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B.TECH. DEGREE EXAMINATION-Nov-Dec.2018
End Semester Examination-III Semester
BMEPC3010-Mechanics of Solids
(Regulations 2017)(Mechanical Engineering)

Time : 3 Hours Maximum : 100 Marks Question Code:191712

Answer ALL Questions

PART-A (10 X 2=20 Marks)

1. a) Hooke's law holds good upto [CO1] [PO1]
   (a)proportional limit(b)yield point (c)Elastic limit (d)plastic limit
   b) The materials having same elastic properties in all directions are called [CO1] [PO1]
   (a) ideal materials (b) uniform materials
   (c) isotropic materials(d) paractical materials
   c) During a tensile test on a specimen of 1 cm cross-section, maximum load observed was 8 tonnes and area of cross-section at neck was 0.5 cm^2. Ultimate tensile strength of specimen is [CO1] [PO2]
   (a) 4 tonnes/cm^2. (b) 8 tonnes/cm^2. (c) 16 tonnes/cm^2. (d) 22 tonnes/cm^2.
   d) Wherever the bending moment is maximum the shear force is [CO2][PO1]
   (a)zero (b)also maximum (c)minimum (d)of any value
   e) Maximum bending moment in a cantilever carrying a uniformly distributed load is [CO2][PO1]
   a)$\frac{wl^2}{4}$ b) $\frac{wl^2}{8}$ c) $\frac{wl^3}{4}$ d) $\frac{wl^2}{2}$
   f) The most common way of keeping the beam of uniform strength is by [CO2][PO1]
   a)keeping the width uniform and varying the depth
   b)keeping the depth uniform and varying the width
   c)varying both width and depth
   d)none of the above
   g) In I-section of beam subjected to transverse shear force S the maximum shear stress is developed [CO4][PO1]
   a) at the centre of the web b)at the top of edge of top flange
   c) at the bottom edge of the top flange d) none of the above
   h) The torsional rigidity of a shaft is defined as the torque required to produce [CO4][PO2]
   a)maximum twist in the shaft b)maximum shear stress in the shaft
   c)minimum twist in the shaft d)a twist of one radian /unit length of the shaft.
   i) The equivalent stiffness of two springs joined in series is [CO4][PO2]
   a) $S=S_1S_2/S_1+S_2$ b) $S=(S_1/S_2)/(S1+s2)$ c)$S=S_1+S_2$ d) $S=S_1*S_2$
   j) For the same material ,length and given torque a hollow shaft weighs ……..a solid shaft [CO4][PO1]
   a) less than b) more than c) equal to d) none of the above

PART-B (10 X 2=20 Marks)

2. a) State the principle of superposition? [CO1][PO1]
   b) Define thermal stress and thermal strain. [CO1][PO1]
   c) What is Mohr's stress circle ? Explain its significance. [CO4][PO1]
   d) Draw the S.F.D and B.M.D for a cantilever beam subjected to concentrated load of W kN at the free end . [CO2][PO2]
   e) What do you understand by point of inflection? Explain with a neat sketch [CO2][PO1]
   f) What do you mean by shear stress in beams? [CO3][PO2]
   g) What are the assumptions in the theory of simple bending? [CO3][PO2]

h) Define section modulus ? State its importance. [CO3][PO2]

i) Write the conditions when two shafts are connected in series and parallel [CO4][PO1]

j) Define stiffness of a spring. [CO4][PO1]

PART-C (4 X 15=60 Marks)

3a. i. A member ABCD is subjected to point loads P1, P2, P3 and P4 as shown fig 1. Calculate the force P2 necessary for equilibrium if P1= 45 kN, P3 = 420 kN, P4 = 120 kN. Determine the total elongation of the member assuming the modulus of elasticity to be $2.05 \times 10^5\ N/mm^2$. The length and cross sectional area of AB, BC and CD are 1000mm, 500mm, 800mm and $500mm^2$, $2000mm^2$, $1200mm^2$, respectively. [7] [10][CO1][PO2]

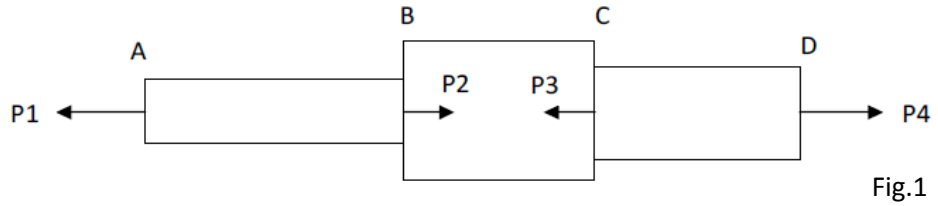

Fig.1

ii. What is a strain rosette ?Name the different types of it ? [5][CO1][PO1]

(or)

b. i. A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end , If at a temperature of 10℃ there is no longitudinal stress ,calculate the stresses in the rod and tube when the temperature is raised to 200℃. Take E for steel and copper as $2.1 \times 10^5\ N/mm^2$and $1 \times 10^5\ N/mm^2$ respectively.Take $\alpha_s = 11 \times 10^{-6}\ per℃$ and $\alpha_c = 18 \times 10^{-6}\ per℃$ [10][CO1][PO2]

ii. Draw the stress versus strain diagram of mild steel and show and discuss on the salient points in it. [5][CO1][PO1]

4.a i. Draw the SFD and BMD diagram for a simply supported beam of uniformly varying load whose intensity is zeo at left end and w/unit run at the right end support. [5][CO2][PO1]

ii. A cantilever of 4m span carries loads of 6kN , 4kN, 6kN and 4kN at 2m, 4m,7m and 4m respectively from the fixed end. It also has a uniform distributed load of 2kN/m as shown in fig. 2. Draw the shear force and bending moment diagrams. [10][CO2][PO2]

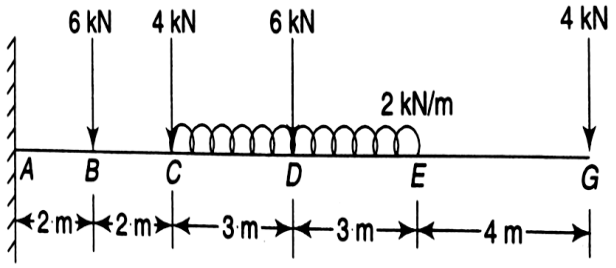

Fig.2

(or)

b. i. A loaded beam is as shown Fig. 3 below. Draw its S.F and B.M diagram. [8][CO2][PO2]

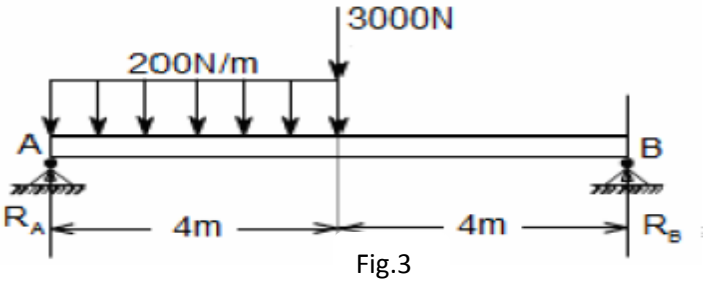

Fig.3

ii. A cantilever of length 2m carries a uniformly distributed load of 2.5kN/m run over the whole length and a point load of 2kN at a distance of 1m from the free end. Draw the SF and BM diagrams for the cantilever. [7][CO2][PO2]

5a. i.Prove the relation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ [7][CO3][PO1]

ii. Two wooden planks 150 mm* 50 mm each are connected to form a T-section as shown in fig-4. If a moment of 3.4 kNm is applied around the horizontal neutral axis, including tensile below the neutral axis, find the stresses at the extreme fibres of the cross section. Also calculate the total tensile force on the cross section. [8][CO3][PO1]

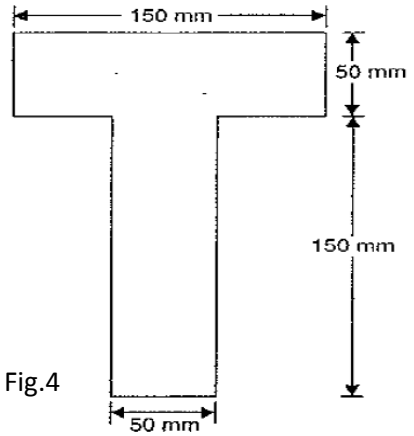

Fig.4

(or)

b i. A laminated wooden beam 10cm wide and 15cm deep is made up of three 5×10 cm wide planks glued together to resist longitudinal shear. The beam is simply supported over a span of 2m. If the allowable shearing stress in the glued joint is 0.45 MN/m^2 find the safe concentrated load that the beam may carry at its centre. [10][CO3][PO1]

ii. Calculate the slope and deflection of a simply supported beam subjected to uniformly distributed load of w/unit run over the whole span of the beam. [5][CO3][PO1]

6a. i. Compare the resistance to torsion of a hollow circular shaft to that of solid shaft if the inside diameter of the hollow shaft is two third of the external diameter and the two shafts have the same material and weight and of equal length. [7][CO4][PO1]

ii. A solid shaft transmits 100 kW at 60 rpm. Determine the diameter of the shaft if the shear stress is not to exceed 75MPa. If the shaft is replaced by a hollow shaft whose internal diameter is 0.6 times external diameter, while length, material and the maximum shear stress are the same, find the percentage saving in weight. [8][CO4][PO1]

(or)

b i. Derive the relation for a circular shaft when subjected to torsion as given below $\frac{T}{J} = \frac{\tau}{R} = \frac{C\theta}{L}$ [5][CO4] [PO1]

ii. A close coiled helical spring absorbs 72 N-m of energy when compressed through 60 mm. there are 8 coils in the spring. The coil diameter is 10 times the wire diameter. Find the diameters of the coil and wire and the maximum shear stress. C= 82 GPa. [10][CO5][PO2]

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