Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

V SEMESTER B.TECH. (MECHANICAL ENGINEERING)
END SEMESTER MAKE UP EXAMINATIONS, DEC 2016/JAN 2017

SUBJECT: MECHANICAL DESIGN- I [MME 3102]

REVISED CREDIT SYSTEM

(27/12/2016)

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 load F on a simply supported shaft as shown in figure **Fig.Q.1A** is 4000 N. Find the fillet radius at the left if maximum stress at the left fillet is same as that of right fillet. **(05)**

1B. A round rod of diameter 30 mm is to sustain axial compressive load of 20 kN and a twisting moment of 1.5 kNm. The rod is made of carbon steel C40. Determine the factor of safety as per the distortion energy theory. Justify whether, the material will withstand the above loading case as per the theory? **(03)**

1C. Explain the method used to reduce the stress concentration in a V-notched flat plate with a neat sketch? **(02)**

2A. A round rod of diameter 1.2d has a semi-circular groove of diameter 0.2d as shown in **Fig.Q.2A**. This rod is to sustain twisting moment that fluctuates between 2.5 kNm and 1.5 kNm together with a bending moment that fluctuates between 2 kNm and -1 kNm. Take σ_y=300 MPa, σ_u=450 MPa and factor of safety = 2.5. Find suitable diameter of rod. Assume size and surface finish factors as 0.85. **(05)**

2B. Derive an expression for stress distribution due to bending moment in a curved beam. **(05)**

3A. A steel shaft is supported on bearings 1m apart. A cast iron pulley of 0.6 m diameter weighing 1 kN is located 0.3 m to the right of the right bearing and receives power from a motor pulley by a horizontal belt drive directly behind it. The torque transmitted is 238.75 Nm. The ratio of belt tensions is 3. A 20^0 spur pinion of pitch circle diameter 0.2 m weighing 200 N is located 0.2 m to the left of the left bearing. The pinion delivers power to another gear mounted directly behind it such that the tangential force on the pinion acts vertically upwards. The allowable shear stress in the material is 54 MPa. Assuming the combined shock and fatigue factors in bending and torsion as 1.5 and 1.2, determine the diameter of the shaft. **(05)**

3B. Classify the shafts based on industrial applications. Mention the ASME code design guidelines for shaft. **(05)**

4A. A triple riveted lap joint zig-zag type is to be made of 10 mm plates. If the safe working stress in tensile, crushing and shear are 100 MPa, 125 MPa and 75 MPa respectively. Sketch the joint and find i) pitch ii) margin iii) overlap iv) least strength. **(05)**

4B. A rectangular bar is welded to the support as shown in Fig.Q.4B**.** Take the allowable shear stress as 40 MPa. Determine the size of the weld. **(03)**

4C. State the advantages and disadvantages of welded joints over riveted joints. **(02)**

5A. Determine the size of the bolts for the ceiling bracket shown in **Fig.Q.5A,** if the allowable stress in the bolt material is limited to 100 MPa. **(05)**

5B. A square thread has a nominal diameter of 50 mm and pitch of 8 mm with triple start threads. The nut is loaded and prevented from turning by guides as shown in **Fig.Q.5B**. The coefficient of friction for the screw is 0.13. Neglect the friction in the thrust collar and the guide, determine **(05)**

i) The load which could be raised by a torque of 60 N-m.

ii) Bearing pressure between the screw and the nut, if the nut height is 60 mm.

iii) Efficiency

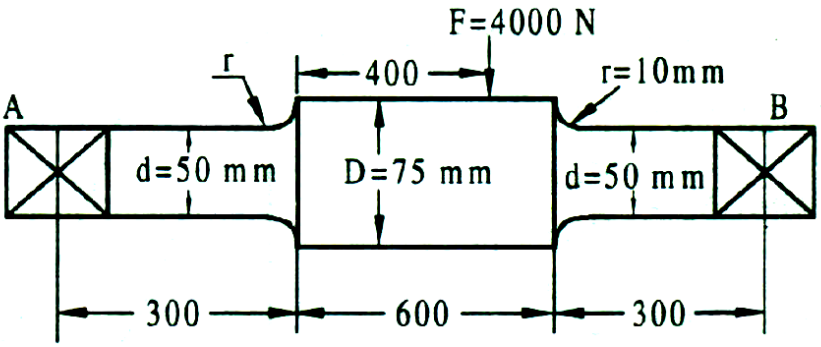

Fig.Q.1A

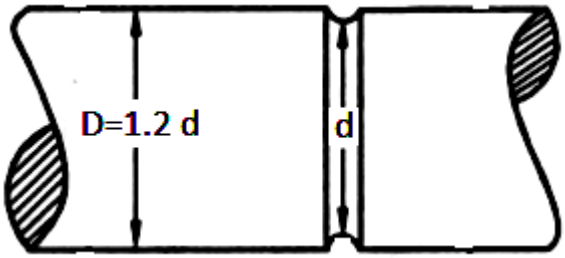

Fig.Q.2A

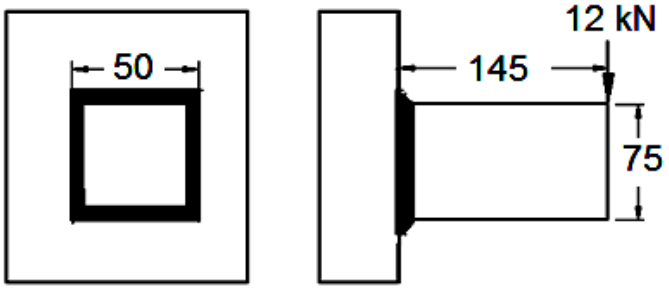

Fig.Q.4B

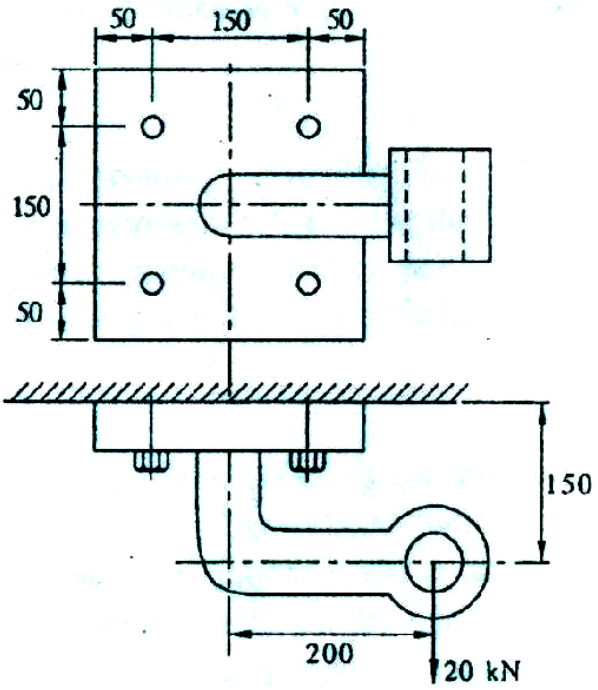

Fig.Q.5A

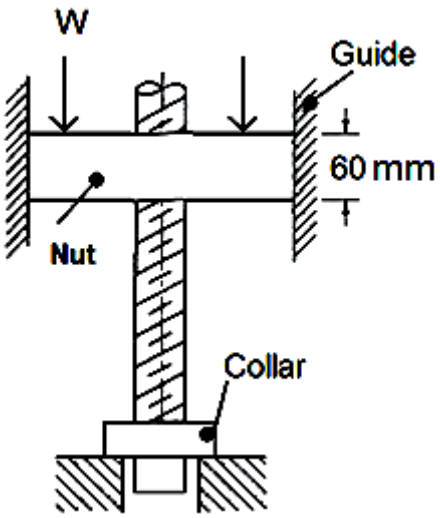

Fig.Q.5B