Total No. of Questions—**12**] [Total No. of Printed Pages—**7**

Seat No.	

[4957]-119

S.E. (Mechanical/Auto.) (Second Semester) EXAMINATION, 2016
STRENGTH OF MACHINE ELEMENT
(2008 PATTERN)

Time : Three Hours **Maximum Marks : 100**

***N.B.* :—** (*i*) Answer any *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Assume suitable data, if necessary.

SECTION I
UNIT I

1. (*a*) Define and explain the following terms : [8]

(*i*) Poisson's Ratio

(*ii*) Factor of safety

(*iii*) Modulus of rigidity

(*iv*) Thermal stress.

(*b*) A bar of 25 mm diameter and 400 mm length is acted upon by axial load of 40 kN. The elongation of the bar and change in diameter are measured as 0.165 mm and 0.0031 mm respectively. Determine Poisson ratio, Youngs modulus, Bulk modulus, Modulus of rigidity. [8]

Or

2. (*a*) Determine elongation of bar of tapering section having diameter of 'D' and '*d*' and length L subjected to an axial load P. [8]

(*b*) An object of weight 100 N falls from a height 5 meter on rigid collar attached at the bottom end of vertical rod by length at the length 10 meter and diameter 20 mm. The top of the bar is rigidly fixed to support. Calculate maximum stress and strain induced in bar during the impact.

Take E = 200 GPa. [8]

UNIT II

3. (*a*) Explain in detail 'point of contraflexure'. [4]

(*b*) A 10 meter long simply supported beam carries two point load and uniformly distributed load as shown in Fig. 1. Draw shear force and bending moment diagram. Also calculate maximum bending moment. [12]

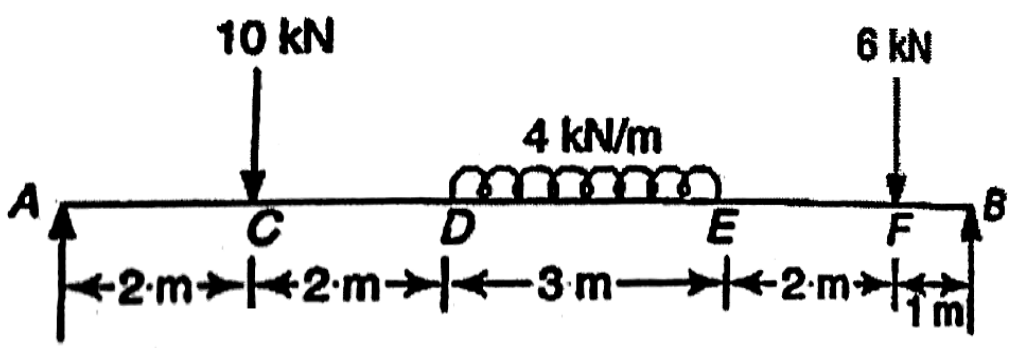

Fig. 1

Or

4. (*a*) Derive the equation for slope and maximum deflection for simply supported beam of length L carrying a uniformly distributed load 'W' N/m over entire span. [8]

(*b*) A cantilever beam 2 meter long is loaded with point load of 1.5 kN at free end and uniformly distributed load of 3.5 kN/m run over 1.2 meter from the fixed end. If the section is rectangular 80 mm × 80 mm, calculate deflection of free end. [8]

UNIT III

5. (*a*) What are the theories of failure ? Explain maximum principal stress theory and maximum shear stress theory. [8]

(*b*) The principal stresses at a point across two mutually perpendicular planes are 75 MN/m^2 and 35 MN/m^2. Using analytical method, find normal, tangential and resultant stresses and its obliquity angle on a plane at 20° with major principal plane. [10]

Or

6. (*a*) Explain the following : [6]

(*i*) Principal planes

(*ii*) Principal stress

(*iii*) Mohr's circle.

(*b*) A steel plate is subjected to stresses on two mutually perpendicular planes are 50 MN/m^2 (Tensile) and 30 MN/m^2 (Compressive). The shear stress across these planes is 10 MN/m^2. Using Mohr's circle, find principal stresses and maximum shear stress. [12]

SECTION II

UNIT IV

7. (*a*) A steel of I section is 600 mm deep. Each flange is 250 mm wide and 25 mm thick. The beam section is subjected to a shear force of 500 kN. Determine shear stress distribution for the beam section when the web is horizontal.

(Refer Fig. 2) [10]

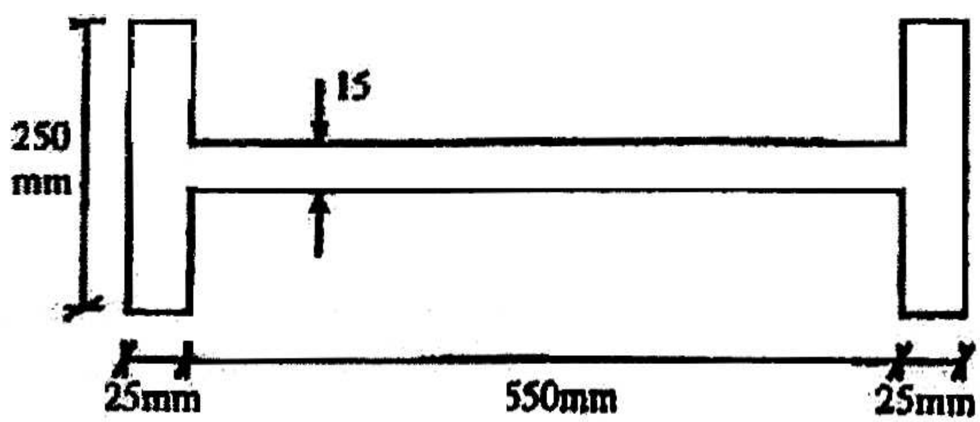

Fig. 2

(*b*) Explain the following terms in brief : [6]

(*i*) Section Modulus

(*ii*) Neutral Axis

(*iii*) Moment of resistance.

Or

8. (*a*) A cast iron beam section is of I section with a top flange 80 mm × 20 mm thick, bottom flange 160 mm × 40 mm thick and the web 200 mm × 20 mm thick. The beam is freely supported on a span of 5 meters. If the tensile stress is not to exceed 20 N/mm^2, find the safe uniformly distributed load which the beam can carry. Find also the maximum compressive stress. [10]

(*b*) Derive the expression for the shear stress induced at a distance Y from neutral axis in the cross-section of a beam subjected to shear force. [6]

UNIT V

9. (*a*) Derive the following relation for torsion. [8]

$$\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{l}.$$

(*b*) A bar of length 4 m is used as simply supported beam and subjected to udl of 30 N/mm^2 over the whole span, deflects 15 mm at centre. Determine buckling loads when it is used as column with the following end conditions : [8]

(*i*) Both ends are pin joined

(*ii*) One end is fixed and other end hinged

(*iii*) Both ends fixed.

Or

10. (*a*) State the limitation of Euler's formula. Hence derive Rankine formula for long as well as short column to overcome the limitations. [8]

(*b*) A hollow shaft with diameter ratio 3/5 is required to transmit 450 kW at 120 rpm with a uniform twisting moment. The shearing stress in the shaft must not exceed 60 N/mm^2 and twist in length of 2.5 m must not exceed 1 degree. Calculate the minimum external diameter of the shaft satisfying these conditions. Take modulus of rigidity $G = 8 \times 10^4$ N/mm^2. [8]

UNIT VI

11. (*a*) Explain any *three* of the following terms in short for design of simple machine parts : [6]

(*i*) Creativity in design

(*ii*) Product life cycle

(*iii*) Selection of FOS

(*iv*) Service factor.

(*b*) Design a knuckle joint for a tie rod for circular section for a maximum pull of 70 kN. The ultimate strength of material against tearing is 420 N/mm^2. The shearing strength of material is 396 N/mm^2. Take FOS as 4. [12]

Or

12. (*a*) Explain briefly various stages involved in the design process of machine elements. [4]

(*b*) Write short notes on : [4]

(*i*) Source of design data

(*ii*) Creativity in design.

(*c*) What is a cotter joint ? Draw neat sketch and explain design procedure of socket and spigot cotter joint showing all parts and their dimensions. [10]