BME-024

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

Term-End Examination

June, 2016

00560

BME-024 : MECHANICAL ENGINEERING DESIGN

Time : 3 hours *Maximum Marks : 70*

*Note : Question no. 1 is **compulsory**. Attempt any **four** questions from the rest. Attempt **five** questions in all. Assume missing data, if any. All questions carry equal marks.*

1. (a) What is stress concentration ? How can it be minimized ?

   (b) How does helix angle influence the efficiency of a square threaded screw ?

   (c) Where will you use circular, oval and square flanged pipe joints ? Write the advantages of each in particular application.

   (d) Explain the bolt of uniform strength with a simple sketch.

   (e) What are the assumptions made in design of welded joints ? Are these joints recommended for fatigue loading ?

   (f) What are the various mode of failure of riveted joints ?

(g) Select the suitable material for the following components with proper reasoning :

   (i) Helical gear for a machine tool gearbox.

   (ii) Connecting rod for a high speed IC engine. *7×2=14*

2. (a) What is the efficiency of a riveted joint ? Why is butt joint preferred over lap joint ? Explain with the help of a double riveted joint. *5*

   (b) Design a circumferential lap joint for a boiler drum whose inner diameter is 1400 mm and steam pressure is 2 MPa. Assume that the joint is double zigzag riveted and ultimate tensile strength, shear and crushing strength of the material is 450, 400 and 800 MPa respectively. Select a factor of safety of 4. Draw a neat sketch. *9*

3. (a) Prove that a hollow shaft is stronger than a solid shaft of same length and weight and made of the same material. *6*

   (b) A 250 mm long hollow circular rod of external diameter of 80 mm and internal diameter of 40 mm is welded to a plate along its circumference. The rod carries a concentrated load of 15 kN at the free end perpendicular to its axis. If the permissible weld strength is 80 MPa, determine the weld size. *8*

4. Design a cotter joint for an axial load of 100 kN in both tension and compression. Assume that cotter, spigot and socket are made of the same material with allowable tensile stress, shear and compressive strength of 50 MPa, 40 MPa and 100 MPa respectively. Sketch the front view of a designed joint.   *14*

5. Design a screw on the basis of a maximum shear strength and safe buckling for a vertical screw jack having square threads to raise or lower a design load of 150 kN through a height of 280 mm. The screw is made of AISI 1040 steel with permissible tensile stress, shearing stress and compressive stress of 75 MPa, 45 MPa and 90 MPa respectively. The safe bearing pressure between the screw and nut is 15 MPa. Assume a coefficient of friction of 0·14 at the interface. Check the screw in bending for an eccentricity of 10 mm, only.   *14*

6. (a) How many types of ends are possible in compression springs ? Specify active and inactive number of coils in each case.   *6*

(b)   Design a closed coil helical spring of a circular cross-section wire to carry an axial load of 5 kN at a maximum stress of 750 MPa. The spring is squared and ground with a spring stiffness of 25 kN/m. Assuming a spring index of 7 and the ratio of solid length to mean coil diameter of 2·5, determine :

(i)   Mean coil diameter of spring

(ii)   Wire diameter

(iii) Solid length of the coil

(iv)   Free length of the coil $4\times2=8$

7.   Design a cast iron protected type flange coupling to connect two shafts of 100 mm dia running at 330 rpm and transmitting a torque of 5000 Nm. Assume the permissible shear stress for shaft, bolts and keys of 50 MPa, crushing stress for bolt and key as 150 MPa and shear stress for cast iron flange of 8 MPa. Sketch the coupling also.   *14*