C 80808 (Pages : 3) Name.....

Reg. No.....



# SIXTH SEMESTER B.TECH. (ENGINEERING) [09 SCHEME] DEGREE EXAMINATION, APRIL 2015

## ME/PTME/AM 09 603—MACHINE DESIGN – I

Time : Three Hours Maximum : 70 Marks

*Use of design data book permitted, assume data wherever necessary.*

### Part A

*Answer* **all** *questions.*

1. State maximum principal stress theory.
2. Define the terms : (i) Rigidity ; (ii) ductility.
3. Which are the modes of failure of cotter in a cotter joint ?
4. Sketch any *three* basic types of welded joints.
5. What are the uses of a flexible coupling.

(5 × 2 =10 marks)

### Part B

*Answer any* **four** *Questions.*

1. A stepped shaft stepped down from 60 mm diameter to 40mm diameter with a fillet radius 8mm rotates at 2000 r.p.m. Find the safe power that can be transmitted by this shaft limiting shear stress to 60 MPa.
2. A bar of rectangular cross section 30mm × 50mm and 300mm long is resting on the ground in an upright position. It is subjected to an impact load of 1.5 kN that falls on to it from a height of 10mm. Determine the maximum stress induced.
3. Determine the size of the bolt subjected to a tensile load of 30 kN. The allowable tensile stress for bolt material may be taken as 120 MPa.
4. Derive the deflection equation for helical spring.
5. A railway car weighing 20 kN and moving with a velocity of 15 kmph is stopped by a buffer consisting of 4 helical springs having mean coil diameter 160mm and a spring index of 8. Find the compression of the spring.
6. Select a rectangular key for transmitting a power of 50 kW at 500 r.p.m., to mount a hub of length 60mm on a solid circular shaft of diameter 50 mm.

(4 × 5 = 20 marks)

**Turn over**

## Part C

### Module I

1. A bolt is subjected to a tensile load of 18 kN and a shear load of 12kN . The material has an yield stress of 328.6 MPa. Taking factor of safety as 2.5, determine the core diameter of bolt according to the following theries of failure : (i) Rankine's theory ; (ii) Shear stress theory ; (iii) Shear energy theory ; and (iv) Saint Venant's theory, take Poisson's ratio = 0.298.

*Or*

2. Discuss the various steps involved in the process of Design. Explain the design principles.

### Module II

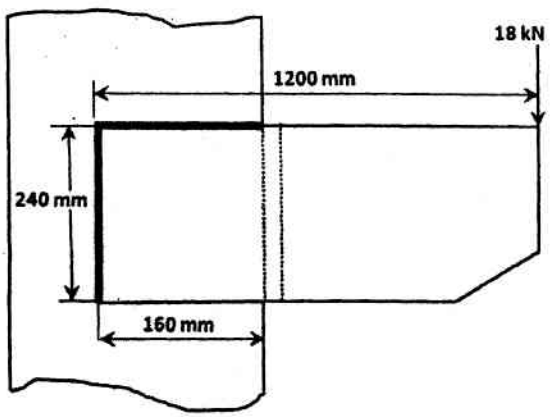
3. A screw jack carries a load of 20 kN. Assuming the coefficient of friction between the screw and nut as 0.15, design the screw and nut. Neglect collar friction and column action. The permissible compressive and shear stresses in the screw should not exceed 40 MPa and 25 MPa respectively. The shear stress in the nut should not exceed 20 MPa. The bearing pressure in the nut is 12 MPa. Also determine the effort required at the handle of 250mm length, in order to raise and lower the load. What will be the efficiency of the screw jack ?

*Or*

4. Design a double riveted double strap butt joint for the longitudinal seam of a boiler of diameter 1.3m with a steam pressure of 2.4 MPa. The working stresses to be used are 77 MPa in tension, 54 MPa in shear and 120 MPa in crushing. Assume joint efficiency as 81%.

### Module III

5. Determine the size of the weld to be used for a welded joint loaded as shown in figure below. The allowable shear stress in the weld is 60 MPa :




*Or*

6. Design a helical compression spring for a maximum load of 1000 N and for a deflection of 25mm. the maximum permissible shear stress for spring material is 420 N/mm$^2$. Modulus of rigidity is $0.84 \times 10^5$. Spring index is 6.

MODULE IV

7. The shaft of an axial flow rotary compressor is subjected to a maximum torque of 200 N-m and a maximum bending moment 400 N-m. the combined shock and fatigue factor in torsion is 1.5 and that in bending is 2.0. Determine the diameter of the shaft, if the shear stress in the shaft is limited to 50 MPa. Design a hollow shaft for the above compressor taking ratio of outer diameter to inner diameter as 2. What is the percentage saving in material ?

*Or*

8. Design a protected type CI flange coupling to transmit 9 kW at 1500 r.p.m. The maximum torque to be transmitted is 20% greater than the mean torque. Assume allowable shear stress for shafts, bolts, and keys is 72 MPa and allowable shear stress for key is 150 MPa.

(4 × 10 = 40 marks)