U.S.N | | | | | | | | | | |

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Industrial and Production Engineering

Semester End Examination; Dec. - 2019

Mechanics of Materials

Time: 3 hrs Max. Marks: 100

Note: i) PART - A is compulsory. **Two** marks for each question.
ii) PART - B: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.

Q. No.	Questions	Marks
	I : PART - A	**10**
I a.	State and prove Hooke's law.	2
b.	Define Shear force and Bending moment.	2
c.	State the assumptions made in pure bending theory.	2
d.	Define polar modules and torsional rigidity.	2
e.	Calculate the critical load of a strut which is made of a bar, circular in section and 5 m long and which is pin jointed at both ends. The same bar when used as simply supported beam gives a mid-span deflection of 10 mm with a load of 10 N at the centre.	2
	II : PART - B	**90**
	UNIT - I	**18**
1 a.	A bar of 20 mm diameter is tested in tension. It is observed that when a load of 37.7 kN is applied, the extension measured over a gauge length of 200 mm is 0.12 mm and contraction in diameter is 0.0036 mm. Find Poisson's ratio and elastic constants E, G, K.	10
b.	A tapering rod has a diameter d_1, at one end and it tapers uniformly to a diameter d_2 at the other end in a length L as shown in Fig. Q1(b). If modulus of elasticity of the material is E. Find its change in length when subjected to an axial force P.	10
c.	A bar of length 1000 mm and diameter 30 mm is centrally bored for 400 mm. The bore diameter being 10 mm as shown in Fig. Q1(c). Under a load of 25 kN, if the extension of the bar is 0.185 mm, what is the modulus of elasticity of the bar?	8
	UNIT - II	**18**
2 a.	Three pillars, two of aluminum and one of steel support a rigid platform of 20 kN as shown in Fig. Q2(a) if area of each aluminum pillar is 1000 mm^2 and that of steel pillar is 800 mm^2, find the stresses developed in each pillar. Take $E_\alpha = 1\times10^5$ N/mm^2 and $Es = 2\times10^5$ N/mm^2. What additional load P can it take if working stresses are 65 N/mm^2 in aluminum and 150 N/mm^2 in steel?	12
b.	The state of stress at a point in a strained material is as shown in Fig. Q2(b). Determine; i) The direction of the principal planes ii) The magnitude of principal stresses iii) The magnitude of the maximum shear stress and its direction. Indicate the above planes by a sketch	12

Contd…2

c. A circular bar of diameter 25 mm is subjected to an axial force of 20 kN as shown in Fig. Q2(c). Find the stresses on a plane making 30° to the plane of axial stresses and also on the plane which has maximum shear stress. 6

UNIT - III **18**

3 a. A cylindrical shell is 3 m long, and is having 1 m internal diameter and 15 mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in the dimensions of the shell, if it is subjected to an internal fluid pressure of 1.5 N/mm^2. Take E = 2×10^5 N/mm^2 and $\mu = 0.3$. 12

b. The simply supported beam shown in Fig. Q3(b) carries two concentrated loads and a uniformly distributed load. Draw the SFD and the BMC. 12

c. A simply supported beam of span L subjected to uniformly distributed load W for unit length. Draw the SFD and BMD. Also deduce an expression for maximum bending moment and state its location. 6

UNIT - IV **18**

4 a. Prove that; $\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$ with usual notations. 9

b. Fig. Q4(b) shows the cross section of a beam which is subjected to a Sheer force of 20 kN. Draw shear stress distribution across the depth marking values at salient points. 9

c. A simply supported beam of span 5m has a cross-section 150 mm × 250 mm. If the permissible stress is 10 N/mm^2, find; 9

i) Maximum intensity of uniformly distributed load it can carry

ii) Maximum concentrated load P applied at 2 m from one end it can carry

UNIT - V **18**

5 a. A simply supported beam of 6m span is subjected to a concentrated load of 18 kN at 4 m from left support calculate; 12

i) The position and the value of maximum deflection

ii) Slope at mid-span

iii) Deflection at the load point

Given; E = 200 GPa, I = 15×10^6 mm^4

b. A hollow circular shaft of 6 m length and inner and outer diameters of 75 mm and 100 mm is subjected to a torque of 10 kN-m. If G = 80 GPa the maximum shear stress produced and the total angle of twist. 6

c. Determine the buckling load for a strut of tee section, the flange width being 100 mm, overall depth 80 mm and both flange and stem 10 mm thick. The strut is 3 m long and is hinged at both ends. Take E = 200 GN/m^2. 6

Contd…3

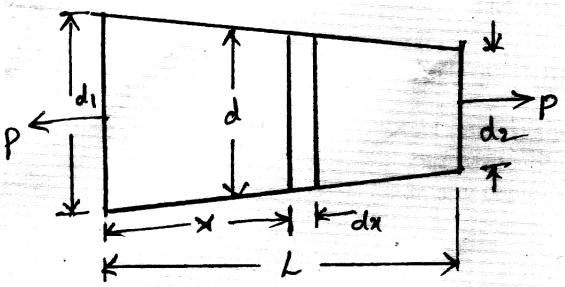

Fig Q.1(b)

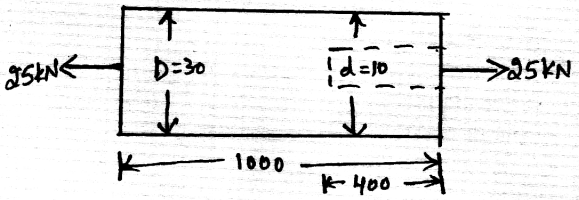

Fig. Q1(c)

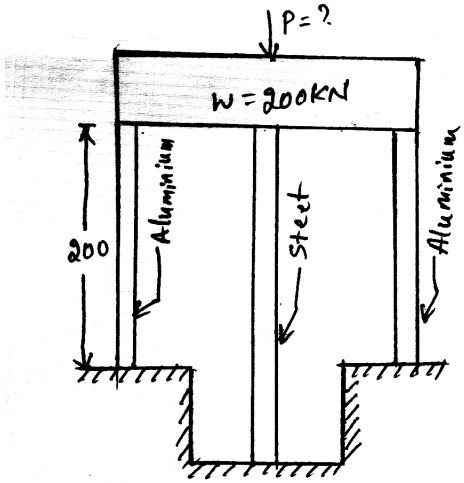

Fig Q.2(a)

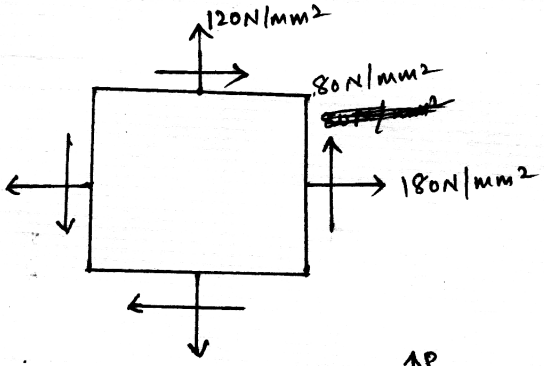

Fig Q. 2(b)

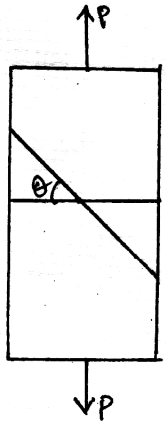

Fig Q.2(c)

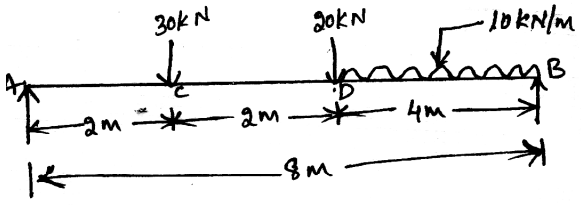

Fig Q.3(b)

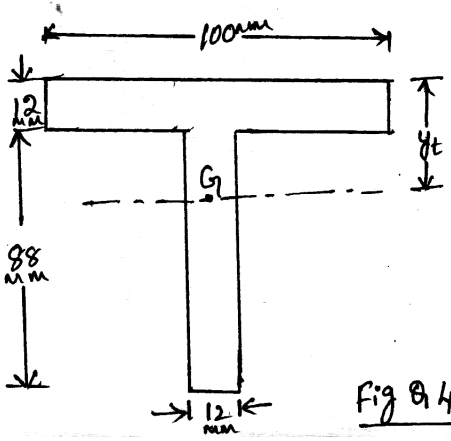

Fig Q.4(b)

* * *