

Course Title	TECHNICAL MANAGEMENT & ENTREPRENEURSHIP	Semester	V
Course Code	MVJ20TEM51	CIE	50
Total No. of Contact Hours	40L: 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
<p>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.</p> <p>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.</p> <p>Laboratory Sessions/ Experimental learning: Case study on decision making process in a corporate.</p> <p>Applications: Planning in engineering field.</p> <p>Web Link and Video Lectures</p> <p>https://nptel.ac.in/courses/110/105/110105146/</p> <p>https://nptel.ac.in/courses/122/108/122108038/</p>		
Module-2	L1., L2	8Hours
<p>Organizing and Staffing: Meaning, Nature and Characteristics of Organization – Process of Organization, Principles of Organization, Departmentalization, Committees – meaning, Types of</p>		

<p>Committees, Centralization Vs Decentralization of Authority and Responsibility, Span of Control, Nature and Importance of Staffing, Process of Selection and Recruitment.</p> <p>Directing and Controlling: Meaning and Nature of Directing-Leadership Styles, Motivation Theories,</p> <p>Communication – Meaning and Importance, Coordination- Meaning and Importance, Techniques of Coordination. Controlling – Meaning, Steps in Controlling.</p> <p>Laboratory Sessions/ Experimental learning</p> <p>Case study of steel plant departmentalization.</p> <p>Applications: Effective communication in a corporate.</p> <p>Web Link and Video Lectures</p> <p>https://nptel.ac.in/content/storage2/courses/122106031/slides/3_2s.pdf</p> <p>https://www.slideshare.net/100005130728571/27-nature-of-directing</p>		
Module-3	L1., L2	8Hours
<p>Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance.</p> <p>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.</p> <p>Laboratory Sessions/ Experimental learning</p> <p>Case study of a startup.</p> <p>Application: Social auditing in a software company Web Link and Video Lectures</p> <p>https://nptel.ac.in/courses/110/106/110106141/</p> <p>https://nptel.ac.in/courses/127/105/127105007/</p>		
Module-4	L1., L2	8Hours
<p>Modern Small Business Enterprises: Role of Small Scale Industries, Concepts and definitions of SSI Enterprises, 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).</p> <p>Institutional Support for Business Enterprises: Introduction, Policies & Schemes of Central–Level Institutions, State-Level Institutions.</p> <p>Laboratory Sessions/ Experimental learning</p>		

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
<p>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.</p> <p>Laboratory Sessions/ Experimental learning</p> <p>Investigation on the market in correspondence to project. Application</p> <p>Preparations of project report. Web Link and Video Lectures</p> <p>https://www.projectmanager.com/project-scheduling</p> <p>https://kissflow.com/project/basics-of-project-scheduling/</p>		
Course outcomes:		
CO1	UnderstandtheconceptofManagement	
CO2	Understandthestaffingprocess	
CO3	ExplainthesocialresponsibilitiesofbusinesstowardsDifferentGroups	
CO4	ExplaintheRoleofSmallScale Industries	
CO5	InterprettheProjectObjectives	

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

4	RobertKreitner&MamataMohapatra,Management ,Biztantra,2008.
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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 <ul style="list-style-type: none"> - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
<p>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.</p> <p>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.</p> <p>xliii. One question must be set from each unit. The duration of examination is 3 hours.</p>

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	MVJ20AS52	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_IU&list=PLwdnzlV3ogoWb_iTQza6Z8dYHR-_1qhh0&index=2
2. https://youtu.be/mS3ZVuOn_IU?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 – Hugoniot 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 – Hugoniot 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:

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- 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.

xliv. 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 STRUCTURAL ANALYSIS	Semester	V
Course Code	MVJ20AS53	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/bQQMIy7DIt0
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	Examine the stress distribution in Pressure Vessels and Spacecraft Structures

Reference Books:

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

CIE Assessment:

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

SEE Assessment:

xlvi. 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.

xlvi. 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	MVJ20AS54/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	08 Hrs.
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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	08 Hrs.
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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	08 Hrs.
<p>Forced Vibration: Single degree of freedom systems, steady state solution with viscous damping due to harmonic force. Solution by Complex algebra, reciprocating and rotating unbalance, vibration isolation, transmissibility ratio due to harmonic excitation and support motion.</p> <p>Vibration Measuring Instruments & Whirling of Shafts: Vibration of elastic bodies – Vibration of strings – Longitudinal, lateral and torsional Vibrations.</p> <p>Laboratory Sessions/ Experimental learning: Whirling of shaft experiment [Design Lab]</p> <p>Applications: Isolators and its Application.</p> <p>Video link / Additional online information (related to module if any): (NPTEL, IIT KANPUR) https://www.youtube.com/watch?v=XGQr1uEX-Dc</p>		
Module 4	L1,L2,L3	08 Hrs.
<p>Systems with Two Degrees of Freedom: Introduction, principle modes and Normal modes of vibration, coordinate coupling, generalized and principal co-ordinates, Free vibration in terms of initial conditions. Geared systems. Forced Oscillations-Harmonic excitation. Applications: Vehicle suspension, Dynamic vibration absorber and Dynamics of reciprocating Engines.</p> <p>Continuous Systems: Introduction, vibration of string, longitudinal vibration of rods, Torsional vibration of rods, Euler's equation for beams.</p> <p>Laboratory Sessions/ Experimental learning: Determination of two natural frequencies, or modes, for the system</p> <p>Applications: Dynamic vibration absorber and its application in reciprocating engine.</p> <p>Video link / Additional online information (related to module if any): (NPTEL, IIT MADRAS) https://www.youtube.com/watch?v=V_Lj4Pun_WM</p>		
Module 5	L1,L2	08 Hrs.
<p>Numerical Methods for Multi-Degree Freedom Systems: Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation. Orthogonality of principal modes, Method of matrix iteration-Method of determination of all the natural frequencies using sweeping matrix and Orthogonality principle. Holzer's method, Stodola method.</p> <p>Non-Linear Vibration : (Advance theory of vibration by ssrao)</p> <p>Laboratory Sessions/ Experimental learning: Plotting displacement curve using Analytical Approach.</p> <p>Applications: Understanding non linear behavior of waves or vibration.</p>		

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 twodegrees of freedom systems.
CO304.5	Evaluate themulti degree of freedom system.

Reference Books:

1.	W.T. Thomson and MarieDillonDahleh, 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

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SEE Assessment:

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

CO,PO Mapping														
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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	MVJ20AS551	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

08 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,

08 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	08 Hrs.
<p>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.</p> <p>Laboratory Sessions/ Experimental learning:Computer Simulation Lab using ANSYS Software</p> <p>Applications:Analysing the effect of various loading over the circular plates.</p> <p>Video link / Additional online information (related to module if any):</p> <p>6. https://ocw.mit.edu/courses/mechanical-engineering/2-081j-plates-and-shells-spring-2007/readings/analysis.pdf (MIT Notes)</p>		
Module 4	L1,L2,L3	08 Hrs.
<p>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.</p> <p>Laboratory Sessions/ Experimental learning:Computer Simulation Lab using ANSYS Software</p> <p>Applications: In the design and analysis of the water/oil tanks, pipelines, aircraft fuselages and nanotubes.</p> <p>Video link / Additional online information (related to module if any):</p> <p>1https://www.youtube.com/watch?v=yiwycdPJib4</p>		
Module 5	L1,L2	08 Hrs.
<p>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.</p> <p>Laboratory Sessions/ Experimental Learning:Computer Simulation Lab using ANSYS Software</p> <p>Applications: Analysing the design of the aircraft fuselage and their strength investigation under influence of the various loadings</p> <p>Video link / Additional online information (related to module if any):</p> <p>1. https://www.youtube.com/watch?v=uDieRHcG3x8&t=124s (NPTEL, IIT Roorkee)</p> <p>2. https://www.youtube.com/watch?v=8iIPEojHB1g</p> <p>3. https://www.youtube.com/watch?v=Mnwn5hRm1Cc</p>		
Course outcomes:		
Upon completion of the course, students will be able to:		
CO305.1.1	Analyze the 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	Identify the 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	MVJ20AS552/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

08 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-bdEEUEIQ9-obrujIKGEhg – IIT Kanpur

Module 2

L1,L2,L3,

08 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

<p>Processing of Polymer Matrix Composites: Thermoplastic Polymers, Extrusion process, Injection Moulding Process, Thermo-forming process.</p> <p>Post Processing of Composites – Adhesive bonding, drilling, cutting processes.</p> <p>Laboratory Sessions/ Experimental learning: Preparation of Composite laminates by Hand layup method</p> <p>Applications: Thermosets and Thermoplastics are used in Aircraft Construction, corrosive environment, Common applications include fans, grating, tanks, ducts, hoods, pumps and cabinets.</p> <p>Video link / Additional online information (related to module if any): https://youtu.be/tP8JCX87DzI - IIT Roorkee</p>		
Module 3	L1,L2,L3	08 Hrs.
<p>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</p> <p>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.</p> <p>Laboratory Sessions/ Experimental learning: Determination of Young's Modulus of a Composite beam</p> <p>Applications:Basics of macro level elastic properties, Scales of analysis of composites. Unidirectional and Woven fibers</p> <p>Video link / Additional online information (related to module if any): https://youtu.be/loyeZN5UQT8 - IIT Madras</p>		
Module 4	L1,L2,L3	08 Hrs.
<p>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.</p> <p>Laboratory Sessions/ Experimental learning: Evaluate the mechanical properties of a lamina and a laminate</p> <p>Applications: Prediction of failure of composite, load analysis methodology.</p> <p>Video link / Additional online information (related to module if any):</p>		

https://youtu.be/6CLEWA2WNqM - IIT Madras		
Module 5	L1,L2	08 Hrs.
<p>Inspection & Quality Control: Destructive & Non-Destructive Testing, Tensile, Compression, Flexural, Shear, Hardness; ultrasonic testing – A-B-C scan</p> <p>Applications of Composites Materials</p> <p>Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, marine, recreational and Sports equipment, future potential of composites.</p> <p>Laboratory Sessions/ Experimental learning:</p> <p>Determination of Defects in a composite by NDT Methods</p> <p>Applications: NDT- DT Methods, Composites in Aerospace sector</p> <p>Video link / Additional online information (related to module if any):</p> <p>https://youtu.be/ZMJ7O4vs-Q8 - IIT Kanpur</p>		
<p>Course outcomes:</p> <p>Upon completion of the course, students will be able to:</p>		
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 <i>composite</i> materials and understand mechanical behaviour at <i>micro and macro</i> levels.	
CO305.2.4	Design and failure <i>analysis</i> for manufacturing <i>composite</i> materials and Determine stresses and strains relation in composites materials.	
CO305.2.5	Carry out various inspections in 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, 2 nd 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 <ul style="list-style-type: none"> - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
<p>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.</p> <p>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.</p> <p>lviii. One question must be set from each unit. The duration of examination is 3 hours.</p>

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	MVJ20AS553	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

08 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

08 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

<p>Applications: Gas turbine combustion chamber, turbine and afterburners etc</p> <p>Video link / Additional online information (related to module if any):</p> <p>https://nptel.ac.in/courses/112/105/112105271/</p>		
Module 3	L1,L2,L3	08 Hrs.
<p>Convection: Concepts of Continuity, Momentum and Energy Equations. Dimensional analysis-Buckingham's Pi Theorem - Application for developing non-dimensional correlation for convective heat transfer</p> <ul style="list-style-type: none"> • 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. <p>Laboratory Sessions/ Experimental learning: Free and Forced convection experiments in HMT lab</p> <p>Applications: Heat exchangers in Aero applications, Gas turbine combustion chamber, turbine and afterburners etc</p> <p>Video link / Additional online information (related to module if any):</p> <p>https://nptel.ac.in/courses/112/106/112106170/</p>		
Module 4	L1,L2,L3	08 Hrs.
<p>Radiation:</p> <ul style="list-style-type: none"> • Introduction to physical mechanism - Radiation properties - Radiation shape factors Heat exchange between non-black bodies – Radiation shields <p>Heat Exchangers:</p> <ul style="list-style-type: none"> • Heat Exchangers used in Aerospace Industry: Classification of heat exchangers; overall heat transfer coefficient, Heat exchanger components, Numerical problems. <p>Laboratory Sessions/ Experimental learning: Radiation experiment in HMT lab</p> <p>Applications: Combustion chambers in Rockets and various gas turbine engines.</p> <p>Video link / Additional online information (related to module if any):</p> <p>https://nptel.ac.in/courses/112/106/112106170/</p>		
Module 5	L1,L2,L3,	10Hrs.
<p>Heat and Mass Transfer Problems in Aerospace Engineering:</p>		

- Abrasive 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	MVJ20ASL56	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	Smoke flow visualization studies on a two-dimensional airfoil at different angles of incidence at low speeds	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,L 3	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 momentum thickness.	L1,L2,L 3	03
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,L 3	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,L 3	03
14	Pressure measurements on aerofoil for a case of reverse flow.	L1,L2,L 3	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	MVJ20ASL57	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: <ul style="list-style-type: none"> • 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 P V and T S diagram using Planimeter.	L1,L2, L3	03
6	Performance Test on Four stroke Petrol Engine and calculation of IP, BP, Thermal efficiencies, SFC, FP and to draw heat balance sheet.	L1,L2, L3	03
7	Performance Test on Four stroke Multi cylinder Engine and calculation 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 A/F 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	MVJ20ASL58	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 underexpanding and overexpanding conditions.	L1,L2,L3	03
9	Preparation of a Solid Propellant.	L1,L2,L3	03
10	Computation of 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	Perform a test 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	MVJ20ENV59	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:

- Relatetointerdisciplinaryapproachtocomplexenvironmentalproblemsusingbasictoolsofthenatural 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.

AdvancesinEnergySystems(Merits,Demerits,GlobalStatusandApplications): Hydrogen,Solar,OTEC, Tidal andWind.

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.
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Global Environmental Concerns (Concept, policies, and case-studies): Global Warming
ClimateChange;AcidRain;OzoneDepletion;Fluorideproblem Indrinkingwater.

Video link:

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

Module 5	L1,L2	10 Hrs.
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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, 2 nd Edition, 2005
2.	Environmental Science – working with the Earth G.Tyler Miller Jr. Thomson Brooks

	/Cole,11 th Edition, 2006
3.	Textbook of Environmental and Ecology, Pratiba Singh, Anoop Singh&PiyushMalaviya ,ACME Learning Pvt. Ltd. New Delhi, 1 st 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

Course Title	UNIVERSAL HUMAN VALUES-II	Semester	V
Course Code	MVJ20UHV510	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 Hours

Course objective is to:

- Appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Module-1

L1, L2, L3

04 Hours

Review on Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Self-exploration as the Process for Value Education, Happiness and Prosperity – Current Scenario,

Value Education: Understanding Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, , Method to Fulfill the Basic Human Aspirations,

Practical Sessions: Sharing about Oneself (Tutorial 1), Exploring Human Consciousness (Tutorial 2), Exploring Natural Acceptance (Tutorial 3)

Video link:

1. <https://www.youtube.com/watch?v=85XCw8SU084>
2. https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6jqzA3pZ3yA7g_OAQz

Module-2

L1, L2, L3

04 Hours

Review on Understanding Human being as the Co-existence of the Self and the Body, The Body as an Instrument of the Self, Harmony of the Self with the Body.

<p>Harmony in the Human Being: Distinguishing between the Needs of the Self and the Body, Understanding Harmony in the Self, Programme to ensure self-regulation and Health.</p> <p>Practical Sessions: Exploring the difference of Needs of Self and Body (Tutorial 4), Exploring Sources of Imagination in the Self (Tutorial 5), Exploring Harmony of Self with the Body (Tutorial 6).</p> <p>Video link:</p> <p>1. https://www.youtube.com/watch?v=GpuZo495F24</p> <p>https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw</p>		
Module-3	L1, L2, L3	04 Hours
<p>Review on Harmony in the Family – the Basic Unit of Human Interaction, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society.</p> <p>Harmony in the Family and Society: 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Vision for the Universal Human Order,</p> <p>Practical Sessions: Exploring the Feeling of Trust (Tutorial 7), Exploring the Feeling of Respect (Tutorial 8), Exploring Systems to fulfill Human Goal (Tutorial 9).</p> <p>Video link:</p> <p>1. https://www.youtube.com/watch?v=F2KVV4WNnS8</p> <p>https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw</p>		
Module-4	L1, L2, L3	04 Hours
<p>Harmony in the Nature/Existence: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.</p> <p>Practical Sessions: Exploring the Four Orders of Nature (Tutorial 10), Exploring Co-existence in Existence (Tutorial 11).</p> <p>Video link:</p> <p>1. https://www.youtube.com/watch?v=1HR-QB2mCF0</p> <p>2. https://www.youtube.com/watch?v=lfN8q0xUSpw</p> <p>https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw</p>		
Module-5	L1, L2, L3	04 Hours
<p>Review on Natural Acceptance of Human Values, Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Holistic Technologies, Production Systems and Management Models-Typical Case Studies.</p> <p>Implications of the Holistic Understanding – a Look at Professional Ethics: Definitiveness of (Ethical) Human Conduct, Competence in Professional Ethics, Strategies for Transition towards Value-based Life and Profession</p> <p>Practical Sessions: Exploring Ethical Human Conduct (Tutorial 12), Exploring Humanistic Models in</p>		

Education (Tutorial 13), Exploring Steps of Transition towards Universal Human Order (Tutorial 14). Video link: 1. https://www.youtube.com/watch?v=BikdYub6RY0 https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw	
Course outcomes:	
CO1	Explore themselves, get comfortable with each other and with the teacher
CO2	Enlist their desires and the desires are not vague.
CO3	Restate that the natural acceptance (intention) is always for living in harmony, only competence is lacking
CO4	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them
CO5	Present sustainable solutions to the problems in society and nature

Reference Books:	
1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4	The Story of Stuff (Book).

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

High-3, Medium-2, Low-1