Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

V SEMESTER B.TECH. (MECHANICAL ENGINEERING)
END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: MECHANICAL DESIGN- I [MME 3102]

REVISED CREDIT SYSTEM
(24/11/2016)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data, if any, may be suitably assumed.
- Use of Machine design data hand book is permitted.

1A. A grooved steel shaft as shown in **Fig.Q.1A** is to transmit 5 kW at 120 rpm. The groove radius is 0.2d. Determine the diameter of the shaft at the groove if it is made of C15 steel by taking a factor of safety of 2. **(05)**

1B. A 50 mm diameter steel rod supports a 9 kN load and in addition is subjected to a torsional moment of 100 Nm as shown in **Fig.Q.1B**. Determine the principal stresses and maximum shear stress for the component. **(05)**

2A. An offset bar has forces applied as shown in **Fig.Q.2A**. The bar is 25 mm × 50 mm. The effect of two applied forces is a pure couple that causes the same bending moment at every section of the beam. Determine the magnitude and location of maximum tensile, maximum compressive and maximum shear stresses. **(05)**

2B. Derive Soderberg's design equation applicable for ductile materials. **(03)**

2C. Define (a) Fatigue stress concentration factor (b) Notch Sensitivity **(02)**

3A. A steel shaft transmits a torque of 477.5 Nm. It is supported by bearings 1 m apart. A pulley and a gear are keyed to the shaft. The 350 mm diameter pulley drives a belt at an angle of 45^0 above the horizontal to another pulley located behind the shaft. The gear of 20^0 pressure angle is driven by a pinion mounted in front of it such that the tangential force on the gear acts vertically **(05)**

downwards. The tangential and radial forces on the shaft are 6367 N and 2317 N respectively. The weight of pulley is 2000 N and weight of the gear is 1200 N. The pulley is located 250 mm to the right of the left bearing and the gear is mounted at a distance of 200 mm to the left from the right bearing. The ratio of belt tensions is 2.57. The allowable shear stress in the material is 54 MPa. Determine the diameter of the shaft considering gradually applied load.

3B. Briefly discuss the stresses in key with a neat sketch. Differentiate between Saddle key and sunk key. **(05)**

4A. A steel plate 10 mm thick is welded to a vertical support using four 6 mm fillet welds as shown in **Fig.Q.4A**. Find the safe load P if permissible shear stress in weld material is 75 MPa. **(05)**

4B. With neat sketch define the types of failure in riveted joints. **(05)**

5A. **Fig.Q.5A** shows a wall bracket required to carry a load of 60 kN. The yield stress for the bolt material is 360 MPa. Take factor of safety as 2.5. Specify the tilting edge and determine the size of the bolt. List the pitch diameter, major diameter and minor diameter of the bolt. **(05)**

5B. A double threaded power screw with square threads is used to raise a load of 300 kN. The nominal diameter is 100 mm and pitch is 12 mm. The coefficient of friction at the screw thread is 0.15. Neglecting collar friction, compute: **(05)**

i) Torque required to raise the load.
ii) Torque required to lower the load.
iii) Efficiency of the screw.

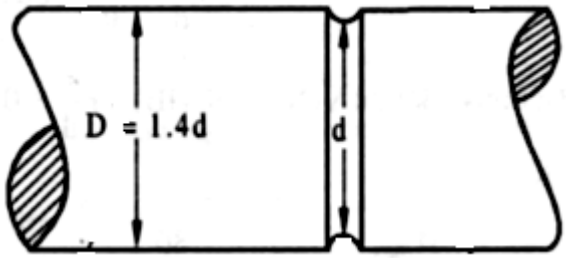

Fig.Q.1A

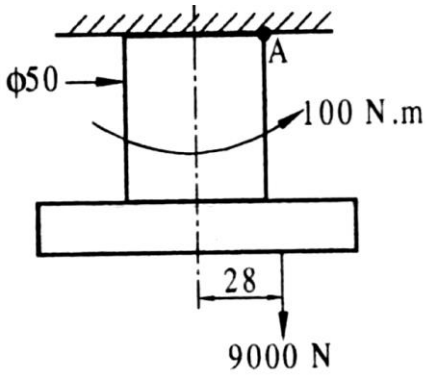

Fig.Q.1B

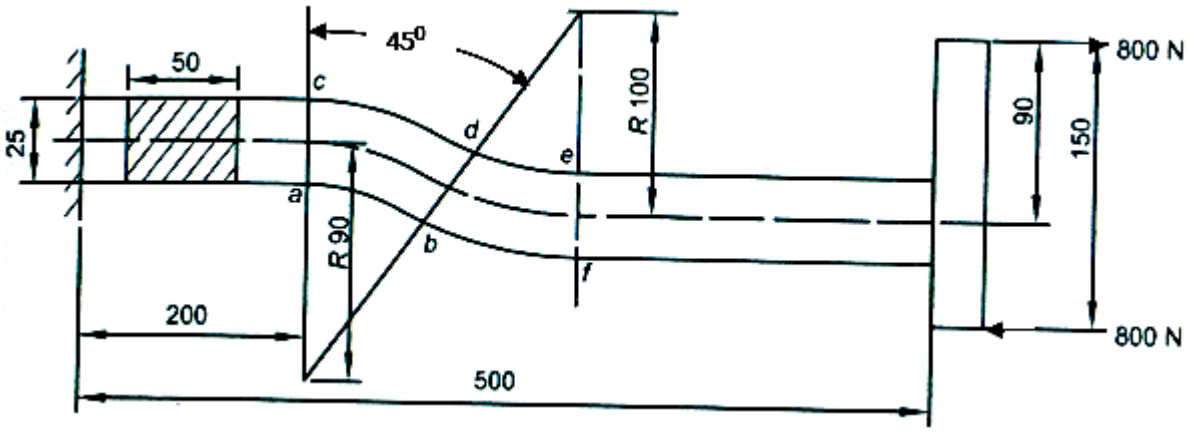

Fig.Q.2A

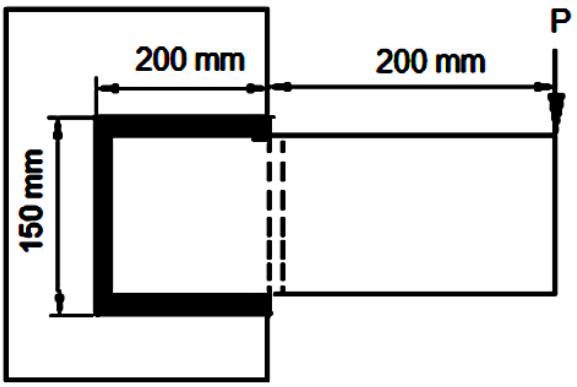

Fig.Q.4A

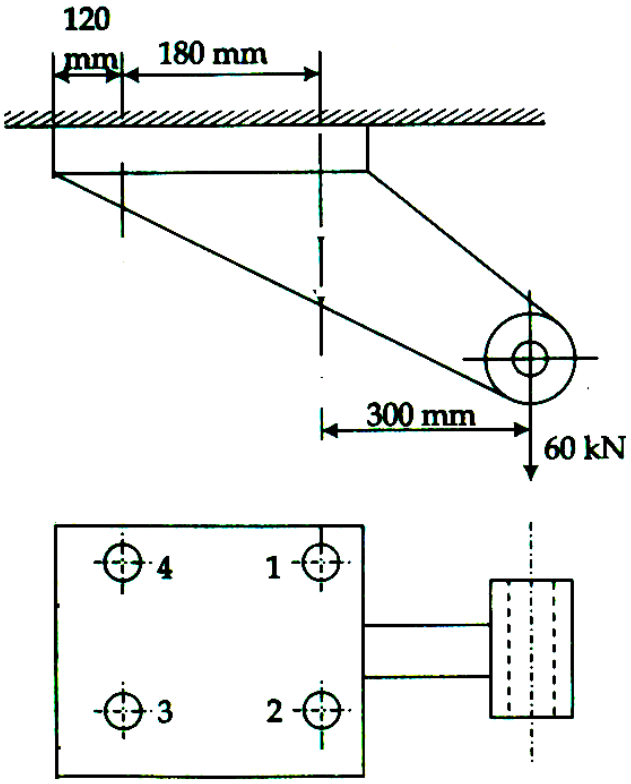

Fig.Q.5A