Paper Code: ME-501	**Roll No.**									

B.Tech.
FIFTH SEMESTER EXAMINATION, 2016-17
MACHINE DESIGN-I

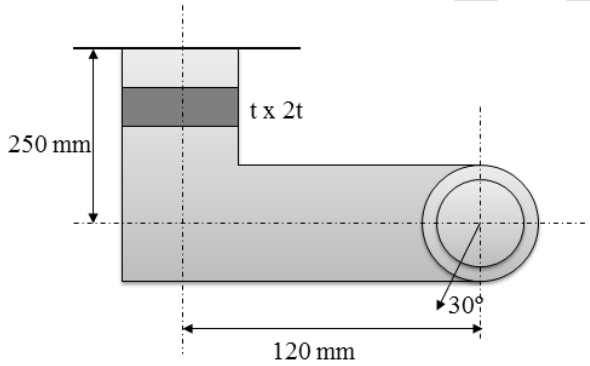
[Time: 2 Hours] [Max. Marks: 50]

Notes: Attempt all questions. Assume any missing data suitably. Use of design data book is permitted.

1. Attempt any *two* parts of the following: - **(6x2=12)**

(a) Determine the limiting value of the torque that can be applied on a 55 mm circular solid shaft in addition to bending moment of 330 N-m. The shaft is made of 30C8 steel and factor of safety is 1.5. Use (i) maximum shear stress theory and (ii) the distortion energy theory.

(b) Figure shows a hanger with square cross section, with the proportions indicated. A force F of magnitude 10 kN acts at 30º to the vertical as shown. The permissible stress in the hanger materials is 60 MPa. Find the cross section of hanger.



(c) Explain the following in brief:-
(i) Stress concentration and notch sensitivity
(ii) Factors affecting endurance strength

2. Attempt any *two* parts of the following: - **(6x2=12)**

(a) Calculate the strength of the double riveted butt joint with two unequal cover plates. The rivet diameter is 7 mm, pitch is 50 mm, back pitch is 35 mm. The plate thickness is 6 mm and the thickness of top and bottom cover plates is 4 and 3 mm respectively. The failure stresses are 360 MPa, 450 MPa and 300 MPa in tension, compression and shear respectively.

(b) Design a double riveted circumferential joint for boiler shell whose inner diameter is 1600 mm and steam pressure is 2.0 MPa. The ultimate tensile, shear and crushing strength are 450 MPa, 400 MPa and 800 MPa respectively.

(c) Explain the following in brief:
   (i) Properties of a rivet material
   (ii) Failure modes of a rivet joint

3. Attempt any *two* parts of the following: - **(6x2=12)**

(a) Design a cast iron flange coupling for mild steel transmitting 80 kW at 220 rpm. Allowable shear stress for shaft material is 40 MPa and for bolt material is 30 MPa. The flange material is FG300 and factor of safety is 2.5.

(b) A shaft 65 mm diameter transmits power at maximum shear stress of 67 MPa. The shear stress in in the key should not exceed 75% of the stress developed in the shaft. The key should be at least 2.5 times strong in crushing compared to shear failure of the key.

(c) A solid circular pin is subjected to completely reverse bending moment of 4.5 N-m. The ultimate strength of the pin material is 340 MPa. Assuming the notch sensitivity and stress concentration factor as 0.85 and 1.5 respectively, determine the diameter of the pin at 90% reliability. Consider the factor of safety as 2.0.

4. Attempt any *one* part of the following: - **(14x1=14)**

(a) A shaft is supported between two bearings 800 mm apart. A 450 mm diameter pulley is mounted at 400 mm right of the right hand bearing in overhang condition and transmits power in vertical direction. The tension ratio in the belt drive is 3 and angle of lap is 180º. A 300 mm diameter spur gear having pressure angle 20º is mounted at 400 mm right of the left hand bearing. The gear is supplied 20 kW at 500 rpm by another gear at the top of it. The tensile strength of the shaft material is 700 MPa and the combined shock and fatigue factor for bending and torsion can be taken as 1.5. Determine the size of shaft for a factor of safety of 5.

(b) A power screw having double start thread is acted upon by an axial load of 12 kN. The inner and outer diameter of the screw collar surfaces is 20 mm and 50 mm respectively and the coefficient of friction for screw and collar are 0.15 and 0.20 respectively. The permissible bearing pressure is 6 N/mm^2. Select an appropriate screw and nut for allowable shear stress of 30 MPa and check its strength for safety. Also determine the height of the nut and the efficiency of the screw jack.