Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

III SEMESTER B.TECH (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: STRENGTH OF MATERIALS [MTE 2102]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. A beam 4m long is freely supported at ends (shown in Fig Q1.A). It carries concentrated loads of 20kN each at points 1m from the ends. Calculate the maximum slope and deflection of the beam. Also calculate the slope and deflection under each loads. Take EI=13000 kNm^2 **(06)**

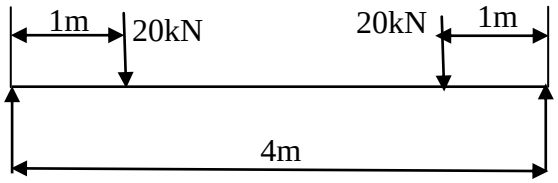

Fig Q1.A

1B. A plane element subjected to stresses is as shown in Fig Q1.B. Determine the principal stresses, maximum shear stress and their planes. **(04)**

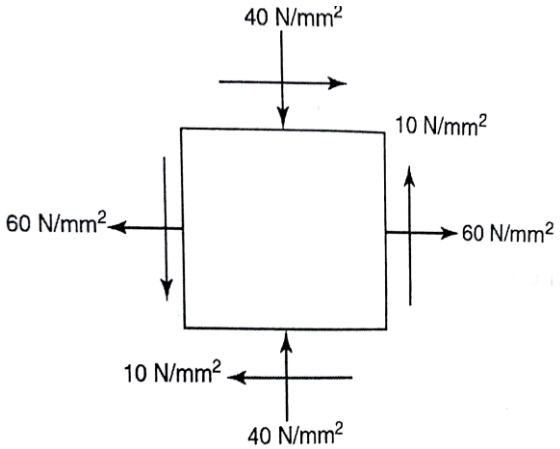

Fig Q1.B

2A. A beam with T section is shown below in figure Q2.A. If a moment of 3.4kNm is applied around the horizontal neutral axis, inducing tension below the neutral axis, find the stresses at the extreme fibers of the cross section. **(06)**

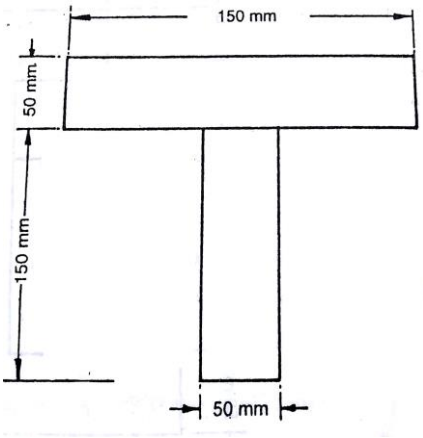

Fig Q2.A

2B. A column 2.5m long is pin connected at both ends. It has 50mm X 100mm rectangular cross section. Young's Modulus of the material is $2X10^5$ MPa. Determine **(04)**

a. Slenderness ratio
b. Euler buckling load 'Pcr'
c. Axial stress at 'Pcr'
d. Safe load if FOS is 2.5

3A. A SAE 1045 steel rod (Yield strength = 309.9MPa) of 80mm diameter is subjected to a bending moment of 3 KNm and torque T. Taking factor of safety as 2.5, find the maximum value of torque T that can be safely carried by rod according to maximum normal stress theory. **(04)**

3B. Find the shortest length 'L' of a hinged steel column having a rectangular cross section 600mm X 100mm for which the elastic Euler's formula applies. Take Yield strength and Modulus of elasticity value for steel as 250MPa and 200GPa respectively **(03)**

3C. A beam of length 'L' is fixed to the wall as shown in Fig Q3.C below. A drum of weight 'W' N is suspended at the free end of the beam. What will be the expression for maximum deflection of the beam if the beam is made of Young's Modulus 'E' and has a moment of inertia 'I'? Develop the expression. **(03)**

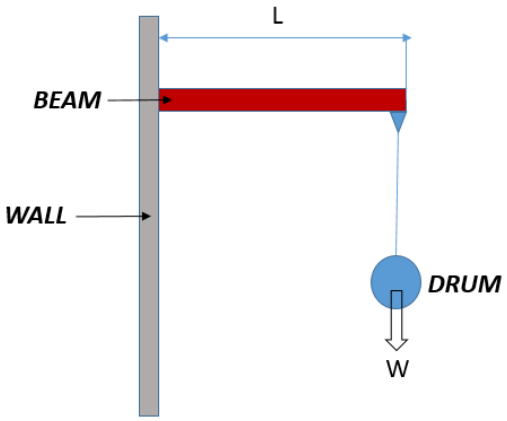

Fig Q3.C

4A. The shaft of an overhang crank subjected to a force P of 1KN is shown in Figure Q4.A. The shaft is made of plain carbon steel (Yield strength of 380 N/mm^2). The factor of safety is 2. Determine the shaft diameter using Maximum shear stress theory. **(05)**

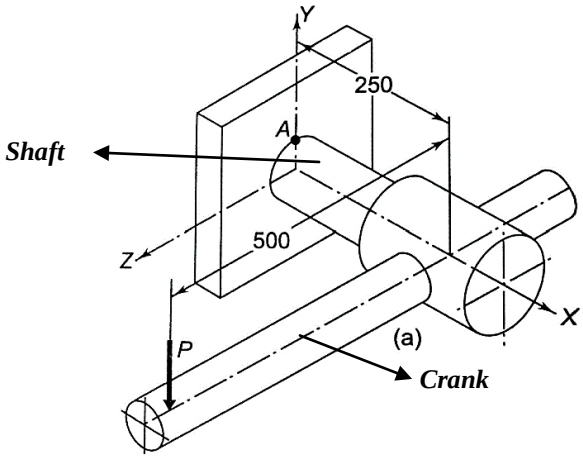

Fig Q4.A

4B. A hollow shaft of diameter ratio 3/8 is required to transmit 600KW at 110 R.P.M, the maximum torque being 20% greater than the mean. The shear stress is not to exceed 63MN/m^2 and the twist in a length of 3m is not to exceed 1.4˚. Calculate the maximum external diameter satisfying these conditions. **(05)**

5A. A 450mm diameter propeller shaft supports a propeller of mass 150 KN as shown in figure Q5.A below. The propeller can be considered to be as a load concentrated at the end of a cantilever of length 2.4m. If the propeller is running at 100RPM and the engine develops 18MW, calculate the principal stresses and the maximum shear stresses in the shaft. A propulsive force of P= 1.721MN acts on the propeller. **(05)**

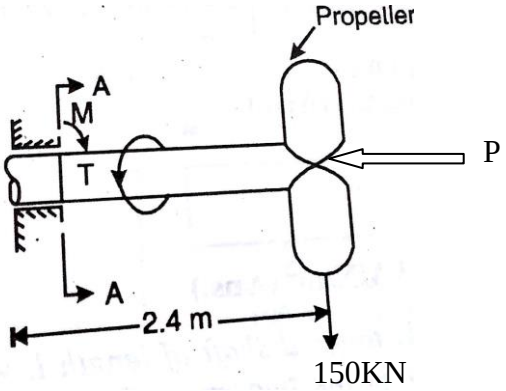

Fig Q5.A

5B. The following figure (Fig Q5.B) shows a Diesel Generator. The diesel engine is coupled to the generator with the help of a shaft. The manufacturer now wants to use the same shaft to transmit more torque (he uses a more powerful engine). An engineer suggests him to use hollow shaft of same length, same weight and same material. But the manufacturer is not convinced. **(05)**

What do you think? Is the engineer right? If yes show with mathematical calculations that the engineer is right to convince the manufacturer.

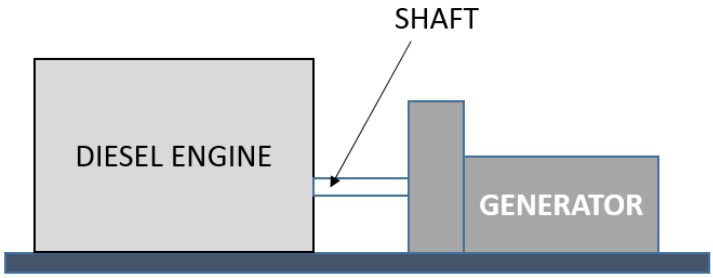

Fig Q5.B