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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
*(A constituent institution of MAHE, Manipal)*

**V SEMESTER B.TECH. (MECHATRONICS ENGINEERING)**

**END SEMESTER EXAMINATIONS, DEC 2018**

SUBJECT: STRENGTH OF MATERIALS [MTE 2102]

**REVISED CREDIT SYSTEM**

Time: 3 Hours MAX. MARKS: 50

**Instructions to Candidates:**

- Answer **ALL** the questions.
- Data not provided may be suitably assumed

**1A.** A round compression member with both ends hinged and made of SAE 1020 cold-drawn steel is to be used in a machine. Its diameter is 25 mm, and its length is 950 mm. Compute the maximum load that the member can take before buckling using the appropriate equation. Also compute the allowable load on the column for a design factor of $N$ = 3. Take Yield stress = 441 MPa; E = 207 GPa. **05**

**1B.** A solid bar of circular cross section has a diameter d = 40 mm, length L = 1.3 m, and shear modulus G = 80 GPa **05**

(a) If torque to be transmitted is T = 340 N-m, calculate the maximum shear stress induced in the shaft and the angle of twist

(b) If allowable shear stress is 42 MPa, and permitted angle of twist is 2.5°, calculate the maximum torque that can be transmitted.

**2A.** A stationary shaft as shown in Fig Q2A is supported by a smooth bearing at *A* and *D*. If the shaft has the cross section shown, evaluate the absolute maximum bending stress in the shaft. **04**

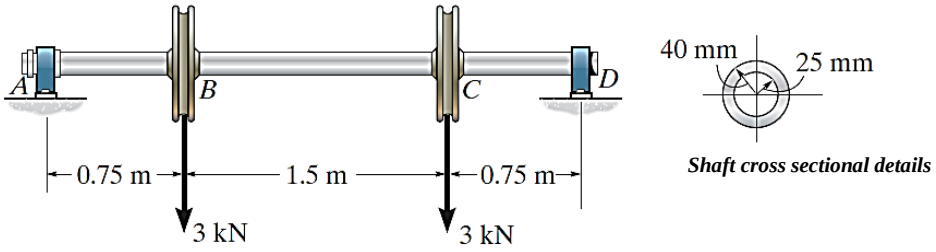


Fig Q2A

**2B.** In a beam shown in Fig Q 2B, calculate the deflection and slope at load points. The material has a Young's modulus of 200 GN/m$^2$. Diameter of the shaft is 20 mm. **06**

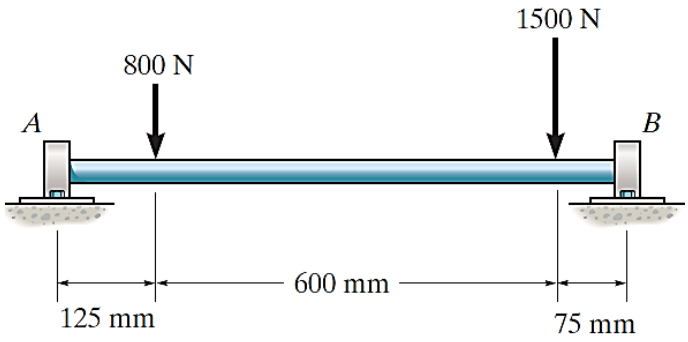


Fig Q2B

**3A** An aluminium beam has a cross-sectional area in the form of a cross. If it is subjected to the moment M = 8 kNm as shown in Fig Q3A, compute the bending stress acting at points *A* and *B*. **04**

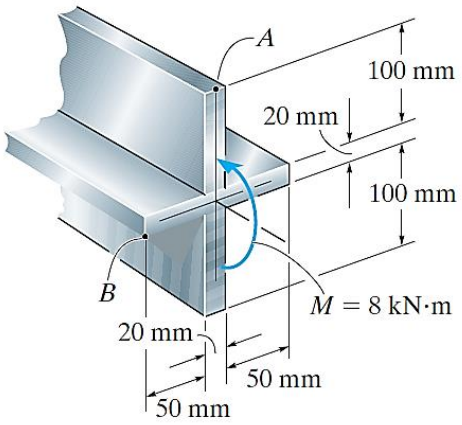


Fig Q3A

**3B** If the 50 mm diameter shaft loaded as shown in Fig Q3B, is made from a material having a yield strength of 350 MPa, determine if the shaft fails according to the maximum-normal-stress theory. Use a factor of safety of 1.5. **06**

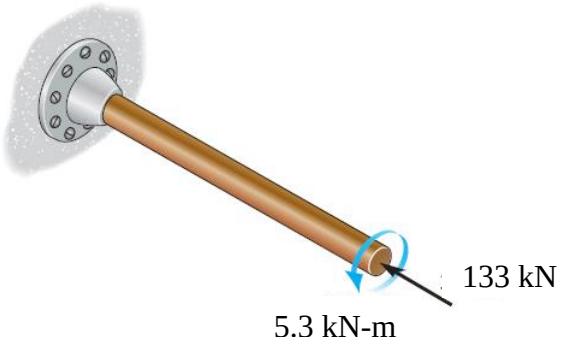


**Fig Q3B**

**4A.** Consider the stepped shaft shown in Fig Q4A rigidly attached to a wall at E. Calcuate the angle-of-twist of the end A with respect to point E. Assume the shear modulus G to be 80 GPa **05**

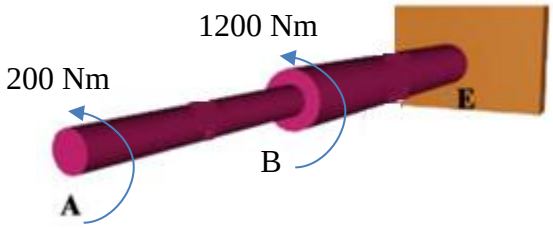


**Fig Q4A**

**4B.** The state of stress acting at a critical point on the seat frame of an automobile during a crash is shown in the figure. Determine the smallest yield stress for a steel that can be selected for the member, based on the maximum shear stress theory **05**


**Fig Q4B**

**5A** A solid round bar of 60 mm diameter and 2.5 m long is used as a strut. Find the safe compressive load for the strut using Euler's formula if (a) both ends are hinged (b) both ends are fixed. Take E = $2 \times 10^5$ N/mm$^2$ and factor of safety = 3. **05**

**5B** Compute the maximum principal stress at point B shown in Fig Q 5B. **05**

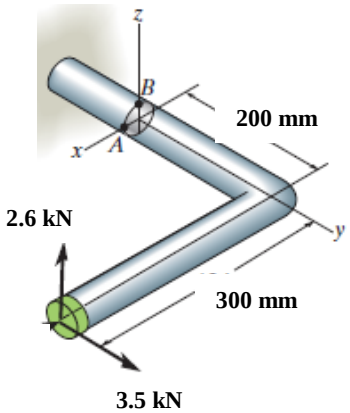


**Fig Q5B**