BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

01139

Term-End Examination
June, 2012

BME-024 : MECHANICAL ENGINEERING DESIGN

Time : 3 Hours *Maximum Marks : 70*

Note : *Solve **any five** Questions. All questions carry **equal** marks. Use of calculator and design data book is permitted. Assume missing data if any.*

1. (a) Give the FOS and suitable material for making following parts /objects and mention for which property the material is selected. **10**

(i) Rivets in riveted joints

(ii) Shaft for power transmission

(iii) Pulley

(iv) Gear

(v) Spring in engine valve

(b) Describe the procedure of design. **4**

2. (a) State distortion energy theory of failure, and theory of maximum shearing stress. It is expected that a bar subjected to torque, will fail if torque is increased to some value. At the time of failure the cross - section of bar will carry a shear stress τ_y = yield strength in shear. Two planes at 45° to cross - section will carry direct stresses equal to the shear stress in cross - section but one tensile and other compressive. Apply the two theories to the failure of the bar under torsion and find relationship between yield strengths in shear and tension. 7

(b) For a transition fit H7/n6 calculate extreme diameters of shaft and hole if the nominal diameter is 12 mm. Calculate largest clearance and interference. 7

For H class of tolerance IT7 is 0.018 for 12mm dia.

For n class of tolerance IT6 is 0.011 for 12mm dia and fundamental deviation is 0.011

3. (a) Sketch an eye bolt. 7

The cover of a gear reducer weighs 100 kN. It is to be lifted by two eye bolts. Each bolt is equidistant from centre of gravity and lies in the central plane. The bolts are made up of steel for which permissible stress is 85 MPa. Find nominal dia and select bolt from following table.

Designation	P(mm)	d(mm)	d_c(mm)	stress area (mm^2)
M 24 × 2	2	24	24.546	384
M 27 × 2	2	27	24.546	496
M 30 × 2	2	30	27.546	621

(b) A shaft of 20mm dia is welded coaxially with another shaft of much larger diameter. The shaft is to transmit a torque, which is just safe. Calculate the width of peripheral fillet weld between two shafts. The permissible shearing stress for the shaft material is 70MPa and that for weld is 50 MPa. **7**

4. (a) Show the distribution of stress on the cross - section of wire of spring which is loaded by a force along its axis. **4**

(b) A vertical spring loaded valve is required for a compressed air reservoir. The valve is to start opening at a pressure of 1N/mm^2 and must be fully open with a lift of 4 mm at a pressure 1.2 N/mm^2. Diameter of valve part is 25 mm. The permissible shearing stress in the spring steel is 48.0 N/mm^2. The spring index is 6 and $G = 8 \times 10^4$ N/mm^2. Wahl's factor **10**

$$K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$$

Design a suitable close coiled helical spring with round section (dia of wire and number of coils). The spring is to have squared ground ends for compression load.

5. (a) Name two couplings used to connect two coaxial shafts. Sketch a simple flange coupling. Give the design procedure of bolts that connect two flanges ? 6

(b) A shaft is required to transmit a power of 25 kW at 60 rpm. The force analysis due to attached parts results in B.M of 830 Nm at a section between the bearings. Calculate equivalent bending moment and equivalent torque. Find dia. of shaft using equivalent torque. Use $K_m = 1.8$ and $K_t = 1.4$, permissible shearing stress $= 40\ N/mm^2$. 8

6. (a) What advantages are offered by V - belt ? What are its disadvantages ? Draw a V - belt section and name its components. 4

(b) It is required to select a V - belt for a drive with following specifications : 10

Power transmitted = 746 W

RPM of driving sheave = 1440,

RPM of driven sheave = 482.

Pitch dia. of driving sheave = 100 mm,

pitch dia of driven sheave = 300 mm.

The power is obtained from single phase A-C motor to drive a blower. The centre distance is restricted to 220mm.

Specify belt section and length.

Use service factor $K_s = 1.1$,

centrifugal force coeff = 0.06 MPa, the permissible tensile stress in belt = 2.245 MPa.

Belt section :	A	B	C
Area of Section : (mm^2)	87.74	118.71	280

7. (a) The force P_n on a tooth of straight tooth spur gear acts on the centre line of its section at a height "a" from bottom section of the tooth. This section is having width "b" which is the face width of the teeth. Assume tooth to be a cantilever. Develop expression for stress at the bottom section of the tooth. The pressure angle of the tooth is 20°. The power transmitted is HkW. RPM of gear is N and pitch circle dia. of gear is d. 7

(b) An SKF6208Z bearing has 9 balls each of 12mm dia. The single row bearing has following dimensions. 7

Outer dia. D_o = 80mm

Inner dia. D_i = 40mm

If the bearing is required to carry a radial load F_r = 4.5 kN and an axial load of F_a = 1.8 kN, Calculate static equivalent radial load and static load capacity of the bearing.

For equivalent load, $X = 0.6$, $Y = 0.5$

For static capacity $f_0 = 49.04 \times 10^6$

8. (a) State the assumptions for calculating friction torque between two rough discs and compare r_f/r_0 and r_i/r_0 where r_f = effective radius at which frictional force acts. r_i and r_0 are respectively the inner and outer radii of the discs in contact. 6

(b) A disc clutch has one pair of friction surfaces faced with asbestos fabric lining and has to transmit 746 kW at 100 rpm. The clutch lining has coefficient of friction of 0.35 and may be subjected to a max. pressure of 0.2 N/mm^2. Outer dia. of friction lining is 1.4 times its inner dia. 8

Determine the dia. of the asbestos lining, and the necessary axial force. Design should be based on uniform wear.