B.E. Mechanical Engineering (Model Curriculum) Sem-IV

PCCME204 : Strength of Materials

P. Pages : 2 **GUG/W/22/14064**

Time : Three Hours Max. Marks : 80

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Notes :
1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.
5. Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.

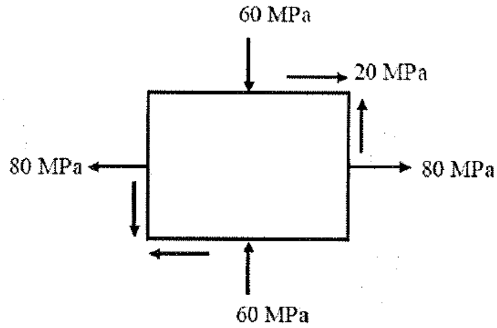
1. a) Define lateral strain, longitudinal strain, and Poisson's ratio (μ), Young's modulus of elasticity (E) and shear modulus of elasticity (G). Also state the relation between E, μ and G. **6**

b) A load of 400 kN is applied on a short concrete column $250\,\text{mm} \times 250\,\text{mm}$. The column reinforced with steel bars of total area $2512\,\text{mm}^2$. If the modulus of elasticity for steel is 18 times that of concrete. Find the stresses in concrete and steel. If the stress in concrete shall not exceed $4\,\text{N/mm}^2$, find the area of steel required so that the column may support a load of 500 kN. **10**

OR

2. a) Define factor of safety? What are the criteria of selecting factor of safety? **4**

b) The state of stress at point is shown in figure. Determine principal stresses and maximum shear stress and the plane on which they act by both analytical and graphical method. Indicate the direction of all the above by the sketches. **12**



3. An overhung beam ABCD is supported at A and C. It is subjected to UDL of intensity 18 kN/m on the span AB of 5 m. Also it carries a point load of 30 kN at D. Draw SF and BM diagram for beam and Determine. **16**

i) Maximum Bending moment ii) Point of contraflexure

Take AB = 5m, BC = 2m and CD = 3m

OR

4. a) A water main of 500 mm internal diameter and 20 mm thick is running full. The water main is a cast iron and is supported by two points 10 m apart. Find the maximum stress in the metal. The cast iron and water weigh $72000\,\text{N/m}^3$ and $10000\,\text{N/m}^3$ receptivity. **8**

b) Show that for rectangular section. $\tau_{max} = 1.5\dfrac{F}{A}$, Where F = shear force and A = Area of section. **8**

5. a) A cantilever beam of span 'L' is subjected to point load 'W' at its free end. Show that the maximum deflection at its free end is given by equation **8**

$$y_{max} = \frac{wL^3}{3EI}$$

Where EI – flexural rigidity of beam.

b) A simply supported beam ABCD, having span of 6 m is supported at ends A and D. It carries UDL of 40 kN/m over its entire span. Find the deflection of beam at points B and C. Take AB = 1m, BC = 3m and CD = 2m. **8**
Take EI = $17000\,kN.m^2$.

OR

6. a) Derive the expression for deflection of the cantilever having UDL over the entire span. **8**

b) For a simply supported beam carrying UDL of intensity $\omega N/m$ over its entire span 'L'. Show that the max^m deflection at its center is given by expression. **8**

$$Y_{max} = \frac{5\omega L^4}{384EI}$$

7. a) Define slenderness ratio, Buckling load and safe load for the column. **4**

b) State the assumptions made in 'Euler's column theory'. **4**

c) A bar of length 4 metres when used as a simply supported beam and subjected to a uniformly distributed load of 30 kN/m. over the whole span deflects 15 mm at the centre. Determine the crippling loads when it is used as a column with the following conditions: **8**
1. Both ends pin jointed. 2. One end fixed and the other hinged.

OR

8. A solid circular shaft is to transmit 300 kW at 100 r.p.m. if the shear stress is not to exceed $80\,N/mm^2$. Find the diameter of the shaft. What percentage saving in weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals 0.6 of the external diameter, the length, the material and the maximum shear stress being the same. **16**

9. a) A hollow cylindrical drum 600 mm in diameter has a thickness of 10 mm. If the drum is subjected to an internal air pressure of $3\,N/mm^2$, determine the increase in volume of the drum. Take $E = 2\times10^5\,N/mm^2$ and $1/m = 0.3$. **8**

b) A cylindrical thin drum 800 mm in diameter and 3 m long has a shell thickness of 10 mm. If the drum is subjected to an internal pressure of $2.5\,N/mm^2$. Determine changes in diameter, change in length and change in volume. Take $E = 2\times10^5\,N/mm^2$ and $1/m = 0.25$. **8**

OR

10. A thin seamless spherical shell of 1.5 meters diameter is 8 mm thick. It is filled with a liquid so that the internal pressure is $1.5\,N/mm^2$. Determine the increase in diameter and capacity of the shell. Take $\frac{1}{m} = 0.3$ and $E = 2\times10^5\,N/mm^2$. **16**

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