BT-MRE-III-12-16-1485 Reg.No. | | | | | | | | |

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# *B.Tech. Degree III Semester Examination in Marine Engineering December 2016*

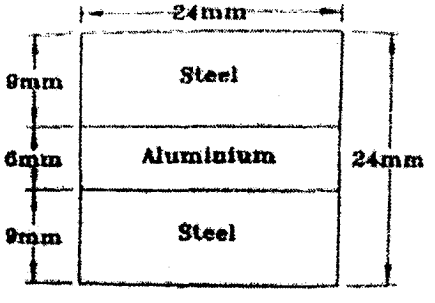
**MRE 1304 MECHANICS OF SOLIDS**

(*2013 Scheme*)

Time : 3 Hours Maximum Marks : 100

(5 × 20 = 100)

I. (a) A flat bar of Aluminium alloy 24 mm wide and 6 mm thick is placed between two steel bars each 24 mm wide and 9 mm thick to form a composite bar 24 *mm* × 24 *mm* as shown in figure below. The three bars are fastened together at their ends when the temperature is 10°C. Find the stress in each of the material if the temperature of the whole assembly is raised to 50°C. If at the new temperature a compressive load of 20 kN is applied to the composite bar what are the final stresses in Steel and Aluminum? Young's modulus for steel and Aluminum are 210 GPa and 67 GPa respectively and coefficient of thermal expansion for steel and Aluminium are $12 \times 10^{-6}$ per °C respectively. (15)




(b) Explain strain energy due to impact load. (5)

**OR**

II. (a) Explain the principle of complementary shear stress theory. (7)

(b) On a plane AB, normal and tangential stresses are 65 MPa and 60 MPa respectively. On another plane AC inclined 40° to AB, both normal and tangential stresses are equal and its value is 23 MPa. Determine the principal stresses. (13)

III. (a) A beam is of square section of side 'b'. If the permissible bending stress is 'f', find the moment of resistance when the beam cross section is placed in such a way that (i) two sides are horizontal (ii) one diagonal is vertical (iii) find also the ratio of flexural strength of the section in the two positions. (12)

(b) Derive Euler – Bernoulli Beam theory. (8)

**OR**

IV. (a) Draw the SFD and BMD for a simply supported beam of length 8 m having equal over hangs 2 m both ends carrying a uniform distributed load of 15 kN/m. (10)

(b) A uniformly tapering vertical post of height H having a diameter D at the base and a diameter d at the top is fixed at its base. A horizontal force P is applied at the top of the post. Determine the maximum bending stress for the post and state where it occurs. (10)

**(P.T.O.)**

V. (a) Find the deflection at free end of a cantilever beam of length '$l$' carrying a concentrated load 'w' at distance 'a' from the fixed end. (8)

(b) A beam 6 m long is subjected to two couples which include a clockwise couple of 200 kNm at 2 m from the left end and an anticlockwise couple of 80 kNm at 4 m from left end. Find the deflection at point of application of couples. Take EI = 41500 kNm$^2$. (12)

**OR**

VI. (a) Explain Clapeyrons three moment theorem. (8)

(b) A beam of uniform section, simply supported at the ends carries a concentrated load W at mid span. If the ends of the beam are fixed find the value of the point load P at the middle point for each of the following cases. (i) The defection at the centre remains same (ii) Maximum bending moment remains same for both simple supported beam and fixed beam. (12)

VII. (a) A solid shaft 7 m long is securely fixed at each end. A torque of 91 Nm is applied to the shaft at a section 3.5 m from one end. Find the fixing torque set up at the end of the shaft. If the shaft is 35 mm diameter find the maximum shear stress in the two portions. Find also the angle of twist for the section where the external torque is applied. Shear modulus is 84 GPa. (15)

(b) State the assumptions in theory of pure torsion. (5)

**OR**

VIII. (a) A safety valve of 80 mm diameter is designed to blow off at a gauge pressure of 1 MPa. The valve is held by a close coiled helical spring of mean diameter 180 mm, the initial compression being 18 mm. Find the diameter of the spring wire and the number of coils required if the allowable shear stress is 80 MPa. Take Shear modulus as 80 GPa. (10)

(b) A close coiled helical spring is to carry a load of 600 N. Its mean coil diameter is 12 times that of the wire diameter. Calculate diameters, if the maximum shear stress in the material of the spring is 90 MPa. (10)

IX. (a) Explain the term shrinkage allowance. (8)

(b) A pipe of 200 mm internal diameter and 100 mm thickness contains a fluid at a pressure of 6 MPa. Find the maximum and minimum hoop stress across the section and draw the variation of hoop stress along the thickness for this cylinder. (12)

**OR**

X. (a) Derive the "Euler's buckling load for a column of length '$l$' fixed at one end and free at the other end. (8)

(b) The biaxial stresses induced at a critical point in a machine component made of steel 45C8 (Yield strength of 380 MPa) are $\sigma_x = 100\,\text{MPa}$, $\sigma_y = 40\,\text{MPa}$, and $\tau_{xy} = 80\text{MPa}$. Calculate the factor of safety based on (i) maximum normal stress theory (ii) maximum shear stress theory and (iii) maximum distortion energy theory. (12)

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