Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, DEC 2016/JAN 2017

SUBJECT: STRENGTH OF MATERIALS [MME 2102]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Determine the deflections of beam shown in Fig Q.1A at C and D using McCaulay's method. Take E =200 GPa and I=50X10^6 mm^4. **6**

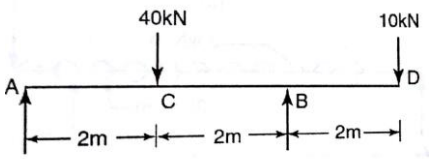

Fig Q1A

1B. A thin steel tube 50mm in diameter is 2mm thick. Find the safe twisting moment that can be applied to the tube if the allowable shear stress is 80 MN/m^2. Find also the twist in the length of 400mm. Take G=80 GN/m^2. **4**

2A. A beam of inverted T section is shown in fig Q.2A. If a moment of 3.4 kNm is applied along the horizontal neutral axis, inducing tension below the neutral axis, find the stresses at the extreme fibers of the cross section **6**

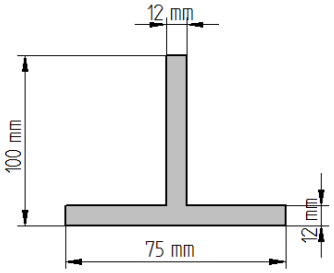

Fig Q.2A

2B. A circular pipe of external diameter 70 mm and thickness 8 mm is used as a simply supported beam over a span of 2.5 m. Find the maximum concentrated load that can be applied at the center of the span if permissible stress in tube is 150 N/mm^2. **4**

3A. The state of stress in a strained material is shown in Fig Q.3A. Determine **4**

i. The direction of principal plane
ii. Magnitude of principal stresses
iii. Magnitude of maximum shear and its direction

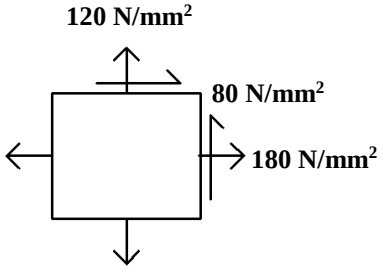

Fig Q.3A

3B. A machine element is subjected to a static bending moment of 450 Nm and a steady torsion of 62 Nm. At a critical section, it has a diameter of 40 mm. What should be the yield strength of the material if desired factor of safety is 4 on elastic limit. Adopt maximum shear stress theory. **4**

3C. A rod of 50 mm diameter is subjected to an axial pull of 500 N. If the length is 0.5 m and Young's modulus is 200 GN/m^2, calculate the deflection of the rod. **2**

4A. Calculate the maximum torque and mean power being transmitted in the case of a hollow shaft of which outer diameter is 200 mm and inner diameter is 100 mm. The shear stress is not to exceed 60 MN/m^2 and the shaft speed is 300 RPM. **4**

4B. A 2m long hinged column of square cross section is to be made of a material with E = 12 GPa and allowable stress being limited to 12 MPa. Determine the size of the column to support the following loads safely. **4**

i. 95 kN
ii. 200 kN

Use a factor of safety of 3 for Euler's load.

4C. A cantilever beam of dimensions 250 mm depth and 150 mm width and 1 m length is subjected to a lateral load of 2000 N at the tip. Calculate the stress induced in the material. **2**

5A. A rod of 50 mm diameter is subjected to a compressive load of 20 KN together with a twisting moment of 1.5 KNm. It is made of C40 steel (Yield stress = 328.6 MPa). Determine the factor of safety according to maximum shear stress theory. **5**

5B. A cantilever beam of length L is subjected to a point load W at the tip. Using double integration method, develop the expression for maximum deflection if the material is made of Young's modulus E. **5**