Exam.Code:0940
Sub. Code: 7047

1048

B.E. (Mechanical Engineering) Fourth Semester
MEC-402: Mechanics of Materials – II

Time allowed: 3 Hours Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Unit.*

x-x-x

I. Attempt the following:-

a) What is Bauschinger Effect?

b) State D'Alembert's Principle.

c) What is St. Venants' Principle of Uniform stress?

d) What is the application of Negative Poisson's ratio for materials?

e) What are the limiting values of Poisson's ratio?

f) Define obliquity of stress on a plane.

g) In case when the principal stresses are of same magnitude and of the same nature, what will be the radius of Mohr circle? Then how many principal planes are there?

h) Where is complete stress strain diagram used? And where is it used upto proportionality limit?

i) What is Prantl's membrane analogy?

j) How does Youngs modulus effect strain gage sensitivity? (10x1)

UNIT – I

II. A timber beam 250 mm wide by 300 mm deep is used as simply supported beam on a span of 5 m. It is subjected to concentrated load of 30 kN at the mid section of the span. If the plane of load makes an angle of 45° with the vertical plane of symmetry, find the direction of neutral axis and the maximum stress in the beam. (10)

III. A shaft of 100 mm diameter is subjected to a bending moment of 5 kNm. Find the value of the maximum torque which can be applied to the shaft for each of the following conditions: (a) maximum direct stress not to exceed 120 MN/m^2 (b) maximum shearing stress not to exceed 60 MN/m^2 (c) maximum shear strain energy per unit volume not to exceed that induced by simple shear stress of 80 MN/m^2. (10)

P.T.O.

IV. A rail road uses steel rails (E=200 GPa) with a depth of 184 mm. The distance from the top of the rail to its centroid is 99.1 mm, and the moment of inertia of the rail is $36.9 \times 10^6 mm^4$. The rail is supported by ties, ballast, and a road bed that together are assumed to act as an elastic foundation with spring constant k=14.0 N/mm^2. (a) Determine the maximum deflection, maximum bending moment, and maximum flexural stress in the rail for a single wheel load of 170 kN. (b) A particular diesel locomotive has three wheels per bogie equally spaced at 1.70 m. Determine the maximum deflection, maximum bending moment, and maximum flexural stress in the rail if the load on each wheel is 170 kN. (10)

V. A rolled steel joist 300 mm by 125 mm and 6 m long is used as a strut with hinged ends. It carries an axial load of 300 kN together with a lateral load of 16 kN/m uniformly distributed along on flange over the entire length. Determine the maximum stress produced. $I=86 \times 10^{-6} m^4$, $A=5.89 \times 10^{-3} m^2$, E=200 GPa. (10)

VI. A steel bar of rectangular section 72 mm x 30 mm is used as a simply supported beam on a span of 1.2 m and loaded at mid span. If the yield stress is 280 MN/m^2 and the long edges of the section are vertical, find the load when yielding first occurs. Assuming that a further increase in load causes yielding to spread in towards the neutral axis with the stress in the yielded part remaining constant at 280 MN/m^2 determine the load required to cause yielding for a depth of 12 mm at the top and bottom of the section at mid span, and find the length of beam over which yielding has occurred. (10)

VII. Two tension members have the same length (L=1.5m), the same diameter (D=100 mm), and the same proportional limit (σ_{PL}=320 MPa). One is made of steel (E_s=200 GPa) and the other is made of aluminum (E_a=72.0 GPa). Which member is capable of absorbing the most energy without exceeding the proportional limit? Explain why. (10)

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