations.

Laboratory Sessions/ Experimental learning:Computer Simulation Lab using ANSYS Software

Applications: In the design and analysis of the water/oil tanks, pipelines, aircraft fuselages and nanotubes.

Video link / Additional online information (related to module if any):

1https://www.youtube.com/watch?v=yiwycdPJib4

Module 5	L1,L2	8 Hrs.

Cylindrical shells under different loading conditions. Fundamentals of structural plasticity, Elastic buckling of cylindrical shells and Limit analysis of simple plastic structures. Solution of some typical problems. Introduction of the stability of shells, experimental testing of the plates and shells.

Laboratory Sessions/ Experimental Learning:Computer Simulation Lab using ANSYS Software

Applications: Analysing the design of the aircraft fuselage and theirs strength investigation under influence of the various loadings

Video link / Additional online information (related to module if any):

1. https://www.youtube.com/watch?v=uDieRHcG3x8&t=124s (NPTEL, IIT Roorkee)
2. https://www.youtube.com/watch?v=8iIPEojHB1g
3. https://www.youtube.com/watch?v=Mnwn5hRm1Cc

Course outcomes:

Upon completion of the course, students will be able to:

CO305.1.1	Analyzethe bending and twisting of the plates
CO.305.1.2	Investigate the effect of the various loading on the plates and learn methods for solving the plate problems.
CO.305.1.3	Illustrate the effect of the large deflection and buckling theories of the plates under compressive and shear loading.
CO.305.1.4	Identifythe types of shells and establish the relation between stresses, strain and force displacement for the shells.
CO.305.1.5	Evaluate the stability of the shells and analyse the effect of the various loading on the cylindrical shells.

Reference Books:	
1.	S. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw Hill, 1961.
2.	E.Ventsel and T.Krauthammer,Thin Plates and Shells,Marcel Dekker,Inc.,2001.
3.	L.S. Srinath, Advanced Mechanics of Solids, Tata McGraw Hill,2000.
4.	P.L.Gould,Analysis of Shells and Plates,Springer-Verlag,1988
5.	S. M. A. Kazimi, Solid Mechanics. Tata McGraw Hill,1994.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

liii. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

liv. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

lv. One question must be set from each unit. The duration of examination is 3 hours.

CO,PO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	1	1	1	1	1	1	0	2	3	1	1

CO2	3	3	1	3	1	1	0	1	1	0	1	3	1	1
CO3	3	3	2	3	2	1	0	0	1	0	1	3	1	1
CO4	3	3	2	3	3	2	0	0	1	0	01	3	1	1
CO5	2	2	2	2	1	1	0	1	1	0	0	3	1	1

High, 3, Medium, 2, Low,1

Course Title	COMPOSITE STRUCTURES	Semester	V
Course Code	MVJ19AS552/AE552	CIE	50
Total No. of Contact Hours	40 L: T: P :: 3 :1: 0	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	3	Exam. Duration	3 Hrs.

The course objective is to:

1.Understand the properties and advantages of composite materials compared to conventional materials.

2.Comprehend the properties of polymer matrix composites with fibre reinforcements and to learn the fabrication methods used in composites

3. Gain knowledge about the Micro and macro mechanical properties of composite lamina and laminates

4.Understand the failure theories for predicting the failure of a composite lamina

5. Learn the NDT and DT methods of Composites with Composite applications

Module 1	L1,L2,L3	8 Hrs.

Introduction to Composite Materials

Definition, classification of composite materials, classification of reinforcement - particulate, short fibers, whiskers, long fibers composites. matrix materials – metals, ceramics, polymers (including thermoplastics and thermosets), Carbon-Carbon Composites

Metal Matrix Composites:

MMC with particulate and short fiber reinforcement, liquid and solid state processing of MMC – stir casting, squeeze casting. Properties of MMCs, Applications of Al, Mg, Ti based MMC

Laboratory Sessions/ Experimental learning:

Determination of various composite materials by different types of fibers with application

Applications: Aircraft structural Parts, Automobile Sector and Many Engineering fields

Video link / Additional online information (related to module if any):

6. https://youtu.be/0kB0G6WKhKE?list=PLSGws_74K01-bdEEUElQ9-obrujIKGEhg – IIT Kanpur

Module 2	L1,L2,L3,	8 Hrs.

Processing of Polymer Matrix Composites: Thermoset Polymers, Hand layup Process, Vacuum Bagging Process, Post Curing Process, Filament winding,**Resin Transfer Moulding**, Pultrusion, Pulforming, Autoclave Process

Processing of Polymer Matrix Composites: Thermoplastic Polymers, Extrusion process, Injection Moulding Process, Thermo-forming process.

Post Processing of Composites – Adhesive bonding, drilling, cutting processes.

Laboratory Sessions/ Experimental learning:

Preparation of Composite laminates by Hand layup method

Applications: Thermosets and Thermoplastics are used in Aircraft Construction, corrosive environment, Common applications include fans, grating, tanks, ducts, hoods, pumps and cabinets.

Video link / Additional online information (related to module if any):

https://youtu.be/tP8JCX87DzI - IIT Roorkee

Module 3	L1,L2,L3	8 Hrs.

Micro-Mechanical Behaviour of a Lamina

Determination of elastic constants-Rule of mixtures, transformation of coordinates, micro-mechanics based analysis and experimental determination of material constants. **Ultimate Strengths of a Unidirectional Lamina**

Macro-Mechanical Behaviour of a Lamina:

Hooke's law for different types of materials, Number of elastic constants, Two - dimensional relationship of compliance and stiffness matrix. Global and local axis for angle lamina, Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.

Laboratory Sessions/ Experimental learning:

Determination of Young's Modulus of a Composite beam

Applications:Basics of macro level elastic properties, Scales of analysis of composites. Unidirectional and Woven fibers

Video link / Additional online information (related to module if any):

https://youtu.be/loyeZN5UQT8 - IIT Madras

Module 4	L1,L2,L3	8 Hrs.

Failure Theory

Different Strengths of Composite Lamina,Failure of Composite, Tsai-Hill, Tsai-Wu, Max Stress and Max Strain theories

Classical plate theory- Stress and strain variation in a laminate- Resultant forces and moments- A B & D matrices- Strength analysis of a laminate.

Laboratory Sessions/ Experimental learning:

Evaluate the mechanical properties of a lamina and a laminate **Applications**: Prediction of failure of composite, load analysis methodology. **Video link / Additional online information (related to module if any)**: https://youtu.be/6CLEWA2WNqM - IIT Madras		
Module 5	**L1,L2**	8 Hrs.
Inspection & Quality Control: Destructive & Non-Destructive Testing, Tensile, Compression, Flexural, Shear, Hardness; ultrasonic testing – A-B-C scan **Applications of Composites Materials** Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, marine, recreational and Sports equipment, future potential of composites. **Laboratory Sessions/ Experimental learning:** Determination of Defects in a composite by NDT Methods **Applications: NDT- DT Methods, Composites in Aerospace sector** **Video link / Additional online information (related to module if any)**: https://youtu.be/ZMJ7O4vs-Q8 - IIT Kanpur		

Course outcomes:

Upon completion of the course, students will be able to:

CO305.2.1	Compare the properties and select material for the given application.
CO305.2.2	Analyse the properties of polymer matrix composites and Fabrication of Composite materials
CO305.2.3	Apply constitutive equations of *composite* materials and understand mechanical behaviour at *micro and macro* levels.
CO305.2.4	Design and failure *analysis* for manufacturing *composite* materials and Determine stresses and strains relation in composites materials.
CO305.2.5	Carry out various inspectionsin accordance with the established procedures and differentiate various defect types and select the appropriate **NDT** methods for better evaluation

Reference Books:

1.	K.K Chawla, Composite Materials- Science and Engineering, IV edition, Springer International Publishing, 2019: ISBN: 978-3-030-28983-6
2.	Autar Kaw, Mechanics of Composites, II edition, Taylor & Francis Group CRC Press. 2006, ISBN:978-0-8493-1343-1

3.	R M Jones,Mechanics of Composite Materials, 2nd Edition, Taylor & Francis, 2015; ISBN:978-1560327127
4.	Ajay Kapadia, Non-Destructive Testing of Composite Materials, National Composites Network, Best Practices Guide, TWI Publications, 2006.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

lvi. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

lvii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

lviii. One question must be set from each unit. The duration of examination is 3 hours.

CO,PO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	2	2	1	2	2	2	2	2	1	1
CO2	3	1	3	2	2	2	2	2	2	2	2	2	1	1
CO3	3	3	3	3	2	2	1	2	2	2	1	1	1	1
CO4	3	3	3	3	2	2	1	2	2	2	1	1	1	1
CO5	3	1	3	2	2	2	2	2	2	2	2	1	1	1

High,3, Medium,2, Low,1

Course Title	HEAT & MASS TRANSFER IN AEROSPACE APPLICATION	Semester	V
Course Code	MVJ19AS553	CIE	50
Total No. of Contact Hours	40 L: T: P :: 3 :1: 0	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	3	Exam. Duration	3 Hrs.

The course objective is to:

1. Understand the different modes of heat transfer.
2. Understand the conduction mode of heat transfer
3. Understand the free convection and forced convection.
4. Acquire the knowledge of heat exchangers.
5. Acquire knowledge on the application of heat exchangers in Aerospace Industry

Module 1	L1,L2	8 Hrs.

Fundamentals:

- Different modes of heat transfer and mass and momentum transfer, elements of mass diffusion and boundary layer theory.
- Mass transfer definition and terms used in mass transfer analysis, Fick's First law of diffusion.Numerical problems

Laboratory Sessions/ Experimental learning:Heat and mass transfer lab

Applications: Gas turbine engines, Heat exchangers in Aero applications.

Video link / Additional online information (related to module if any):

7. https://nptel.ac.in/courses/112/101/112101097/

Module 2	L1,L2,L3	8 Hrs.

Conduction: Derivation of general three-dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems.

Effect of variation of thermal conductivity on heat transfer in solids - Heat transfer problems in infinite and semi-infinite solids - Extended surfaces.

One dimensional transient heat conduction: Systems with negligible internal resistance, Significance of Biot and Fourier Numbers, Chart solutions of transient conduction systems.

Laboratory Sessions/ Experimental learning:Heat conduction experiment in HMT lab

Applications: Gas turbine combustion chamber, turbine and afterburners etc

Video link / Additional online information (related to module if any):

https://nptel.ac.in/courses/112/105/112105271/

Module 3	L1,L2,L3	8 Hrs.

Convection: Concepts of Continuity, Momentum and Energy Equations. Dimensional analysis-Buckingham's Pi Theorem - Application for developing non-dimensional correlation for convective heat transfer

- **Free Convection**: Development of Hydrodynamic and thermal boundary layer along a vertical plate, Use of empirical relations for Vertical plates and pipes.
- **Forced Convection**: External Flows, Concepts of hydrodynamic and thermal boundary layer and use of empirical correlations for Flat plates and Cylinders. Internal Flows, Concepts about Hydrodynamic and Thermal Entry Lengths, use of empirical correlations for Horizontal Pipe Flow and annulus flow.

Laboratory Sessions/ Experimental learning: Free and Forced convection experiments in HMT lab

Applications: Heat exchangers in Aero applications, Gas turbine combustion chamber, turbine and afterburners etc

Video link / Additional online information (related to module if any):

https://nptel.ac.in/courses/112/106/112106170/

Module 4	L1,L2,L3	8 Hrs.

Radiation:

- Introduction to physical mechanism - Radiation properties - Radiation shape factors Heat exchange between non-black bodies – Radiation shields

Heat Exchangers:

- Heat Exchangers used in Aerospace Industry: Classification of heat exchangers; overall heat transfer coefficient, Heat exchanger components, Numerical problems.

Laboratory Sessions/ Experimental learning:Radiation experiment in HMT lab

Applications: Combustion chambers in Rockets and varies gas turbine engines.

Video link / Additional online information (related to module if any):

https://nptel.ac.in/courses/112/106/112106170/

Module 5	L1,L2,L3,	8 Hrs.

Heat and Mass Transfer Problems in Aerospace Engineering:

- Abrative heat transfer, heat transfer in rocket thrust chambers. Heat and mass transfer in satellite systems
- Spacecraft environmental control. Thermal control in re-entry vehicles.

Laboratory Sessions/ Experimental learning: Basics in Aerospace propulsion lab

Applications: Rocket thrust chambers - Aerodynamic heating -Ablative heat transfer turbine and nozzle blades.

Video link / Additional online information (related to module if any):

https://nptel.ac.in/courses/112/101/112101097/

Course outcomes:

Upon completion of the course, students will be able to:

CO305.3.1	Analyse the fundamentals of heat and mass transfer
CO305.3.2	Explain the concept of one dimensional steady and transient heat conduction through various systems
CO305.3.3	Evaluate the heat transfer by convection with the flow of fluids
CO305.3.4	Analyzing heat transfer in heat exchangers
CO305.3.5	Analysing heat transfer problems occurring in aerospace systems.

Reference Books:

1.	Ozisik, Heat transfer-A basic approach, Tata McGraw Hill 2002
2.	Holman Heat Transfer, J.P McGraw Hill Book Co., Inc., New York 8th edition,1996
3.	Sachdeva.Fundamentals of Engineering Heat and Mass Transfer, S.C Wiley Eastern Ltd., New Delhi 1981
4.	Sutton,Rocket Propulsion Elements, G.P John Wiley and Sons 5th Edn.1986

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

lix. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

lx. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

lxi. One question must be set from each unit. The duration of examination is 3 hours.

CO,PO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	0	0	0	0	0	0	1	1	1	1
CO2	3	3	2	3	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	0	0	0	0	0	0	0	2	1	1
CO4	3	3	2	3	0	0	0	0	0	0	0	1	1	1
CO5	3	2	2	2	0	0	0	0	0	0	1	1	1	1

High,3, Medium,2, Low,1

Course Title	AERODYNAMICS LAB	Semester	V
Course Code	MVJ19ASL56	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	03	Total	100
Credits	02	Exam. Duration	3 Hours

Course objective is to:

- Be acquainted with basic principles of aerodynamics using wind tunnel.
- Acquire the knowledge on flow visualization techniques.
- Understand the procedures used for calculating the lift and drag.

Sl No	Experiment Name	RBT Level	Hours
1	Calibration of a subsonic wind tunnel: test section static pressure and total head distributions.	L1,L2,L3	03
2	Smoke flow visualization studies on a two-dimensional circular cylinder at low speeds.	L1,L2,L3	03
3	Smokeflowvisualizationstudiesonatwodimensionalairfoilatdifferentanglesofincidenceatlowspeeds	L1,L2,L3	03
4	Smoke flow visualization studies on a two dimensional wing with flaps and slats at different angles of incidence at low speeds	L1,L2,L3	03
5	Tuft flow visualization on a wing model at different angles of incidence at low speeds: identify zones of attached and separated flows.	L1,L2,L3	03
6	Surface pressure distributions on a two dimensional smooth circular cylinder at low speeds and calculation of pressure drag.	L1,L2,L3	03
7	Surface pressure distributions on a two-dimensional wing of symmetric airfoil and estimation of Center of pressure and Aerodynamic center	L1,L2,L3	03
8	Surface pressure distributions on a two-dimensional wing of cambered airfoil at different angles of incidence, and estimation of Center of pressure and Aerodynamic center.	L1,L2,L3	03
9	Calculation of total drag of a two-dimensional circular cylinder at low speeds using pitot-static probe wake survey.	L1,L2,L3	03
10	Calculation of total drag of a two-dimensional wing of cambered airfoil at low speeds at incidence using pitot-static probe wake survey.	L1,L2,L3	03
11	Measurement of a typical boundary layer velocity profile on the tunnel wall (at low speeds) using a pitot probe and calculation of boundary layer displacement and	L1,L2,L3	03

	momentum thickness.		
12	Calculation of aerodynamic forces and moments acting on a model aircraft at various Angle of Attack and speeds using wind tunnel balance With Yaw.	L1,L2,L3	03
13	Calculation of aerodynamic coefficients and forces acting on a model aircraft at various Angle of Attack and speeds using wind tunnel balance Without Yaw.	L1,L2,L3	03
14	Pressure measurements on aerofoil for a case of reverse flow.	L1,L2,L3	03

Course outcomes:

CO1	Apply the flow visualization techniques
CO2	Estimate the pressure distribution over the bodies
CO3	Calculate the forces and moments on models.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	1	1	1	1	1	1	1
CO2	3	3	3	3	3	1	1	1	1	1	1	1
CO3	3	3	3	3	3	1	1	1	1	1	1	1

High-3, Medium-2, Low-1

Course Title	ENERGY CONVERSION & FLUID MECHANICS LAB	Semester	V
Course Code	MVJ19ASL57	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	03	Total	100
Credits	02	Exam. Duration	3 Hours

Course objective is to:

- Familiarize with the flash point, fire point and viscosity of lubricating oils.
- Study IC engine parts, opening and closing of valves to draw the valve-timing diagram.
- Gain the knowledge of various flow meters and the concept of fluid mechanics.
- Understand the Bernoulli's Theorem.

Sl No	Experiment Name	RBT Level	Hours
1	Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Pensky Martins Apparatus.	L1,L2,L3	03
2	Determination of Calorific value of solid, liquid and gaseous fuels.	L1,L2,L3	03
3	Determination of Viscosity of lubricating oil using Torsion viscometers.	L1,L2,L3	03
4	Valve Timing diagram of 4-stroke IC Engine.	L1,L2,L3	03
5	Calculation of work done and heat transfer from PV and TS diagram using Planimeter.	L1,L2,L3	03
6	Performance Test on Four stroke Petrol Engine and calculations of IP, BP, Thermal efficiencies, SFC, FP and to draw heat balance sheet.	L1,L2,L3	03
7	Performance Test on Four stroke Multicylinder Engine and calculations of IP, BP, Thermal efficiencies, SFC, FP and to draw heat balance sheet.	L1,L2,L3	03
8	Calibration of Venturimeter.	L1,L2,L3	03
9	Determination of Coefficient of discharge for a small orifice by a constant head method.	L1,L2,L3	03

10	Determination of Viscosity of a Fluid.	L1,L2,L3	03
11	Calibration of contracted Rectangular Notch.	L1,L2,L3	03
12	Verification of Bernoulli's equation.	L1,L2,L3	03
13	Pipe friction apparatus with loss of head on pipe fittings.	L1,L2,L3	03
14	Determination of Coefficient of loss of head in a sudden contraction and friction factor.	L1,L2,L3	03

Course outcomes:	
CO1	Operate the instrument and measure the BP, FP, IP and AF ratio.
CO2	Find the efficiency of the engine and Estimate the calorific value of the given fuel.
CO3	Verify the Bernoulli's equation.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	1	1	1	1	1	1	1
CO2	3	3	3	3	3	1	1	1	1	1	1	1
CO3	3	3	3	3	3	1	1	1	1	1	1	1
CO4	3	3	3	3	3	1	1	1	1	1	1	1
CO5	3	3	3	3	3	1	1	1	1	1	1	1

High-3, Medium-2, Low-1

Course Title	AEROSPACE PROPULSION LAB	Semester	V
Course Code	MVJ19ASL58	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	03	Total	100
Credits	02	Exam. Duration	3 Hours

- Course objective is to:
- Study of heat transfer phenomenon
- Learn flame propagation phenomenon
- Acquire knowledge of burning of propellants

Sl No	Experiment Name	RBT Level	Hours
1	Study of an aircraft jet engine (Includes study of assembly of sub systems, various components, their functions and operating principles)	L1,L2,L3	03
2	Study of forced convective heat transfer over a flat plate.	L1,L2,L3	03
3	Study of free convective heat transfer over a flat plate.	L1,L2,L3	03
4	Determination of heat of combustion of aviation fuel.	L1,L2,L3	03
5	Measurement of burning velocity of a premixed flame.	L1,L2,L3	03
6	Flame stability of pre-mixed flame through flame stability setup.	L1,L2,L3	03
7	Study of Free Jet/Wall Jet.	L1,L2,L3	03
8	Investigation of the pressure in a convergent-divergent nozzle for under expanding and over expanding conditions.	L1,L2,L3	03
9	Preparation of a Solid Propellant.	L1,L2,L3	03
10	Computation o burning rate of the propellant.	L1,L2,L3	03
11	Determine the Calorific value of liquid fuel.	L1,L2,L3	03
12	Measurement of Ignition delay of a single propellant with different shapes.	L1,L2,L3	03

13	Determine the specific impulse of solid motor.	L1,L2,L3	03
14	Performance study of Hybrid Motor using a thrust stand.	L1,L2,L3	03
Course outcomes:			
CO1	Analyze heat transfer phenomenon		
CO2	Investigate flame propagations		
CO3	Evaluate propellant burning		

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	1	1	1	1	1	1	1
CO2	3	3	3	3	3	1	1	1	1	1	1	1
CO3	3	3	3	3	3	1	1	1	1	1	1	1

High-3, Medium-2, Low-1

Course Title	ENVIRONMENTAL STUDIES	Semester	V
Course Code	MVJ19ENV59	CIE	50
Total No. of Contact Hours	20 L: T: P 1 : 0 :0	SEE	50
No. of Contact Hours/week	1	Total	100
Credits	1	Exam. Duration	3 Hrs.

Course objective is to:

- Relate to interdisciplinary approach to complex environmental problems using basic tools of the natural and social sciences including geo-systems, biology, chemistry, economics, political science and international processes; Study drinking water quality standards and to illustrate qualitative analysis of water.
- Critically evaluate the science and policy ramifications of diverse energy portfolios on air and water quality, climate, weapons proliferation and societal stability..

Module 1	L1,L2,	04 Hrs.

Introduction to environmental studies, Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.

Ecosystems (Structure and Function): Forest, Desert, Rivers, Ocean

Biodiversity: Types, Hot spots; Threats and Conservation of biodiversity, Deforestation.

Video link:

https://nptel.ac.in/courses/127/106/127106004/

Module 2	L1,L2,L3,	10 Hrs.

Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind.

Natural Resource Management (Concept and case-study): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

Video link:

https://nptel.ac.in/courses/121/106/121106014/

Module 3	L1,L2,L3	10 Hrs.

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant EnvironmentalActs, Case-studies):SurfaceandGroundWaterPollution;Noisepollution;SoilPollutionand Air Pollution.

Waste Management & Public Health Aspects: Bio-medical Waste; Solid waste; Hazardous waste;

E-waste.

Video link:

- https://nptel.ac.in/courses/122/106/122106030/
- https://nptel.ac.in/courses/105/103/105103205/

Module 4	L1,L2,L3	10 Hrs.

. **Global Environmental Concerns (Concept, policies, and case-studies)**: Global Warming Climate Change; Acid Rain; Ozone Depletion; Fluoride problem In drinking water.

Video link:

- https://nptel.ac.in/courses/122/106/122106030/
- https://nptel.ac.in/courses/120108004/

Module 5	L1,L2	10 Hrs.

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO 14001.

Video link:

- https://nptel.ac.in/courses/105/102/105102015/

https://nptel.ac.in/courses/120/108/120108004/

Course outcomes:

Upon completion of the course, students will be able to:

CO1	Describe the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.
CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
CO3	Demonstrate ecology knowledge of a complex relationship between biotic and Abiotic components.
CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

Reference Books:

1.	Principals of Environmental Science and Engineering, Raman Siva kumar, Cengage learning, Singapur, 2nd Edition, 2005
2.	Environmental Science – working with the Earth G.Tyler Miller Jr. Thomson Brooks /Cole, 11th Edition, 2006

3.	Textbook of Environmental and Ecology, Pratiba Singh, Anoop Singh & Piyush Malaviya , ACME Learning Pvt. Ltd. New Delhi, 1st Edition.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	-	2	2	1	1	-	2	1
CO2	3	3	2	1	-	1	2	-	1	1	2	1
CO3	3	3	2	1	-	2	2	-	1	1	2	1
CO4	3	3	2	2	-	2	2	-	1	1	2	1

High,3, Medium,2, Low,1