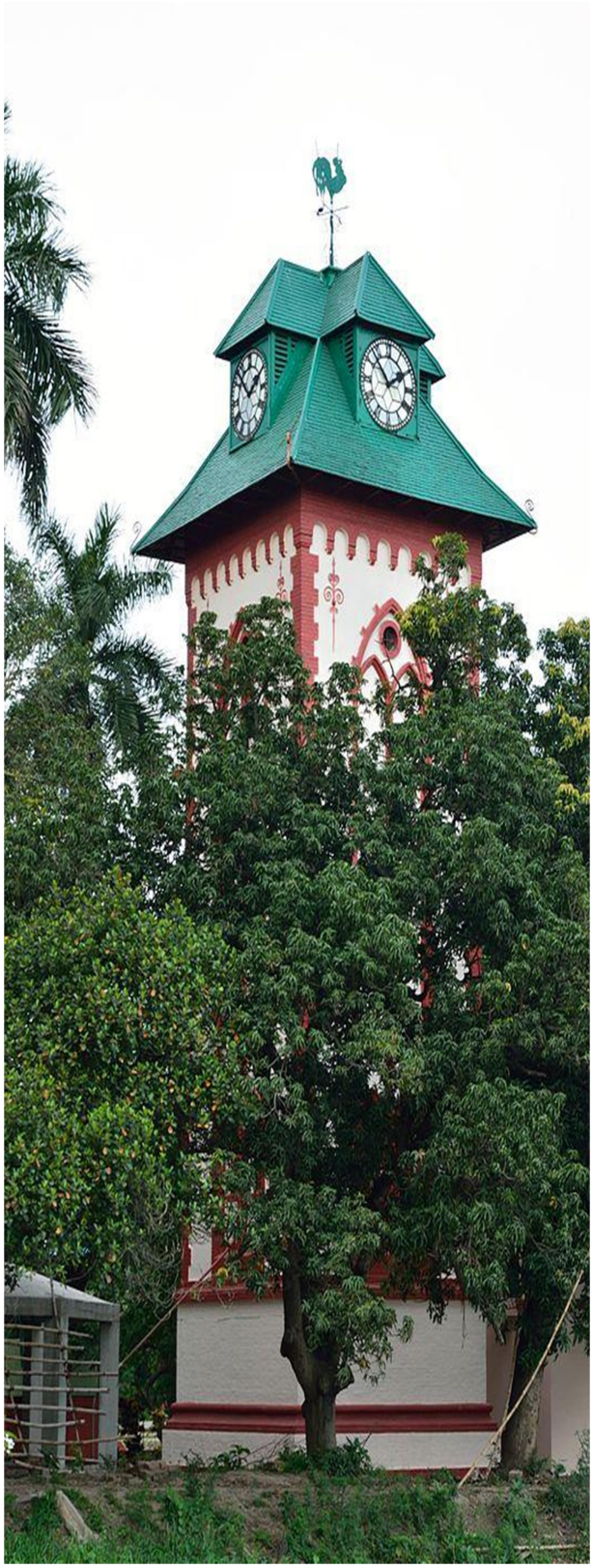

Aerospace Engineering and Applied Mechanics

(ESC courses offered to Other Branches)

B.Tech. Program

Course Structure and Syllabus

Indian Institute of Engineering Science and Technology (IIEST), Shibpur

Botanic Garden, Howrah

Contents

Course Structure

First Semester **[Branch, for which the course is offered, is shown just below this table]**

Sl. No.	Type	Course Name	Course code	Class Load/Week			Credit	Class load/ week	Marks
				L	T	P			
1	ESC	Engineering Mechanics	AM1101N	3	0	0	3	3	100
2	ESC	Mechanics	AM1102N	3	0	0	3	3	100
3	ESC	Engineering Graphics	AM1171N	0	0	3	2	3	50

1. Engineering Mechanics (AM1101N): for Civil, Mechanical, Metallurgy, Mining
2. Mechanics (AM1102N): for Architecture
3. Engineering Graphics (AM1171N): for Civil, Mechanical, Metallurgy, Mining

Second Semester **[Branch, for which the course is offered, is shown just below this table]**

Sl. No	Type	Course Name	Course code	Class Load/Week			Credit	Class load/ Week	Marks
				L	T	P			
1	ESC	Engineering Mechanics	AM1201N	3	0	0	3	3	100
2	ESC	Engineering Thermodynamics	AM1204N	3	0	0	3	3	100
3	ESC	Solid Mechanics	AM1203N	3	0	0	3	3	100
4	ESC	Strength of Materials	AM1202N	3	0	0	3	3	100
5	ESC	Engineering Graphics	AM1271N	0	0	3	2	3	50
6	ESC	Machine Drawing	AM1272N	0	0	3	2	3	50
7	ESC	Solid Mechanics Laboratory	AM1273N	0	0	3	2	3	50

1. Engineering Mechanics (AM1201N): Computer Science, Electronics, Electrical, Information Technology, as applicable
2. Engineering Thermodynamics (AM1204N): Civil, Mechanical, Metallurgy, Mining, as applicable
3. Solid Mechanics (AM1203N): for Civil
4. Strength of Materials (AM1202N): for Architecture
5. Engineering Graphics (AM1271N): for Computer Science, Electronics, Electrical, Information Technology
6. Machine Drawing (AM1272N): for Mechanical
7. Solid Mechanics Laboratory (AM1273N): for Civil

Third Semester [Branch, for which the course is offered, is shown just below this table]									
Sl. No	**Type**	**Course Name**	**Course**	**Class Load**			**Credit**	**Class load**	**Marks**
				L	**T**	**P**			
1	ESC	Fluid Mechanics	AM2101N	3	0	0	3	3	100
2	ESC	Strength of Materials	AM2103N	3	0	0	3	3	100
3	ESC	Rigid Body Dynamics	AM2102N	3	0	0	3	3	100
4	ESC	Fluid Mechanics and Fluid Machinery	AM2104N	3	0	0	3	3	100
5	ESC	Strength of Materials Laboratory	AM2171N	0	0	3	2	3	50
6	ESC	Fluid Mechanics Laboratory	AM2172N	0	0	3	2	3	50
7	ESC	Fluid Mechanics and Fluid Machinery Laboratory	AM2173N	0	0	3	2	3	50

1. Fluid Mechanics (AM2101N): for Civil, Mechanical
2. Strength of Materials (AM2103N): for Mechanical
3. Rigid Body Dynamics (AM2102N): for Mechanical
4. Fluid Mechanics and Fluid Machinery (AM2104N): for Mining
5. Strength of Materials Laboratory (AM2171N): for Mechanical
6. Fluid Mechanics Laboratory (AM2172N): for Civil, Mechanical
7. Fluid Mechanics and Fluid Machinery Laboratory (AM2173N): for Mining

Fourth Semester [Branch, for which the course is offered, is shown just below this table]									
Sl. No	**Type**	**Course Name**	**Course**	**Class Load/Week**			**Credit**	**Class load/ week**	**Marks**
			Code	**L**	**T**	**P**			
1	ESC	Fluid Power Engineering	AM2201N	3	0	0	3	3	100
2	ESC	Fluid Power Engineering Laboratory	AM2271N	0	0	3	2	3	50

1. Fluid Power Engineering (AM2201N): for Mechanical
2. Fluid Power Engineering Laboratory (AM2271N): for Mechanical

Syllabi of Courses

Detailed Syllabus

1st Semester Courses Syllabi

(For Other Branches)

Course Code	AM1101N	Course Name	Engineering Mechanics	Course Category	ESC	L	T	P
						3	0	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Mechanics of Solids and Fluids
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	The primary objective of this course is to • To develop the ability to analyze and solve engineering problems involving forces and motion by understanding the fundamental concepts of statics and dynamics. • Analyze the behavior of rigid bodies and particles under static and dynamic loads respectively, including techniques like free body diagrams, equilibrium equations, and kinematic analysis. • Laying the groundwork for more advanced subjects such as strength of materials, fluid mechanics, and mechanical design.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	**Introduction to Statics:** Mechanics; Basic Concepts; Scalars and Vectors; Newton's Law	01	By the end of this module, students will be able to: • **Understand fundamental concepts of mechanics** i.e., distinction between statics and dynamics and also differentiate between scalar and vector quantities in solving mechanics problems.
II	**Force Systems:** Force Systems in Two Dimensions; Moments and Couples;	02	By the end of this module, students will be able to: • Classify different types of force systems, including concurrent, parallel, coplanar, non-coplanar, and general force systems. • Determine the resultant of a force system, including both magnitude and direction, and locate the point of application using moment and couple analysis.
III	**Equilibrium:** Free Body Diagram, Conditions for Equilibrium in Two Dimensional	03	By the end of this module, students will be able to: • Determine unknown forces and moments in beams, trusses, and frames using equilibrium principles. • Evaluate stability and

			determinacy of two-dimensional structures.
IV	**Structures:** Plane Trusses and Frames	05	By the end of this module, students will be able to: • Apply the method of joints and method of sections to determine member forces in statically determinate trusses.
V	**Distributed Force Systems:** Center of Mass; Centroid of Lines; Areas and Volumes; Theorems of Pappus; Area Moments of Inertia	07	By the end of this module, students will be able to: • Calculate the **resultant force and Area moment of Inertia** of distributed loads and locate the **center of gravity** or **point of application.**
VI	**Friction:** Friction – Application to wedges	06	By the end of this module, students will be able to: • Analyze Equilibrium Involving Frictional Forces, • Apply Friction Principles to Wedge Problems.
VII	**Kinematics of Particles:** Two Dimensional Particle Kinematics in Rectangular Coordinates, Cylindrical Co-ordinates and in terms of Normal and Tangential Components.	09	By the end of this module, students will be able to: • Solve problems involving projectile motion and general 2D kinematics in rectangular coordinates.
VIII	**Kinetics of Particles:** Conservation Laws – Approaches in terms of Force, Mass and Acceleration; Work and Energy; Linear Impulse and Momentum – Impact; Angular Impulse and Momentum – Central Force Motion;	09	By the end of this module, students will be able to: • Apply the work-energy theorem to solve problems involving conservative and non-conservative forces. • Analyze systems under impulsive loading, including sudden forces and collisions.

Course Outcome	At the end of the course, the student will be able to: • Obtain the equivalent force – couple system of a given system • Analyze the equilibrium state of a particle and rigid body • Estimate the moment of inertia of composite area about centroidal or any arbitrary axis • Determine the velocity and acceleration of a particle in rectangular and cylindrical coordinate systems of rigid bodies in general plane motion.

Learning Resources	**Text Book:** • Engineering Mechanics Statics (Vol. I) and Dynamics (Vol. II) – J.L. Meriam & L.G. Kraige **Reference Books:** • Engineering Mechanics Statics and Dynamics – I.H. Shames • Vector Mechanics for Engineers Statics – F.P. Beer and E.R. Johnston Jr. • Vector Mechanics for Engineers Dynamics – F.P. Beer and E.R. Johnston Jr.

Course Code	AM1102N	Course Name	Mechanics	Course Category	ESC	L	T	P
						3	0	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Strength of Materials
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	The primary objective of this course is to • Understanding and applying the principles of statics (equilibrium of particles and rigid bodies). • Understanding the basics of dynamics (kinematics and kinetics of particles and rigid bodies). • Analyze the behavior of rigid bodies and particles under static and dynamic loads respectively, including techniques like free body diagrams, equilibrium equations, and kinematic analysis.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	Introduction: Concept of Engineering Mechanics- Statics and Dynamics – Scalar and Vector	02	By the end of this module, students will be able to: • Understand the physical significance of vectors in mechanics.
II	System of Force: Force – Linear representation of force – System of co-planar forces – Parallelogram Law – Composition and Resolution – Transmissibility – Action & Reaction – Triangle Law & Polygon Law – Resultant by Analytical & graphical method – Vector diagram – Bow's notation. Condition of Equilibrium : Lami's Theorem – Conditions of equilibrium of co-planar system of (i) concurrent forces, (ii) non-concurrent parallel forces (like & unlike), (iii) non-concurrent non-parallel forces [simple problems excluding statically indeterminate]	04	By the end of this module, students will be able to: • Calculate resultant forces analytically by resolving force components. • Draw free body diagrams and apply equilibrium equations to determine unknown forces.
III	Moments & Couples : Moment of a force about a point – Physical significance of moment – moment of a system of parallel and inclined forces – Varignon's Theorem – Moment of a couple	03	By the end of this module, students will be able to: • Calculate the moment of a single force using the perpendicular distance from the point to the line of action of the force.
IV	Friction : Definition – Useful and harmful effects of friction – Laws of Static friction – Co-efficient of friction – Angle of friction – Angle of repose – Equilibrium of a body on a rough inclined surface with and without external force	05	By the end of this module, students will be able to: • Explain the laws of dry friction and distinguish between static and kinetic friction.

V	Analysis of simple plane truss using method of joints and method of sections – analysis of simple space truss	05	By the end of this module, students will be able to: • Recognize the assumptions and idealizations involved in truss.
VI	Concept and definition of Centroid, Centre of Gravity, Centre of mass – Centroid by integration method of the uniform lamina of triangular, rectangular, circular, semi-circular shape – Centroid by moment method of T-section, equal and unequal angle-sections, equal and unequal I-sections, Channel sections, Z-sections. Theorem of Pappus	05	By the end of this module, students will be able to: • Differentiate between point loads, uniformly distributed loads (UDL), uniformly varying loads (UVL), and general distributed loads.
VII	Second Moment of Area : Parallel axis theorem, Perpendicular axis theorem – Radius of Gyration – Second moment of Area of the different sections about axes lying in the plane of the sections by integration – Second Moment of Area of I-sections, T-sections, Angle-sections, Channel sections, Z-sections, Composite sections (composite area method) – related simple problems	06	By the end of this module, students will be able to: • Compute centroids of complex sections by dividing them into simpler shapes and applying the moment (first moment of area) method
VIII	Rectilinear Motion : Newton's Law of motion – D'Alembert's principle – Momentum and conservation of momentum of a body	06	By the end of this module, students will be able to: • Understand and use D'Alembert's principle to convert a dynamic problem into a static problem.
IX	Curvilinear Motion : Angular displacement, velocity, acceleration – relation between linear & angular velocity, linear & angular acceleration – D'Alembert's principle – Motion and path of a projectile (numerical problems) – Centripetal and centrifugal force (numerical problems)	06	By the end of this module, students will be able to: • Solve numerical problems related to projectile range, time of flight, and maximum height.

Course Outcome	At the end of the course, the student will be able to: • Obtain the equivalent force–couple system of a given system • Analyze the equilibrium state of a particle and a rigid body • Estimate the moment of inertia of the composite area about the centroid or any arbitrary axis • Determine the velocity and acceleration of a particle in rectangular and cylindrical coordinate systems of rigid bodies in general plane motion.

Learning Resources	**Textbook:** • Engineering Mechanics - Timoshenko and Young. • Engineering Mechanics Statics (Vol. I) and Dynamics (Vol. II) – J.L. Meriam & L.G. Kraige **Reference Books:** • Engineering Mechanics Statics and Dynamics – I.H. Shames • Vector Mechanics for Engineers Statics – F.P. Beer and E.R. Johnston Jr. • Vector Mechanics for Engineers Dynamics – F.P. Beer and E.R. Johnston Jr.

Course Code	AM1171N	Course Name	Engineering Graphics	Course Category	ESC	L	T	P
						0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Machine Drawing
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	• To introduce students to the fundamentals of engineering drawing and visualization, enabling them to effectively communicate technical information through graphical representation using manual and computer-aided drafting tools. • Introduce the principles of orthographic projection, isometric views, sectional views, and dimensioning.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	**Introduction to Engg. Drawing:** Geometric Constructions, Types of Lines, Symbols, Hatchings, Dimensioning Styles, and Copy Figure	02	By the end of this module, students will be able to: • Construct standard geometric shapes using drawing instruments (e.g., bisecting angles, drawing tangents, polygons, etc.).
II	**Projection of Points, Lines & Surfaces:** Concept of Projection Planes and Corresponding Methods, Concept of True Length and True Angles, Plan and Elevation Lengths and Angles only in First angle Projection, Projection of Plane Surfaces with regular Geometric Boundaries	08	By the end of this module, students will be able to: • Differentiate between various projection planes (Horizontal Plane, Vertical Plane) • Generate and analyze **top view (plan), front view (elevation)** and side view of points and lines in various spatial positions.
III	**Projection of Solids:** Projection of Regular Solids resting on H.P. on corners, sides, and bases.	08	By the end of this module, students will be able to: • Draw accurate projections (front view and top view) of regular solids resting on H.P. on their base, side, corner and angle with VP.
IV	**Section of Solids:** Sectional Views of Regular Solids, Concept of True Shapes	06	By the end of this module, students will be able to: • Generate accurate sectional front and top views of regular solids (prisms, pyramids, cylinders, cones, etc.) cut by various types of planes.
V	**Orthographic Projection:** Conversion of Pictorial Views to Two-Dimensional Views on Planes of Projections	07	By the end of this module, students will be able to: • Draw accurate two-dimensional

			views (front, top, side) from given pictorial sketches.
VI	**Isometric Projection:** Concept of Isometric Scales, Isometric View, and Isometric Projection	08	By the end of this module, students will be able to: • Draw isometric projection/view along isometric axes.
VII	**End Test**	03	• Evaluating the Performance

Course Outcome	At the end of the course, the student will be able to: • Interpret and create 2D and 3D engineering drawings. • Use standard drawing conventions and scales effectively. • Apply geometric constructions, orthographic projections, and isometric views. • Communicate design ideas clearly through graphical methods.

Learning Resources	**Reference Books:** • Engineering Drawing by N. D. Bhatt • Engineering Drawing And Graphics by K. Venugopal

2nd Semester Courses Syllabi

(For Other Branches)

Course Code	AM1201N	Course Name	Engineering Mechanics	Course Category	ESC	L	T	P
						3	0	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Mechanics of Solids and Fluids
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	The primary objective of this course is to • To develop the ability to analyze and solve engineering problems involving forces and motion by understanding the fundamental concepts of statics and dynamics. • Analyze the behavior of rigid bodies and particles under static and dynamic loads respectively, including techniques like free body diagrams, equilibrium equations, and kinematic analysis. • Laying the groundwork for more advanced subjects such as strength of materials, fluid mechanics, and mechanical design.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	**Introduction to Statics:** Mechanics; Basic Concepts; Scalars and Vectors; Newton's Law	01	By the end of this module, students will be able to: • **Understand fundamental concepts of mechanics** i.e., distinction between statics and dynamics and also differentiate between scalar and vector quantities in solving mechanics problems.
II	**Force Systems:** Force Systems in Two Dimensions; Moments and Couples;	02	By the end of this module, students will be able to: • Classify different types of force systems, including concurrent, parallel, coplanar, non-coplanar, and general force systems. • Determine the resultant of a force system, including both magnitude and direction, and locate the point of application using moment and couple analysis.
III	**Equilibrium:** Free Body Diagram, Conditions for Equilibrium in Two Dimensional	03	By the end of this module, students will be able to: • Determine unknown forces and moments in beams, trusses, and frames using

			equilibrium principles. • Evaluate stability and determinacy of two-dimensional structures.
IV	**Structures:** Plane Trusses and Frames	05	By the end of this module, students will be able to: • Apply the method of joints and method of sections to determine member forces in statically determinate trusses.
V	**Distributed Force Systems:** Center of Mass; Centroid of Lines; Areas and Volumes; Theorems of Pappus; Area Moments of Inertia	07	By the end of this module, students will be able to: • Calculate the **resultant force and Area moment of Inertia** of distributed loads and locate the **center of gravity** or **point of application.**
VI	**Friction:** Friction – Application to wedges	06	By the end of this module, students will be able to: • Analyze Equilibrium Involving Frictional Forces, • Apply Friction Principles to Wedge Problems.
VII	**Kinematics of Particles:** Two Dimensional Particle Kinematics in Rectangular Coordinates, Cylindrical Co-ordinates and in terms of Normal and Tangential Components.	09	By the end of this module, students will be able to: • Solve problems involving projectile motion and general 2D kinematics in rectangular coordinates.
VIII	**Kinetics of Particles:** Conservation Laws – Approaches in terms of Force, Mass and Acceleration; Work and Energy; Linear Impulse and Momentum – Impact; Angular Impulse and Momentum – Central Force Motion;	09	By the end of this module, students will be able to: • Apply the work-energy theorem to solve problems involving conservative and non-conservative forces. • Analyze systems under impulsive loading, including sudden forces and collisions.

Course Outcome	At the end of the course, the student will be able to: • Obtain the equivalent force – couple system of a given system • Analyze the equilibrium state of a particle and rigid body • Estimate the moment of inertia of composite area about centroidal or any arbitrary axis • Determine the velocity and acceleration of a particle in rectangular and cylindrical coordinate systems of rigid bodies in general plane motion.

Learning Resources	**Text Book:** • Engineering Mechanics Statics (Vol. I) and Dynamics (Vol. II) – J.L. Meriam & L.G. Kraige **Reference Books:** • Engineering Mechanics Statics and Dynamics – I.H. Shames • Vector Mechanics for Engineers Statics – F.P. Beer and E.R. Johnston Jr. • Vector Mechanics for Engineers Dynamics – F.P. Beer and E.R. Johnston Jr.

Course Code	AM1204N	Course Name	Engineering Thermodynamics	Course Category	ESC	L	T	P
						3	0	0

Pre-requisite Courses	• Engineering Physics • Engineering Mathematics-I (Calculus and Linear Algebra)	Co-requisite Courses	• Workshop / Engineering Graphics • Engineering Mathematics -II	Progressive Courses	• Heat Transfer • Fluid Mechanics • Aircraft Propulsion • Combustion • Gas Dynamics • Turbomachinery
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	• Thermodynamic Property Tables (Steam, Air, Refrigerants) • Ideal Gas Tables and Compressibility Charts

Course Objectives	To introduce the fundamental principles of classical thermodynamics and their engineering applications. The course aims to equip students with the analytical tools necessary to understand energy conversion, work and heat interactions, and the formulation and application of the first and second laws of thermodynamics in aerospace and mechanical systems.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	**Introduction to classical thermodynamics**: Energy conversion, Internal energy, Microscopic vs. Macroscopic viewpoint; Thermodynamic system and control volume, Properties and State of a substance, Processes and Cycles; Thermodynamic equilibrium, The Zeroth law of thermodynamics; Quasi equilibrium process	03	• Understand basic thermodynamic concepts including energy conversion, system types, state, process, and equilibrium. • Apply the Zeroth Law and distinguish between microscopic and macroscopic approaches in analyzing thermodynamic systems.
II	**Introduction to classical thermodynamics**: Energy conversion, Internal energy, Microscopic vs. Macroscopic viewpoint; Thermodynamic system and control volume, Properties and State of a substance, Processes and Cycles; Thermodynamic equilibrium, The Zeroth law of thermodynamics; Quasi equilibrium process	04	• Describe the foundational principles of thermodynamic systems, control volumes, state postulates, and energy interactions including internal energy and process paths. • Analyze thermodynamic equilibrium and quasi-equilibrium processes, and apply the Zeroth Law to define the thermodynamic temperature scale within macroscopic and microscopic frameworks.
III	**Work and Heat interactions**: Work, Simple compressible system, Work done at a moving boundary; Other modes of work transfer; Heat, Comparison of heat and work	03	• Formulate expressions for different modes of work and heat transfer in simple compressible systems, including boundary work. • Interpret the thermodynamic significance of work and heat interactions and differentiate their

			roles in energy exchange processes.
IV	**First law of thermodynamics**: 1st law for a Cycle, 1st law for a control mass, Internal energy – a thermodynamic property, Enthalpy, Specific heats; 1st law for a control volume – the steady-state steady-flow (SSSF) model, the transient flow model, and their applications	07	• Apply the first law of thermodynamics to closed and open systems, including cyclic and non-cyclic processes. • Evaluate energy conservation using internal energy, enthalpy, and specific heats in steady-state steady-flow (SSSF) and transient flow conditions.
V	**Second law of thermodynamics**: Limitations of 1st law, Statements of 2nd law of thermodynamics, 1st law (thermal) efficiency and C.O.P; Reversible and irreversible processes; The Carnot cycle; Thermodynamic temperature scale; Inequality of Clausius, Entropy – a thermodynamic property, 2nd law equation for a control mass, Principle of the increase of entropy; Thermodynamic property relations, Reversible polytropic processes for an ideal gas; 2nd law equation for a control volume - The steady-state steady-flow (SSSF) model, the transient flow model; Thermal efficiencies of nozzle, turbine and compressor	10	• Explain the second law of thermodynamics, including its statements, limitations of the first law, and reversible vs. irreversible processes. • Apply second law principles to analyze entropy changes, the Carnot cycle, and thermal efficiencies for control masses and control volumes. • Evaluate the thermal performance of nozzles, turbines, and compressors using entropy and polytropic process concepts.
VI	**Irreversibility and Availability**: Reversible work, Evaluating irreversibility in a general transport process, Availability or Exergy, Exergy balance for a closed system, Exergy balance for control volumes at steady state, 2nd law efficiency, The Maxwell relations; Behaviour of real gases	06	• Understand irreversibility and exergy concepts, including evaluation of irreversibility and exergy balances for closed and open systems. • Apply second law efficiency and Maxwell relations to analyze real gas behavior and thermodynamic processes.
VII	**Power cycles**: Rankine cycle; Brayton cycle, regenerator, Air standard cycle for jet propulsion; Working principle of Spark-ignition and Compression-ignition engines, Otto cycle, Diesel cycle	06	• Describe Rankine, Brayton, and jet propulsion cycles. • Explain spark-ignition and compression-ignition engines with Otto and Diesel cycles.
VIII	**Combustion thermodynamics**: Mixture of ideal gases, fugacity; Fuels, Combustion process, Enthalpy of formation, First-law analysis of reacting systems, Adiabatic flame temperature, Higher and lower heating value; Third law of thermodynamics	03	• Understand combustion fundamentals, including fuel properties, reacting mixtures, and enthalpy of formation. • Apply first law to reacting systems and analyze adiabatic flame temperature and heating values.

Course Outcome	Upon successful completion of this course, the students will be able to: 1. Define and explain basic thermodynamic properties and concepts including system, control volume, state, process, and cycle. 2. Interpret and use thermodynamic property tables and equations of state for pure substances. 3. Analyze work and heat interactions in thermodynamic systems.

	4. Apply the first law of thermodynamics to closed and open systems. 5. Understand and apply the second law of thermodynamics, including the concepts of entropy and exergy. 6. Evaluate the performance of thermodynamic cycles used in power generation and propulsion systems. 7. Analyze chemical reactions and combustion processes from a thermodynamic perspective.

Learning Resources	**Textbooks:** • Thermodynamics: An Engineering Approach by Yunus A. Cengel and Michael A. Boles, McGraw Hill • Fundamentals of Engineering Thermodynamics by Moran, Shapiro, Boettner, and Bailey, Wiley **Reference Books:** • Engineering Thermodynamics by P.K. Nag, McGraw Hill Thermodynamics by J.P. Holman, McGraw Hill • Classical and Statistical Thermodynamics by Ashley H. Carter, Pearson **Data Book:** Thermodynamic Tables and Charts (available with standard textbooks or department resource)

Course Code	AM1203N	Course Name	Solid Mechanics	Course Category	ESC	L	T	P
						3	0	0

Pre-requisite Courses	Engineering Mechanics	Co-requisite Courses	Nil	Progressive Courses	Analysis and Design of Structures
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	• To acquire basic knowledge of stress, strain due to various types of loading. • To draw Shear Force and Bending Moment Diagram for transverse loading. • To determine Bending, Shear stress of Beam. • To solve problems of Torsional shear stress for shaft. • To apply the concept of Transformation of Stresses and Strains • To utilize the concepts of Solid Mechanics on application based combined mode of loading.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	Introduction and concept of elastic behaviour, Concept of stress and strain : normal stress, shear stress, state of stress at a point, normal strain, shear strain, Hooke's law, Poisson's ratio, analysis of axially loaded members, Thermal stress	05	• Develops the **foundation** for stress-strain analysis in structural components. • Enables calculation of **axial stresses and deformations.** • Introduces **material behaviour** under loading
II	Flexural loading: shear and moment in beams, load-shear-moment relationship, shear and moment diagrams	06	• Equips to analyze and interpret beams for internal forces.
III	Flexure and shear stress in beam	04	• Enables to determine of **bending, shear stresses** and actual stresses in beams under transverse loading.
IV	Torsion: Torsion of cylindrical bars, torsional stress, modulus of rigidity and deformation	03	• Introduces **torsional analysis,** enabling evaluation of stresses and deformations in **shafts and cylindrical members.**
V	Transformation of stress and strain, principal stresses, principal strains, Mohr's circle for stress and strain, introduction to theories of failure	09	• Equips to **analyze stress at inclined planes.** • Enables **prediction of critical stress conditions** using Mohr's circle. • Prepares for assessing **failure criteria.**
VI	Combined loading: axial and torsional; axial and bending; axial, torsional and bending.	04	• Prepares students to analyze **real-world structures** subjected to multiple types of loads.

			• Integrates earlier concepts to compute **resultant stresses.**
VII	Bending of non-symmetric sections, shear flow, shear centre for thin walled section	05	• Extends beam theory to **non-standard cross-sections.** • Introduces **shear center** to prevent twisting, important in **thin-walled structural design.**
VIII	Strain energy due to axial forces, bending and torsion, Castigliano's theorem and simple applications	06	• Provides tools to compute reactions and deformations using energy methods.

Course Outcome	At the end of the course, the student will be able to: • Apply the fundamental concepts of stress and strain in the analysis of various structural components and machines. • Analyze the beams to determine shear forces, bending moments. • Determine the bending, shear stresses produced in a beam • Analyze stresses at inclined planes and construct Mohr's circle to predict the principal and maximum shear planes

Learning Resources	**Text Book:** • Elements of Strength of Materials - S.P. Timoshenko and D.H. Young. **Reference Books:** • Mechanics of Materials – E. Popov • A Text Book of Strength of Materials – R.K. Bansal • Strength of Materials – F.P. Beer and E.R. Johnston Jr. • 4. Strength of Materials (Vol. 1) – D.S. Prakash Rao

Course Code	AM1202N	Course Name	Strength of Materials	Course Category	ESC	L	T	P
						3	0	0

Pre-requisite Courses	Engineering Mechanics	Co-requisite Courses	Nil	Progressive Courses	Structure
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	• To acquire basic knowledge of stress, strain due to various types of loading. • To draw the Shear Force and Bending Moment Diagram for transverse loaded beam. • To determine Bending, Shear stress, Slope, and Deflection on the Beam. • To solve problems of Torsional shear stress for the shaft and Buckling for the Column.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	Stress, Strain, Elasticity, Hooke's Law, Factor of Safety, Concept of Working Stress	4	To acquire basic knowledge of deformable bodies and its elastic properties
II	Determinant and indeterminate problems on direct Stress. Thermal stress	5	To learn difference between determinate and indeterminate structures. Learn stress and elongation of the structural members due to temperature change.
III	Thin wall pressure vessels. Mohr's circle for biaxial stresses. Elastic constants, mutual relationship	6	To solve biaxial stress problem analytically and using Mohr's circle
IV	Shear Force and Bending Moment in Beams, Diagrams	8	To determine shear force and bending moment of transversely loaded beam and show it by diagram along the length of the beam
V	Analysis of bending stress in beams, stress distribution diagrams, relevant applications	3	To determine bending stress along the depth of the beam. Relevant application of this knowledge is on any type of structure.
VI	Analysis of shear stress in beams, stress distribution diagrams, relevant applications	3	To determine shear stress and represent its distribution along the depth of the beam. Relevant application is on any type of structure.
VII	Deflection of beams using direct integration method & Macaulay's method, diagrams and relevant applications	4	To determine deflection and slope of transversely loaded beam
VIII	Torsion of shaft of circular section	4	To determine torsional shear stress and torque developed in twisted structural members.
IX	Columns & Struts, determination of critical load subjected to concentric loading in different end	5	To calculate stress developed in short and long column.

	conditions		

Course Outcome	At the end of the course, the student will be able to: • Apply the fundamental concepts of stress and strain in the analysis of various structural components and machines. • Analyze the beams to determine shear forces, bending moments. • Determine the bending, shear stresses and deflection produced in a beam • Analyze a biaxial stress problem and construct Mohr's circle, and find principal stresses

Learning Resources	**Text Book:** • Strength of Materials - Timoshenko and Young.

Course Code	AM1271N	Course Name	Engineering Graphics	Course Category	ESC	L	T	P
						0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Machine Drawing
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	• To introduce students to the fundamentals of engineering drawing and visualization, enabling them to effectively communicate technical information through graphical representation using manual and computer-aided drafting tools. • Introduce the principles of orthographic projection, isometric views, sectional views, and dimensioning.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	**Introduction to Engg. Drawing:** Geometric Constructions, Types of Lines, Symbols, Hatchings, Dimensioning Styles, and Copy Figure	02	By the end of this module, students will be able to: • Construct standard geometric shapes using drawing instruments (e.g., bisecting angles, drawing tangents, polygons, etc.).
II	**Projection of Points, Lines & Surfaces:** Concept of Projection Planes and Corresponding Methods, Concept of True Length and True Angles, Plan and Elevation Lengths and Angles only in First angle Projection, Projection of Plane Surfaces with regular Geometric Boundaries	08	By the end of this module, students will be able to: • Differentiate between various projection planes (Horizontal Plane, Vertical Plane) • Generate and analyze **top view (plan), front view (elevation)** and side view of points and lines in various spatial positions.
III	**Projection of Solids:** Projection of Regular Solids resting on H.P. on corners, sides, and bases.	08	By the end of this module, students will be able to: • Draw accurate projections (front view and top view) of regular solids resting on H.P. on their base, side, corner and angle with VP.
IV	**Section of Solids:** Sectional Views of Regular Solids, Concept of True Shapes	06	By the end of this module, students will be able to: • Generate accurate sectional front and top views of regular solids (prisms, pyramids, cylinders, cones, etc.) cut by various types of planes.
V	**Orthographic Projection:** Conversion of Pictorial Views to Two-Dimensional Views on	07	By the end of this module, students will be able to:

	Planes of Projections		• Draw accurate two-dimensional views (front, top, side) from given pictorial sketches.
VI	**Isometric Projection:** Concept of Isometric Scales, Isometric View, and Isometric Projection	08	By the end of this module, students will be able to: • Draw isometric projection/view along isometric axes.
VII	**End Test**	03	• Evaluating the Performance

Course Outcome	At the end of the course, the student will be able to: • Interpret and create 2D and 3D engineering drawings. • Use standard drawing conventions and scales effectively. • Apply geometric constructions, orthographic projections, and isometric views. • Communicate design ideas clearly through graphical methods.

Learning Resources	**Reference Books:** • Engineering Drawing by N. D. Bhatt • Engineering Drawing And Graphics by K. Venugopal

Course Code	AM1272N	Course Name	Machine Drawing	Course Category	ESC	L	T	P
						0	0	3

Pre-requisite Courses	Engineering Graphics	Co-requisite Courses	None	Progressive Courses	CAD Drawing
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	None

Course Objective	To equip students with the skills to interpret and create accurate mechanical drawings, including parts and assemblies, using standard drafting practices and conventions.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	Development of Surfaces	06	Students will learn to draw the lateral surface of different hollow solids, truncated in various ways.
II	Rivet Joints, Nuts & Bolts	06	Students will learn to draw two views of Rivet joints (Lap & Butt), and three views of Nuts and Bolts (Hexagonal & Square), along with its assembly.
III	Interpenetration of Solids	06	Students will learn to draw one or two views of the curves, generated due to intersection of two different solids, in different combinations and different orientations.
IV	Section of Machine Parts	06	Students will learn to draw three views of various machine parts, having sections in different planes.
V	Component drawing and Assembly drawing of Machines	15	Students will learn to draw three views of all the components of various machines and also to draw the assembled views having sections.
VI	End Test	03	

Course Outcome	At the end of the course, the student will be able to: • Understand and apply the principles of machine drawing and represent mechanical components using standard drawing conventions. • Interpret orthographic views, sectional views, and dimensioning systems used in machine drawings. • Visualize and communicate design ideas effectively through technical drawings. • Analyze and understand the functional relationships between assembled components in a machine.

Learning Resources	**<u>Text Book</u>:** • Engineering Drawing – N.D. Bhatt • Machine Drawing – N.D. Bhatt **<u>Reference Books:</u>** • Engineering Graphics – Venugopal

Course Code	AM1273N	Course Name	Solid Mechanics Laboratory	Course Category	ESC	L	T	P
						0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Engineering Mechanics
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	• Determine the Hardness of a given material. • Observe the behaviour of materials in tension and torsion by conducting tension and torsion test respectively. • Observe the behaviour of materials in conducting strain hardening test. • Evaluate the Impact Strength of Material. • Determine the Elastic constants of a given material using tension and torsion tests. • Determine deflection of beam subjected to bending load and also buckling analysis.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	Introduction to Equipment and Facilities	03	• **Identify and describe** the purpose and function of standard laboratory equipment and facilities relevant to their field of study. • **Understand the operating principles** and safe handling procedures of laboratory instruments.
II	Rockwell Hardness Test	03	• Understand the significance of different Rockwell scales (e.g., B, C). • Recognize suitable applications for Rockwell hardness testing in quality control and material selection.
III	Brinell Hardness Test	03	• Measure and calculate the diameter of the indentation to determine the hardness number. • Interpret hardness values in relation to material properties like strength and wear resistance.
IV	Tension Test of Metals	03	• Calculate mechanical properties including Young's modulus, yield strength, tensile strength, ductility (% elongation and reduction in area).
V	Experiment on Strain Hardening of Metals	03	• Understand the relationship between plastic deformation and increased material strength.

VI	Torsion Test of Circular Shaft	03	• Calculate shear stress, shear strain, modulus of rigidity (rigidity modulus), and torsional stiffness.
VII	Experiment on Impact Test	03	• Relate impact test results to material properties such as brittleness, ductility, and fracture toughness.
VIII	Buckling or Critical Load for Long Column	03	• Calculate critical loads for columns with various boundary conditions (e.g., pinned-pinned, fixed-pinned).
IX	Testing of wood	03	• Interpret results from mechanical tests to determine strength, elasticity, and durability of wood samples.
X	Measurement of Beam Deflection Using Dial Gauge	03	• Understand the working principle of a dial gauge and its suitability for precise deflection measurement.
	End Test	03	• Evaluating the Performance
	Viva-Voce	03	• Evaluating the Performance

Course Outcome	At the end of the course, the student will be able to: • Analyse the behaviour of the solid bodies subjected to various types of loading • Apply knowledge of materials and structural elements to the analysis of simple structures • Analyse and interpret laboratory data relating to behaviour of structures and the materials they are made of, and undertake associated laboratory work individually and in teams. • Write a technical laboratory report and to interpret technical graphs.

Learning Resources	• Solid Mechanics Laboratory Manual

3rd Semester Courses Syllabi

(For Other Branches)

Course Code	AM2101N	Course Name	Fluid Mechanics	Course Category	ESC	L	T	P
						3	0	0

Pre-requisite Courses	10+2 Physics Integral and Differential calculus, Engineering Mechanics	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	• To equip students with the general understanding of fluid mechanics and be able to apply mass, momentum and energy conservation laws for fluid engineering applications such as boundary layers, pipe flows • To understand the general principles of the measurement of discharge, velocity, pressure for closed conduit and free surface flows; design piping systems and networks for both laminar and turbulent regime and understand velocity distributions laws, head losses and power transmission in pipes. • To understand Reynolds and Froude similarity laws and apply these laws in model studies together with dimensional analysis

Module	Syllabus	Duration (class-hour)	Module Outcome
I	Dimensions and SI units of physical quantities relevant to fluid mechanics. Fluid pressure: Concept of fluids, absolute and gauge pressures, measurement of pressure by piezometer, different types of manometers, and pressure gauges. Hydrostatic pressure forces on flat and curved surfaces, concept of pressure prism. Centre of pressure.	05	Understand and apply the principles of fluid statics in engineering applications
II	Fluid kinematics & basic equations of fluid flow: steady flow, uniform flow, laminar flow, turbulent flow, streamline, stream tube, streak line, path line, concept of one/two/three-dimensional analysis of flow. Conservation of mass, momentum, and energy, Application to control volumes, local & convective accelerations, Euler's equation of motion along a streamline, Bernoulli's energy equation, momentum equation, KE correction factor and momentum correction factor.	06	Understand the basic principles of fluid flow and different conservation laws and apply them in engineering applications
III	Flow measurements: flow through orifices, orifice coefficients, mouthpieces attached to orifices, velocity measurement by Pitot tube, measurement of discharge by Venturimeter, orificemeter, notches & weirs of different shapes and corresponding formulae.	06	To understand the general principles of the measurement of discharge, velocity, pressure for closed conduit and free surface flows

IV	Basic hydrodynamics [ideal fluid flow]: three-dimensional continuity equation, rotational & irrotational flows, velocity potential function & stream function, equipotential line & stream line, flow net, circulation & vorticity.	04	Comprehend the assumptions and limitations of ideal (inviscid and incompressible) fluid flow models.
V	Dimensional analysis: dimensional homogeneity of an equation, Buckingham π theorem and their application to fluid flow problems. Geometric, kinematic and dynamic similitude. Reynolds law & Froude's law, corresponding dimensionless parameters applicable to various flow situations.	05	To understand Reynolds and Froude similarity laws and apply these laws in model studies together with dimensional analysis
VI	Viscous flow through pipes: derivation of Navier-Stokes equations and its application to viscous flow through circular pipes, Hagen-Poiseuille velocity distribution, average velocity, discharge, pressure drop, wall shear stress, and friction factor. Critical Reynold's number.	08	Understand the governing equations of fluid mechanics in three-dimensional space, laminar flow in pipes
VII	Turbulent flow through pipes: concept of turbulence, effects of turbulence on velocity distribution, Prandtl mixing length and universal velocity distribution. Hydraulically smooth & rough pipes. Average velocities derived from velocity distributions. Friction factors given by the Karman-Prandtl equation and the Colebrook & White equation. Derivation of Darcy-Weisbach equation for major head loss, friction factor & Moody diagram, different types of minor losses, hydraulic & energy grade lines, flow through pipes connected in series and/or parallel. Transmission of hydraulic power through pipes.	08	Understand and quantify the turbulent flow in pipes, velocity distribution, together with friction loss, analysis of pipe network and reservoir problems connected by pipes.

Course Outcome	• Ability to apply mass conservation, momentum conservation and energy conservation equation to fluid flow problems. Understand the different terms of the Euler, Navier Stokes and the Bernoulli's equation and apply them in engineering applications. • Understand the operating principle and use the different flow measurement equipment associated with pipe flow and free surface flow and perform model studies to evaluate the performance of prototypes. • Design pipe networks for domestic and industrial use together with the operation of reservoirs.

Learning Resources	1. R W Fox and A T McDonald, Introduction to Fluid Mechanics, Wiley India 2. F M White, Fluid Mechanics, McGraw-Hill International 3. D.F. Elger, B.C. Williams, C.T. Crowe, and J.A. Roberson. Engineering Fluid Mechanics. 10/e, 2012, Wiley.

Course Code	AM2103N	Course Name	Strength of Materials	Course Category	ESC	L	T	P
						3	0	0

Pre-requisite Courses	Engineering Mechanics	Co-requisite Courses	Nil	Progressive Courses	Analysis and Design of Structures
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	The objective of this course is to: • Provide a fundamental understanding of stress, strain, and deformation of materials under various types of loading. • Develop analytical skills to evaluate internal forces and stresses in structural elements such as bars, beams, and shafts. • Introduce the concepts of material behavior under axial, bending, shear, and torsional loads. • Enable students to analyze deflection of beams, buckling of columns, and assess failure criteria for structural components.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	Stress, Strain, stress at a point, stress-strain diagrams of ductile and brittle materials, Hooke's Law, Factor of Safety	03	• Explain the fundamental concepts of stress and strain, including stress at a point, and interpret stress-strain behavior for ductile and brittle materials.
II	Elastic constants, Poisson's ratio, pure shear, shear modulus, bulk modulus, relation among the Elastic constants	04	• Identify and compute elastic constants, including Young's modulus, Poisson's ratio, shear modulus, and bulk modulus, and derive relationships among them.
III	Problems related to stress and strains, thermal stress problems	04	• Solve practical problems involving axial stress and strain, including thermal stress scenarios in constrained materials.
IV	Bi-axial stress, principal stress and strain, thin-walled pressure vessels, rings subjected to internal pressure	04	• Analyze bi-axial stress systems, determine principal stresses and strains, and evaluate stresses in thin-walled pressure vessels and circular rings under internal pressure.
V	Shear force and bending moment diagrams, bending of beams due to transverse load, Euler-Bernoulli's Equation, section modulus, simple bending formula, applications	05	• Draw shear force and bending moment diagrams for beams under various loading conditions and apply Euler-Bernoulli's beam theory to determine bending stresses
VI	Shear stresses in beams, built-up sections, stiffened sections	03	• Evaluate shear stresses in beams, including those with built-up and stiffened sections, to assess structural performance.
VII	Complex stress and strain, Mohr's circle	03	Use Mohr's circle to analyze complex stress and strain states, including transformation of stresses.
VIII	Torsion of circular shaft & applications	03	Apply torsion theory to circular shafts to calculate torsional stresses, angles of twist,

			and solve real-world shaft design problems.
IX	Combined bending, torsion and axial thrust & applications	03	Solve combined loading problems, involving axial thrust, bending, and torsion for various engineering components.
X	Deflection of beams subjected to transverse forces – integration method, area-moment theorems	03	Determine deflection of beams using the integration method and area-moment theorems for statically determinate systems.
XI	Energy method – Castigliano's theorem	03	Use energy methods, particularly Castigliano's Theorem, to calculate displacements and strain energy in elastic systems.
XII	Elastic theories of failure & applications	04	Understand and apply elastic theories of failure, such as Maximum Normal Stress, Maximum Shear Stress, and von Mises criteria.

Course Outcome	At the end of the course, the student will be able to: • Understand and compute normal and shear stresses and strains in materials under axial, torsional, and bending loads. • Draw and interpret shear force and bending moment diagrams for statically determinate beams. • Apply the concepts of stress-strain relationships and elastic moduli to analyze deformation in simple elements and composite bars. • Determine bending and shear stresses in beams using flexural and shear formulas.

Learning Resources	Text Book: 1. Elements of Strength of Materials - S.P. Timoshenko and D.H. Young. Reference Books: 1. Mechanics of Materials – E. Popov 2. A Text Book of Strength of Materials – R.K. Bansal 3. Strength of Materials – F.P. Beer and E.R. Johnston Jr. 4. Strength of Materials (Vol. 1) – D.S. Prakash Rao

Course Code	AM2102N	Course Name	Rigid Body Dynamics	Course Category	ESC	L	T	P
						3	0	0

Pre-requisite Courses	Engineering Mechanics	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	1. Understanding basic laws and principles of plane kinematics and kinetics of rigid bodies. 2. To learn fundamental concepts and principles of rigid body kinetics 3. Application of Newton's second law to solve problems for rigid bodies in rotating and non-rotating frames. 4. To understand the fundamentals of free and forced vibrations. 5. To develop analytical competency in solving problems.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	**Introduction:** Kinematics and dynamics, frames of reference, coordinate systems, particle and rigid bodies, scalars, vectors, and tensors Illustrative problems	02	• Develops a conceptual foundation for motion analysis. • Equips students to distinguish between types of motion and physical quantities (scalar/vector/tensor). • Prepares for coordinate-based analysis of motion.
II	**Kinetics of systems of particles and variable mass problems** Illustrative problems	07	Enables to apply Newton's laws to collection of particle systems in real-world.
III	**Kinetics of particles in an accelerating frame of reference:** • Frames with Linear Acceleration, D'Alembert's Principle • Motion in Rotating Frame of Reference Illustrative problems	07	• Allows motion analysis in non-inertial frames, critical for vehicle dynamics and rotating systems. • Provides foundational understanding of fictitious forces and frame transformations.
IV	**Dynamics of rigid bodies in plane motion**: • Definition of Rigid Bodies and Kinematic Constraints • Kinematics of Rigid Bodies – Translational Motion, Pure Rotation, and General Motion • Linear and Angular Momentum, Kinetic Energy • FBD and Laws of Motion • Conservation Principles – linear and angular Momentum, Energy	13	• Equips to **analyze rigid body dynamics in 2D.** • Enables the use of **energy and momentum principles** for force/motion predictions to rigid bodies.

	• Impulsive Forces and Moments Illustrative problems		
V	**Dynamics of Motion in Three Dimensions**: • Chasle's Theorem and Spherical Motion • Angular Momentum and Inertia Tensor, Kinetic Energy • Free Motion of an Axisymmetric Body – Body cone and Space cone • Euler's Equation, Modified Euler's Equation, Euler Angles, Gyroscopic Action. Illustrative problems	13	• Develops ability to analyze **3D rotational motion** and **gyroscopic dynamics.** • Introduces tools for advanced structural systems**.** • Strengthens understanding of **complex rigid body behaviour** in space.

Course Outcome	Upon completing this course, students will be able to: • Determine the kinematic relationships between position, velocity, and acceleration for two-dimensional motion of systems of particles and rigid bodies • Apply Newton's equation in two dimensions to calculate the motion due to applied forces or to calculate the forces resulting from a specified motion. • Analyze the two-dimensional motion of particles and rigid bodies using conservation laws for energy, momentum, and angular momentum. • Apply dynamics concepts to the design of simple machines and structures to accomplish a specific task

Learning Resources	• Engineering Mechanics: Dynamics – Meriam & Kraige

Course Code	AM2104N	Course Name	Fluid Mechanics and Fluid Machines	Course Category	ESC	L	T	P
						3	0	0

Pre-requisite Courses	10+2 Physics Integral and Differential calculus	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	The objective of this course is to: 1. Provide foundational knowledge of fluid properties and behavior under static and dynamic conditions. 2. Develop analytical skills to understand and apply fluid flow principles using control volume and differential approaches. 3. Enable students to analyze pipe flow systems and apply principles to real-world engineering problems.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	Properties of fluid and Pressure Measurement: Fluid properties, units and dimensions, pressure at a point, manometers and pressure gauges. Hydrostatic pressure forces on immersed plane and curved surfaces, concept of pressure prism, centre of pressure.	08	• Understand and classify the physical properties of fluids (density, viscosity, compressibility, etc.) and their units and dimensions.
II	Fluid kinematics & basic equations of fluid flow: steady flow, uniform flow, laminar flow, turbulent flow, streamline, stream tube, streak line, path line, concept of one/two/three dimensional analysis of flow, three-dimensional continuity equation of flow, local & convective accelerations, Euler's equation of motion along a streamline, Bernoulli's energy equation, momentum equation, problems in pipe bends, practical application of Bernoulli's theorem, Kinetic Energy correction factor and Momentum correction factor	08	• Apply Euler's equation and derive Bernoulli's equation for various engineering problems.
III	Flow Measurement: Flow through orifices, orifice coefficients, velocity measurement by Pitot tube, measurement of discharge by venturimeter, orificemeter, notches & weirs of different shapes and corresponding formulae.	04	• Determine discharge using venturimeters, orificemeters, and notches/weirs of various shapes with corresponding equations.
IV	Basic hydrodynamics [ideal fluid flow]: rotational & irrotational flows, velocity potential function &	04	• Construct and analyze flow nets,

	stream function, equipotential line & stream line, flow net, circulation & vorticity.		equipotential lines, and streamlines.
V	Flow through pipes: Hagen-Poiseuille equation, pipe friction laws, minor losses, Derivation of Darcy-Weisbach equation for major head loss, friction factor & Moody diagram, hydraulic and energy grade lines, pipes in series and parallel, hydraulic transmission of power, pipe network.	10	• Understand major and minor losses in pipes and derive the Darcy-Weisbach equation.
VI	Centrifugal and other rotodynamic pumps: classification, application of principle of similarity of hydraulic machines, specific speed of pumps, performance characteristics for head, discharge and efficiency, selection of pumps, cavitation and setting height of pumps.	08	• Classify different types of rotodynamic pumps and understand their working principles.

Course Outcome	Upon successful completion of this course, students will be able to: • Identify and explain fundamental fluid properties and calculate pressure forces on submerged surfaces using principles of hydrostatics. • Describe different types of fluid flow and apply continuity**,** momentum, and Bernoulli's equations to solve practical fluid flow problems. • Analyze and design flow measurement systems using devices such as orifices, venturimeters, notches, weirs, and Pitot tubes**.**

Learning Resources	1. Fluid Mechanics – Streeter & Wylie 2. Fluid Mechanics – Som & Biswas 3. Fluid Mechanics – Fox, McDonald and Pritchard 4. Fluid Mechanics – Cengel and Cimbala 5. Fluid Mechanics – F.M. White

Course Code	AM2171N	Course Name	Strength of Materials Laboratory	Course Category	ESC	L	T	P
						0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	1. Introduce experimental procedures and common measurement instruments, equipment, and devices. 2. To determine experimental data, include the hardness test, universal testing machines and torsion equipment. 3. To determine experimental data for the impact test and buckling analysis. 4. To determine deflection of beam subjected to bending load. 5. Provide physical observations to complement concepts learnt.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	Introduction to Equipment and Facilities	03	• **Identify and describe** the purpose and function of standard laboratory equipment and facilities relevant to their field of study. • **Understand the operating principles** and safe handling procedures of laboratory instruments.
II	Rockwell Hardness Test	03	• Understand the significance of different Rockwell scales (e.g., B, C). • Recognize suitable applications for Rockwell hardness testing in quality control and material selection.
III	Brinell Hardness Test	03	• Measure and calculate the diameter of the indentation to determine the hardness number. • Interpret hardness values in relation to material properties like strength and wear resistance.
IV	Tension Test of Metals	03	• Calculate mechanical properties including Young's modulus, yield strength, tensile strength, ductility (% elongation and reduction in area).
V	Experiment on Strain Hardening of Metals	03	• Understand the relationship between plastic deformation and increased material strength.

VI	Torsion Test of Circular Shaft	03	• Calculate shear stress, shear strain, modulus of rigidity (rigidity modulus), and torsional stiffness.
VII	Experiment on Impact Test	03	• Relate impact test results to material properties such as brittleness, ductility, and fracture toughness.
VIII	Buckling or Critical Load for Long Column	03	• Calculate critical loads for columns with various boundary conditions (e.g., pinned-pinned, fixed-pinned).
IX	Fatigue Testing of Metals (Lecture & Demonstration)	03	• Understand the importance of fatigue testing in material selection and design of durable components.
X	Measurement of Beam Deflection Using Dial Gauge	03	• Understand the working principle of a dial gauge and its suitability for precise deflection measurement.
	End Test	03	• Evaluating the Performance
	Viva-Voce	03	• Evaluating the Performance

Course Outcome	At the end of the course, the student will be able to: • Know about the operational details of various testing machines for materials. • Analysis of structural members subjected to tension, torsion, bending, strain hardening and fatigue using the fundamental concepts of stress, strain, and elastic behaviour of materials. • Write a technical laboratory report and to interpret technical graphs.

Learning Resources	• Strength of Materials Laboratory Manual

Course Code	AM2172N	Course Name	Fluid Mechanics Laboratory	Course Category	ESC	L	T	P
						0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	• The objective of the Fluid Mechanics Laboratory is to provide students with hands-on experience in verifying the fundamental principles of fluid mechanics through experiments. • The course aims to enhance the understanding of flow measurement techniques, fluid properties, flow behavior in pipes and open channels, and energy losses in fluid systems.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	Introduction to Equipment and Facilities	03	• Learn the rules, guidelines and safety protocol (DOS and DON'TS) of performing laboratory experiments. • Be introduced to the experimental set-ups, in general.
II	Determination of Orifice Coefficients	03	• Determine the Coefficient of Velocity, Coefficient of Discharge and Coefficient of Contraction for a small orifice located at the vertical wall of a big water tank, • Understand the role of orifice coefficients on flow rate measurements
III	Verification of Bernoulli's theorem	03	• Measure total (Bernoulli) head along a slightly converging rectangular duct, • Plot the actual EGL and HGL obtained during the experiment
IV	Reynolds experiment	03	• Visualize laminar, transitional and turbulent flow in a tube using a streakline, • Verify the values of critical Re for a circular tube
V	Friction losses in commercial pipe	03	• Investigate the friction factor variation with the Reynolds number for fully developed flow through commercial pipes
VI	Friction losses in pipes and pipe fittings	03	• Measure the minor loss coefficients for sudden expansion, sudden contraction, mitre bend, long and

			short bends, etc. • Assess the dependence of minor loss coefficients on flow rate
VII	Calibration of an orifice meter	03	• Calibrate an orifice meter, and develop the relationship between pressure drop and flow rate for discharge measurement.
VIII	Determination of Pressure Characteristics of a Venturitube	03	• Determine the pressure characteristics in a Venturi-tube, • Estimate the pressure-recovery coefficient of the diffuser
IX	Measurement of surface pressure distribution around a circular cylinder.	03	• Understand the nature of external flow around a circular cylinder, including concepts of flow separation, wake formation, and vortex shedding.
	End Test	03	• Evaluating the Performance
	Viva voce	06	• Evaluating the Performance

Course Outcome	Upon successful completion of this course, students will be able to: • Understand and operate fluid mechanics equipment and instruments with proper safety procedures. • Determine flow coefficients such as the coefficient of discharge and coefficient of velocity through orifices and notches. • Record, interpret, and analyze experimental data, compare results with theoretical predictions, and present findings in a technical format.

Learning Resources	• Fluid Mechanics Laboratory Manual

Course Code	AM2173N	Course Name	Fluid Mechanics and Fluid Machines Laboratory	Course Category	ESC	L	T	P
						0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	• The objective of the Fluid Mechanics and Fluid Machines Laboratory is to provide students with hands-on experience in the principles of fluid mechanics and fluid machinery. • The course aims to enhance students' understanding of fluid flow behavior, energy conversion in hydraulic machines, and experimental methods used in the analysis and testing of fluid systems.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	Introduction to Equipment and Facilities	03	• Identify and operate basic hydraulic equipment and facilities, following standard procedures and safety protocols.
II	Determination of Orifice Coefficients	03	• Determine the orifice coefficients (coefficient of discharge, velocity, and contraction) through experimentation
III	Verification of Bernoulli's theorem	03	• Verify Bernoulli's theorem experimentally and validate the conservation of energy principle in incompressible, steady fluid flow.
IV	Reynolds experiment	03	• Conduct Reynolds experiment to classify flow regimes (laminar, transitional, or turbulent) and understand the significance of Reynolds number.
V	Friction losses in commercial pipe	03	• Measure and analyze friction losses in commercial pipes, accounting for material roughness and flow rate effects.
VI	Friction losses in pipes and pipe fittings	03	• Evaluate head losses due to pipe fittings and bends, and understand the practical implications of minor losses in piping systems.
VII	Calibration of an orifice meter	03	• Calibrate an orifice meter, and develop the relationship between pressure drop and flow rate for discharge measurement.
VIII	Calibration of a rectangular weir	03	• Calibrate a rectangular weir, and use it to measure flow rate over open channels, applying empirical

			discharge equations.
IX	The forces of impact of the jet on the vanes	03	• Experimentally determine the force exerted by a water jet on flat and curved vanes, and relate findings to momentum transfer theory.
X	Performance study of a centrifugal pump	03	• Analyze the performance of a centrifugal pump, determine efficiency, head-discharge characteristics, and identify operating conditions for optimum performance.
	End Test	03	• Evaluating the Performance
	Viva voce	03	• Evaluating the Performance

Course Outcome	Upon successful completion of this course, students will be able to: • Demonstrate the ability to conduct experiments to determine fluid properties and behavior in different flow regimes. • Measure and analyze flow characteristics such as pressure, velocity, and discharge using various flow measuring devices (e.g., venturimeter, orifice meter, notches).

Learning Resources	• Fluid Power Engineering Laboratory Manual

4th Semester Courses Syllabi

(For Other Branches)

Course Code	AM2201N	Course Name	Fluid Power Engineering	Course Category	ESC	L	T	P
						3	0	0

Pre-requisite Courses	Fluid Mechanics	Co-requisite Courses	Nil	Progressive Courses	Advance Hydraulics and Pneumatics
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objective	This course aims to provide a foundational understanding of fluid power principles and their application in engineering systems. It covers the analysis and operation of rotodynamic and positive displacement machines, including turbines, pumps, and motors. Students will learn about performance parameters such as torque, power, efficiency, and specific speed. The course also introduces control components like valves, actuators, accumulators, and hydraulic accessories, along with various industrial applications including fluid couplings, torque converters, cranes, and lifts.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	**Introduction:** Basic Principle, Jet Propulsion, Dynamic forces on fixed and moving symmetrical and unsymmetrical vanes.	5	• Explain the basic principles of jet propulsion. • Analyze the dynamic forces acting on fixed and moving vanes (both symmetrical and unsymmetrical).
2	**Rotodynamic machines:** General classifications, Basic theory of turbomachines, Impulse and Reaction (Pelton, Francis, and Kaplan) turbines — operation, torque, power and efficiency. Degrees of Reaction. Draft tube, Application of similarity principle on hydraulic turbine, Specific speed, Characteristic curve governing the turbines.	12	• Understand the function and design of draft tubes in reaction turbines. • Apply the similarity principles to turbine model testing and performance prediction.
3	**Centrifugal and Axial flow pumps:** operation, torque, power and efficiency. Application of similarity principle on rotodynamic pump, Specific speed, Characteristic curves, pumps in series and parallel.	7	• Explain the construction and operation of centrifugal and axial flow pumps. • Analyze pump performance parameters including torque, power, and efficiency.
4	**Cavitation and setting height of rotodynamic machines**	3	• Determine Net Positive Suction Head (NPSH) and calculate safe setting heights for pumps and turbines to avoid cavitation.

5	**Positive Displacement Machines:** General classifications, Reciprocating pump — operation, type, work done, friction and acceleration head, air vessels.	4	• Explain the working of reciprocating pumps, including work done, acceleration head, and the function of air vessels.
6	**Rotary pump and motor:** Gear, Vane and Piston type pumps and motors—operation, torque, power and efficiency. Characteristic curves.	3	• Evaluate torque, power, and efficiency characteristics of rotary machines. • Analyze characteristic curves for performance interpretation.
7	**Control valves and accessories:** Pressure, Flow and Direction Control Valves, Actuators, Accumulator and Intensifier, Working principle, construction and operation.	5	• Explain the working principles and applications of actuators, accumulators, and intensifiers.
8	**Miscellaneous Hydraulic Machines:** Fluid Coupling. Torque Converter, Crane, Lift etc. Working principle, construction and operation	3	• Understand the construction and operating principles of fluid couplings, torque converters, hydraulic cranes, and lifts.

Course Outcome	By the end of the course, students will have a solid grasp of the fundamental principles of fluid power and be able to analyze fluid flow behavior. They will understand the dynamic forces acting on vanes and the operation of jet propulsion systems. Students will be equipped to classify and assess the performance of rotodynamic machines like turbines and pumps. The course also covers the functioning of reciprocating and rotary pumps and motors. Furthermore, students will gain insight into the design and operation of hydraulic control components and explore various hydraulic machinery, including fluid couplings, torque converters, cranes, and lifts.

Learning Resources	1. Hydraulic Machines - Dr. Jagdish Lal. 2. Hydraulic Machines, Theory & Design - V.P. Vasandani. 3. A Textbook of Hydraulic Machines – R.K. Rajput 4. Fluid Mechanics Through Problems - R.J. Garde 5. Applied Fluid Mechanics - D.N.Roy 6. Fluid Mechanics-Victor L. Streeter, E. Benjamin Wylic. 7. Fluid Mechanics - Frank M White. 8. Hydraulic Control System- Herbert E. Merrit.

Course Code	AM2271N	Course Name	Fluid Power Engineering Laboratory	Course Category	ESC	L	T	P
						0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		Aerospace Engineering and Applied Mechanics		Data Book / Codes/Standards	Nil

Course Objectives	• The objective of this course is to provide students with a comprehensive understanding of the principles and applications of fluid power systems. • It aims to develop the ability to design, analyze, and troubleshoot hydraulic and pneumatic circuits used in industrial automation and mechanical systems.

Module	Syllabus	Duration (class-hour)	Module Outcome
I	Introduction to Equipment and Facilities	03	• Understanding the layout, components, and safety protocols essential for fluid machinery testing.
II	Force of impact of jet on vanes	03	• Verify momentum transfer principles through experimental analysis.
III	Performance study of a Centrifugal pump	03	• Determine key parameters such as head, flow rate, input/output power, and calculate pump efficiency.
IV	Performance study of a Kaplan turbine	03	• Evaluate efficiency under varying flow and load conditions.
V	Performance study of a Pelton turbine	03	• Interpret efficiency curve and hydraulic energy conversion process.
VI	Performance study of a Francis turbine	03	• Understand its role in medium-head hydroelectric power applications.
VII	Hydraulics and Pneumatics circuits	03	• Identifying the function and operation of components like valves, actuators, compressors, and control units.
VIII	Application of Fluid Powers in Electro-Mechanical System	03	• Understand the integration and application of fluid power systems in electro-mechanical setups.
IX	End Test	06	• Evaluating the Performance
X	Viva	03	• Evaluating the Performance

Course Outcome	Upon successful completion of this course, students will be able to: • Understand the fundamental principles of fluid power, including properties of hydraulic fluids, energy transmission, and basic laws governing fluid systems. • Demonstrate the ability to troubleshoot fluid power systems and suggest

	improvements for performance and efficiency.

Learning Resources	• Fluid Power Engineering Laboratory Manual