

COURSE TITLE : APPLIED MECHANICS & STRENGTH OF MATERIALS
COURSE CODE : 4017
COURSE CATEGORY : A
PERIODS/WEEK : 6
PERIODS/ SEMESTER : 108
CREDITS : 5

TIME SCHEDULE

MODULE	TOPICS	PERIODS
1	Simple stresses and strains Shear stresses and strains Thermal stresses and strains	26
2	Friction Centre of gravity of Sections Moment of inertia of Sections	26
	TEST I	2
3	Riveted joints Welded joints Thin Cylinders Torsion of circular shafts Springs	26
4	Shear Force and Bending Moment Deflection of beams Columns and struts	26
	TEST II	2
	Total	108

OBJECTIVES

MODULE – I

- 1.1.0 Apply the theory of simple stresses and strains on members of machines and structures**
- 1.1.1 Define the terms stresses and strains , tensile and compressive , longitudinal strain, lateral strain and Poisson’s ratio.
 - 1.1.2 Draw stress strain diagram for mild steel under tension and identify the significant points.
 - 1.1.3 Draw stress strain diagram for a brittle material and compare with stress strain diagram of mild steel.
 - 1.1.4 Define elastic limit, ultimate stress, working stress and factor of safety.
 - 1.1.5 State Hook’s law.
 - 1.1.6 Explain Young’s modulus.
 - 1.1.7 Explain principle of super position.
 - 1.1.8 Solve simple problems involving direct stress and strain, longitudinal strain, lateral strain, Poisson’s ratio and Young’s modulus for bars of solid, composite and varying sections.
 - 1.1.9 Solve simple problems to compute ultimate stress, working stress, factor of safety and elastic limit of members under direct tensile load.

1.2.0 Apply the theory of shear stresses and strains on members of machines and structures

- 1.2.1 Define shear stress and shear strain.
- 1.2.2 Explain modulus of rigidity.
- 1.2.3 Define volumetric strain and bulk modulus.
- 1.2.4 State relation between Young's modulus, modulus of rigidity and bulk modulus.
- 1.2.5 Solve simple problems involving shear stress, shear strain, volumetric strain, modulus of rigidity, bulk modulus and the relation between three moduli.

1.3.0 Apply the effect of stress due to change in temperature of materials

- 1.3.1 Define thermal stress and strain.
- 1.3.2 Define coefficient of linear expansion.
- 1.3.3 Find the magnitude and nature of temperature stresses in a bar of uniform cross section when it is prevented from expansion or contraction partially or totally by end grips.
- 1.3.4 Calculate the load on the end grips.
- 1.3.5 Calculate the magnitude and nature of temperature stress induced in a composite bar made of two materials.

MODULE – II

2.1.0 Interpret the laws of friction

- 2.1.1 Define friction.
- 2.1.2 List types of friction.
- 2.1.3 Explain static and dynamic friction.
- 2.1.4 Explain sliding friction, rolling friction, and pivot friction.
- 2.1.5 Explain limiting friction.
- 2.1.6 State the laws of friction.
- 2.1.7 Explain coefficient of friction, angle of friction and cone of friction.
- 2.1.8 Force analysis of a sliding body resting on horizontal plane.
- 2.1.9 Solve simple problems based on the laws of friction and force analysis.

2.2.0 Understand the centre of gravity of sections.

- 2.2.1 Define centroid and centre of gravity.
- 2.2.2 List the methods of finding centre of gravity of simple geometrical shapes.
- 2.2.3 Find the centre of gravity by geometrical consideration and by moments.
- 2.2.4 Explain axis of reference and axis of symmetry.
- 2.2.5 Find the centre of gravity of symmetrical and unsymmetrical geometrical sections.
- 2.2.6 Find the centre of gravity of plane sections with cut out holes.

2.3.0 Understand the moment of inertia of sections.

- 2.3.1 Define moment of inertia and radius of gyration.
- 2.3.2 List the methods of finding moment of inertia of plane area.
- 2.3.3 Derive the expression for the moment of inertia of a rectangular section.
- 2.3.4 Derive the moment of inertia of a circular section.
- 2.3.5 State and prove parallel axis theorem and perpendicular axis theorem.
- 2.3.6 Calculate the moment of inertia of standard geometrical sections.

MODULE – III

3.1.0 Compute the strength and efficiency of riveted joints

- 3.1.1 List the different types of riveted joints.
- 3.1.2 Explain failure of riveted joints.
- 3.1.3 Define plate value, rivet value, strength and efficiency of riveted joints.
- 3.1.4 Calculate strength and efficiency of single and double riveted lap joint and butt joint.
- 3.1.5 Explain with the aid of sketches the purpose and procedure of caulking and fullering.
- 3.2.0 Compute the strength and efficiency of welded joints**
- 3.2.1 List different types of welded joints on plates
- 3.2.2 Define different welding terms.
- 3.2.3 Calculate the strength of welded joints.
- 3.3.0 Compute the thickness of thin cylinders for various stress conditions**
- 3.3.1 State failure of thin cylindrical shell due to an internal pressure.
- 3.3.2 Define stresses in a thin cylinder subjected to an internal pressure.
- 3.3.3 Calculate thickness of cylinder.
- 3.4.0 Apply the theory of torsion on shafts**
- 3.4.1 Derive the torsion equation and state the assumptions.
- 3.4.2 Understand the expression for strength of solid and hollow shaft.
- 3.4.3 Understand the equation for power transmitted by the shaft.
- 3.4.4 Define polar moment of inertia.
- 3.4.5 Calculate strength and power of solid shaft and hollow shaft.
- 3.5.0 Understand the effect of forces on springs**
- 3.5.1 List types of springs.
- 3.5.2 Distinguish between closely coiled and open coiled helical spring.
- 3.5.3 Define the terms spring index and stiffness.
- 3.5.4 Understand the expressions for deflection, stiffness, torque and energy stored in the spring.
- 3.5.5 Calculate the stress induced, diameter, deflection and stiffness of closely coiled helical spring subjected to an axial load.

MODULE – IV

- 4.1.0 Compute the shear force and bending moment at any section of a Horizontal beam carrying vertical loads**
- 4.1.1 Explain types of beams and loading.
- 4.1.2 Define shear force and bending moment.
- 4.1.3 Draw bending moment and shear force diagram for cantilever with point load.
- 4.1.4 Draw bending moment and shear force diagram for cantilever with uniformly distributed load.
- 4.1.5 Draw bending moment and shear force diagram for cantilever with point load and Uniformly distributed load.
- 4.1.6 Draw bending moment and shear force diagram for simply supported beam with point load.
- 4.1.7 Draw bending moment and shear force diagram for simply supported beam with uniformly distributed load.
- 4.1.8 Draw bending moment and shear force diagram for simply supported beam with point load and uniformly distributed load.
- 4.1.9 Calculate the maximum bending moment on the section.

4.2.0 Compute deflection and slope of beams

- 4.2.1 Define the slope and deflection.
- 4.2.2 Calculate the maximum deflection and slope of simply supported beam with central point load.
- 4.2.3 Calculate the maximum deflection and slope of simply supported beam with uniformly distributed load over entire span.
- 4.2.4 Calculate the maximum deflection and slope of cantilever beam with a point load at free end.
- 4.2.5 Calculate the maximum deflection and slope of cantilever beam with uniformly distributed load over entire span.

4.3.0 Apply the theory of axial loads

- 4.3.1 Define column and struts.
- 4.3.2 Distinguish between long and short columns.
- 4.3.3 Define the terms buckling load or crippling load, effective length and slenderness ratio .
- 4.3.4 State Euler's formulae and Rankine's formula.
- 4.3.5 Calculate the slenderness ratio, equivalent length and buckling load on columns using the two formulae under different end conditions.

CONTENT DETAILS

MODULE – I

1.Direct Stresses and strains

Types of stresses and strains – tensile and compressive – longitudinal and lateral strain – Poisson's ratio – behaviour of mild steel under tension – stress strain diagram – limit of proportionality – elastic limit – yield point – ultimate stress – working stress – factor of safety – comparison of stress strain diagram of a mild steel and a brittle material– Hooks law and Young's modulus – principle of super position – stresses in varying section – stresses in composite section – simple problems.

2.Shear stress and shear strain

Shear stress and strain – modulus of rigidity – volumetric strain, bulk modulus – simple problems

3.Thermal Stress and strain

Nature and magnitude of stresses due to change in temperature – total or partial prevention of expansion and contraction – temperature stress on composite bar– simple problems.

MODULE – II

1.Friction

Introduction – type of friction – static friction, dynamic friction, sliding friction, rolling friction, pivot friction, limiting friction, angle of friction, coefficient of friction, cone of friction – state laws of friction. – static friction and kinetic friction – force analysis of a sliding body resting on a horizontal plane – force acting along the plane and at an angle.

2.Centre of gravity of sections

Centroids – centre of gravity – axis of symmetry and axis of reference – methods to find center of gravity – simple geometric sections such as rectangle, triangle, circle and semi-circle sections – combinations of symmetrical sections such as T, I and channel sections –

combinations of unsymmetrical sections such as L section. – plane sections with cut out holes.

3.Moment of inertia of sections

Moment of inertia – radius of gyration – methods to find moment of inertia – moment of inertia of rectangular and circular sections by integration method – parallel axis theorem–perpendicular axis theorem – moment of inertia of standard geometrical sections such as T ,I, L and channel sections.

MODULE – III

1.Riveted joints

Types – lap joint – single riveted, double riveted (chain and zigzag) – butt joint – single cover single riveted, double cover single riveted – failure of riveted joints – failure of rivets – shearing and crushing – failure of plates – tearing across a row of rivets – tearing off plate at an edge – strength of rivet, plate and riveted joint – efficiency of a riveted joint – simple problems on single and double riveted lap joint, single cover and double cover single riveted butt joint – caulking and Fullering operations.

2.Welded joints

Types of fillet and butt welds – welding terms – leg of the weld, size of the fillet weld, throat thickness, effective length of the weld, side fillet weld and end fillet weld – strength of welded joints – fillet and butt – transverse – single and double rows – parallel welds – combination of transverse and parallel welds – butt welds (flat plates only).

3.Thin Cylinders

Introduction – failures of thin cylinder – stresses in thin cylindrical shell – hoop stress – longitudinal stress – simple problems to calculate thickness and pressure of thin cylinders.

4.Torsion of circular shafts

Introduction–assumptions for shear stress in a circular shaft subjected to torsion – torsion equation – strength equation for solid and hollow shaft (no proof) – power equation – polar moment of inertia –simple problems to calculate strength and power.

5.Springs

Introduction – types of spring – leaf spring – helical springs – closely coiled and open coiled helical spring with round wire –formulae for deflection, stiffness, torque and energy stored (no proof) –simple problems on closely coiled helical springs subjected to an axial load to find out stress induced, deflection ,stiffness and diameter.

MODULE – IV

1.Shear force and bending moment

Types of beams – cantilever beam, simply supported beam, over hanging beam, built in beam or fixed beam and continuous beam – types of loading — concentrated or point load, uniformly distributed load and uniformly varying load – shear force and bending moment diagrams – cantilever beams – point load, uniformly distributed load and combination of point load and uniformly distributed load – simply supported beam – point load, uniformly distributed load and combination of point load and uniformly distributed load – maximum bending moment on the section.

2.Deflection of beams

Introduction – simply supported beam with central point load (no proof) – simply supported beam with uniformly distributed load on entire span (no proof) – cantilever with

a point load at the free end (no proof) — cantilever with a uniformly distributed load over entire span (no proof) – simple problems on cantilever and simply supported beams.

3.Columns and struts

Introduction – column, strut, buckling load, equivalent length, slenderness ratio – types of columns – short column, medium size column, long column – Euler's equations and its assumption for crippling load for different end conditions (no proof) – both end hinged, one end is fixed and other is free, one end is fixed and other is hinged, both ends fixed – equivalent length – Rankine's formulae for columns – simple problems on columns to calculate buckling load, slenderness ratio, equivalent length on different end conditions.

REFERENCE BOOKS

1. Strength of Materials – Dr. R.K.Bansal, Lakshmi Publishers
2. Strength of Materials – Ramamrutham, Dhanpat rai & sons
3. Strength of Materials – R.K. Rajput, S.Chand & Company Ltd
4. Strength of Materials – R.S. Khurmi, S.Chand & Company Ltd
5. Engineering Mechanics – Dr. R.K.Bansal, Lakshmi Publishers
6. Applied Mechanics and Strength of Materials – R.S. Khurmi, S.Chand & Company Ltd
- 7 Theory of Machines – Sadhu Singh, Pearson