Reg. No.										

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

V SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOV 2018

SUBJECT: STRENGTH OF MATERIALS [MTE 2102]

REVISED CREDIT SYSTEM
(24/11/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Compute the critical load on a steel column having a square cross section 12 mm x 12 mm, with a length of 300 mm by appropriately identifying the equation to be used. The column is to be made of SAE 1040, hot rolled steel (Yield stress = 414 MPa; E = 207 GPa). It will be rigidly welded to a firm support at one end and connected by a hinge joint at the other. Also compute the allowable load on the column for a factor of safety N = 3. **05**

1B. A hollow stainless steel shaft is 3 m long and has an outer diameter of 60 mm. When it is rotating at 580 RPM, it transmits 30 kW of power from the engine to the generator (Fig Q1B). Compute the smallest thickness of the shaft if the allowable shear stress is 150 MPa and the shaft is restricted not to twist more than 0.08 rad. Take G=75 GPa. **05**

Fig Q1B

2A. A shaft is loaded as shown in Fig Q2A. If allowable normal stress in the material is limited to 48 MPa, calculate the diameter of solid shaft required. **04**

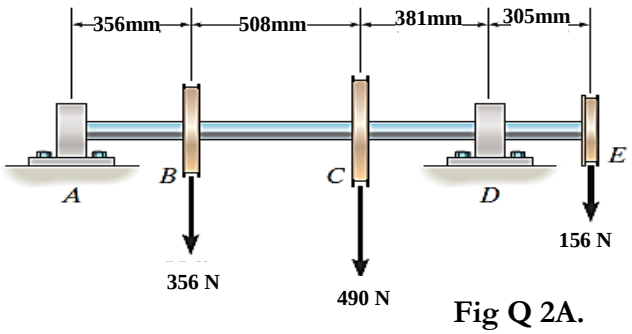

Fig Q 2A.

2B. When the diver stands at end *C* of the diving board, it deflects downward by 90 mm as shown in Fig Q2B. Analyse the scenario and determine the weight of the diver. The board is made of material having a Modulus of Elasticity of E = 10 GPa. The board has a rectangular cross section with breadth of 457 mm and a depth of 50 mm. The board is simply supported at A and B. **06**

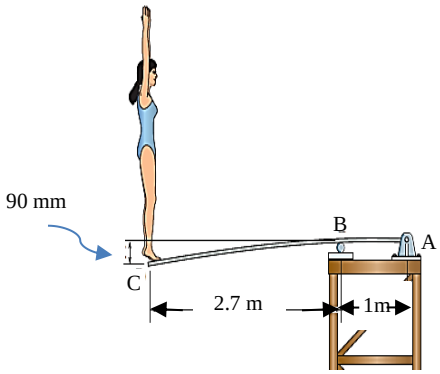

Fig Q 2B.

3A A beam is constructed from four boards as shown in Fig Q3A. If it is subjected to a moment of 10 kNm, compute the magnitude of stress at point A and B. Identify if the stresses are compressive or tensile. **04**

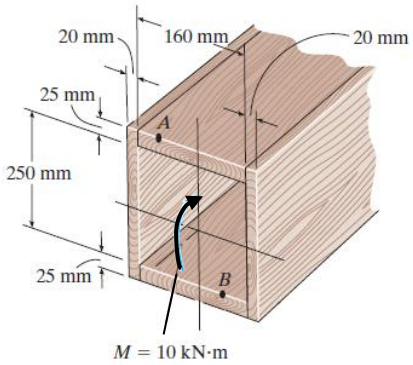

Fig Q 3A

3B The shaft consists of a solid segment AB and a hollow segment BC, which are rigidly joined by the coupling at B as shown in Fig Q3B. If the shaft is made from A-36 steel (Yield stress is 250 MPa), determine the maximum torque T that can be applied according to the maximum-shear-stress theory. Use a factor of safety of 1.5 against yielding. **06**

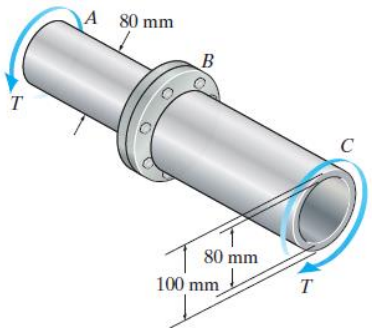

Fig Q3B

4A. Three pulleys are mounted on a stepped shaft as shown in Fig Q4A. The forces acting on the pulleys contribute only to torque and the effect of bending can be neglected. If each pulley has a diameter of 300 mm, calculate the angle of twist of point A relative to E. Take G= 80 GPa. **05**

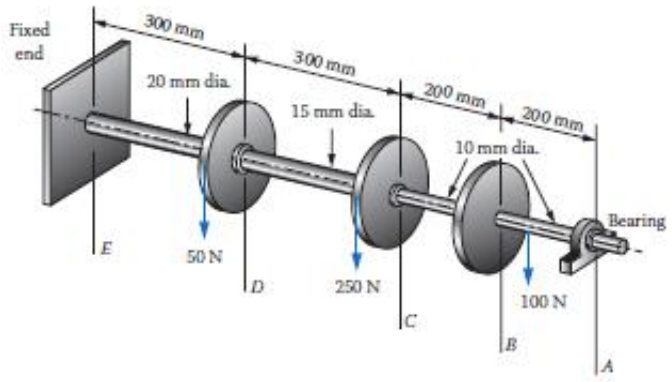

Fig Q4A

4B. A steel pipe has an outer and inner diameters of 30 mm and 20 mm respectively (Fig Q4B). Analyze the given loading setup and determine the factor of safety for yielding at point A according to maximum shear stress theory. Yield stress of the material is 250 MPa. **05**

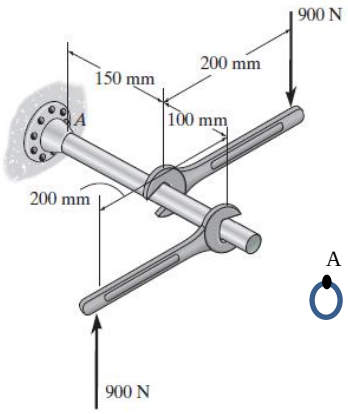

Fig Q4B

5A An aluminium column of dimensions shown in Fig Q5A is loaded axially and fixed at both ends. Determine the dimension 'b' if the yield strength of the material is 414 MPa and Young's modulus is 72.4 GPa. **04**

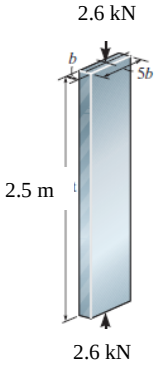

Fig Q5A

5B A wrench is used to tighten a threaded rod made of mild steel as shown in Fig Q5B. An inclined force is applied on to the tip of the wrench. Determine the principal stresses at point A and B. **04**

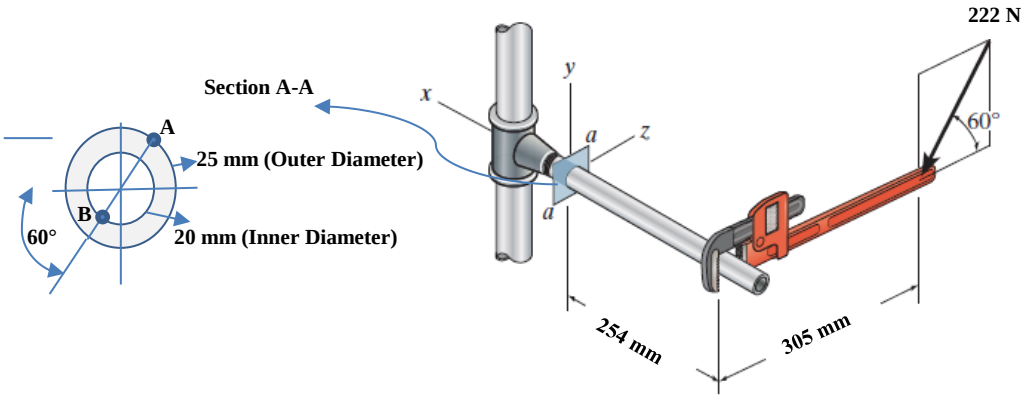

Fig Q5B

5C A woman weighing 780 N stands on a vinyl floor wearing stiletto high-heel shoes. If the heel has the dimensions as shown in Fig Q5C, determine the average normal stress she exerts on the floor and compare it with the average normal stress developed when a man having the same weight is wearing flat-heeled shoes. Assume the load is applied slowly, so that the dynamic effects can be ignored. Also, assume that the entire weight is supported only by the heel. **02**

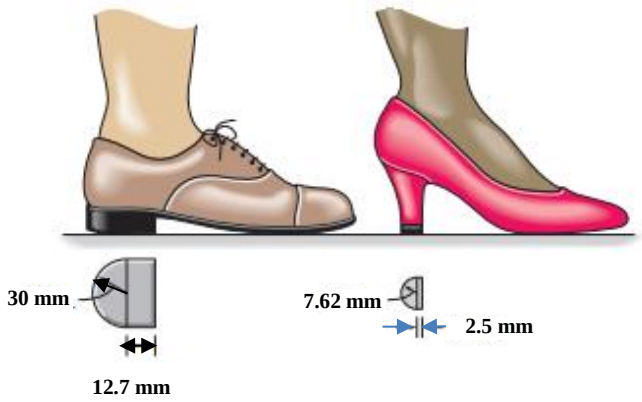

Fig Q5C