Registration No: | | | | | | | | | | |

Total Number of Pages: 03 **B.Tech.**
PCI31001

3rd Semester Regular/Back Examination 2017-18
MECHANICS OF SOLIDS
BRANCH: CIVIL
Time: 3 Hours
Max Marks: 100
Q.CODE: B793

Answer Question No.1 and 2 which are compulsory and any four from the rest.
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions: *multiple type or dash fill up type*** **(2 x 10)**

a) A 40 mm diameter steel rod when subjected to an axial tensile force was subjected to a strain of 0.30 X 10^{-3}. The tensile force that caused the above strain is ……

b) Stress concentration factor is defined as ……

c) Maximum stress intensity due to a suddenly applied load is……the stress intensity produced by the load of the same magnitude applied gradually.

d) A cantilever beam is subjected to a moment at the free end. The fixed end moment is ……..

e) Section modulus is defined as ……..

f) On any plane if the shear stress is zero, then the plane is called…….

g) Kernel of a section is defined as……..…

h) The deflection at the free end of a cantilever subjected to an UDL over the entire span is ……

i) Torsional rigidity is defined as ……..

j) For a column fixed at one end and free at the other, the Euler's load is given by……..

Q2 **Answer the following questions: *Short answer type*** **(2 x 10)**

a) What is the ratio of the elongations of a conical bar under the action of its own weight and that of a prismatic bar of same length and material?

b) Define and explain the term proof stress.

c) Sketch the BMD of a simply supported beam subjected to a moment M at its mid-span.

d) In a Mohr's circle, what do the followings indicate?

(i) the coordinate axes (ii) the coordinates of a point on the circle, and (iii) a radial line

e) As one goes away from the neutral axis, how the torsional and bending stresses vary?

f) For a solid circular section, where the maximum shear stress occurs? What is its value?

g) What is the slope and deflection at the free end of a cantilever subjected to a point load at the free end?

h) What is torsional resilience?

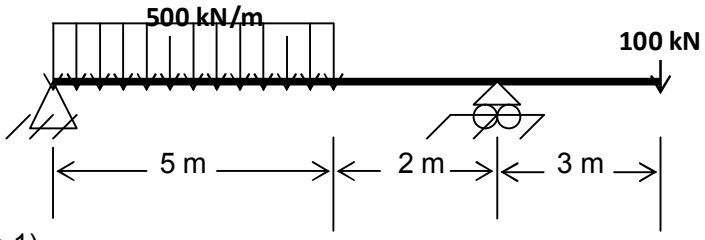
i) What do you mean by effective length of a column?

j) Define ductility of a material.

Q3 **a)** A steel tube of 40 mm outer diameter and 30 mm inner diameter encloses a gun metal rod of 20 mm diameter and is rigidly joined at each end. If at a temperature of 25 ^{0}C there is no longitudinal stress, determine the stresses developed in the rod and the tube when the temperature of the assembly is raised to 200 ^{0}C. Take; α_{steel} = 11 X 10^{-6} / ^{0}C, $\alpha_{gun\ metal}$ =18 X 10^{-6} / ^{0}C , E_{steel} = 200 GPa, $E_{gun\ metal}$ = 90 Gpa. Also find the increase in length if the original length of the assembly is 1 m. **(10)**

b) A point inside a body is subjected to a biaxial tensile stress system of σ_x = 500 kPa and σ_y = 250 kPa. Find the plane on which the resultant stress will make the minimum angle with the plane. **(5)**

Q4 For the beam loaded and supported as shown in Figure 1, draw the shear force and bending moment diagrams. Find the position and magnitude of maximum bending moment and locate the point of contra-flexure if any. **(15)**



(Figure 1)

Q5 **a)** The cross section of the beam shown in Figure 1 above is a T section symmetric about YY axis having a flange of 24 cm X 2 cm and web of 2 cm X 26 cm. Draw the bending stress distribution diagram at a section where the maximum bending moment occurs. **(10)**

b) The internal diameter of a hollow shaft is 4/5 of its external diameter. Compare its resistance to torsion with that of a solid shaft of same weight, material and length. **(5)**

Q6 A cantilever wooden mast 12 m high tapers linearly from 20 cm diameter at the base to 10 cm diameter at the top. At what point will the mast break under a horizontal load at the top. If the ultimate strength of the material of the mast is 3.5 kN/cm^2, calculate the magnitude of the load which will cause failure. **(15)**

Q7 A simply supported beam of 10 m length carries a point load of 100 kN and a pure moment of 100 kNm at 3 m and 7 m respectively from the left end. Find the slopes at the simply supported ends and the deflection under the point load. Also find the position and magnitude of maximum deflection. Take E = 210 GPa and I = 180 X 10^6 mm^4. **(15)**

Q8 **a)** A hollow cast iron column whose diameter is 200 mm has a thickness of 20 mm. It is 4.5 meters long and is fixed at both ends. Calculate the critical load by Rankine's formula. Calculate the slenderness ratio and the ratio of Euler's and Rankines critical loads. For cast iron take σ_c = 550 N/mm^2 and α = 1/1600 and E = 8*10^4 N/mm^2, notations have their usual meanings. **(10)**

b) A close coiled helical spring absorbs 80 Nm of energy when compressed through 60 mm. There are 10 coils in the spring. The coil diameter is 10 times the wire diameter. Find the diameters of the coil and the wire and the maximum shear stress. Take G = 80 GPa. **(5)**

Q9 **(a)** A rectangular block 24 cm X 20 cm X 16 cm is subjected to various stresses as follows: **(10)**

Compressive stresses of 500 kPa on 24 cm X 16 cm faces

Tensile stresses of 250 kPa on 20 cm X 16 cm faces

Compressive stresses of 100 kPa on 24 cm X 20 cm faces.

If Young's Modulus of Elasticity (E) of the material of the block = 300 GPa and the poisons ratio (μ) = 0.3, find;

Strains and changes in the dimensions (length, breadth and depth) of the block.

Volumetric strain and the change in volume.

(b) A cylindrical shell 2.5 m long which is closed at its ends has an internal diameter of 1 m and a wall thickness of 12 mm. Calculate the circumferential and longitudinal stresses induced and also the change in dimensions of the shell if it is subjected to an internal pressure of 1.8 MN/m^2. Take E = 200 GN/m^2 and Poisson's ratio (μ) = 0.25. **(5)**