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BME-024

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

00411

Term-End Examination

June, 2015

BME-024 : MECHANICAL ENGINEERING DESIGN

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **five** questions. All questions carry equal marks. Use of calculator and Design Hand Book is permitted. Assume missing data, if any.*

1. (a) Discuss the procedure of design.

   (b) Differentiate between strain energy theory and distortion energy theory.

   (c) Describe the general characteristics of fatigue fracture.

   (d) Distinguish between nominal size and basic size, allowance and tolerance, interference and clearance, with the help of a sketch. $4 \times 3\frac{1}{2} = 14$

2. (a) Distinguish between square and acme threads. Also mention the relation for pitch and various diameters. 4

(b) Design a double riveted lap joint for MS plates 10·00 mm thick. Determine the efficiency of the joint. The permissible stresses are :

σ_t = 90 MPa, τ_s = 75 MPa and

σ_c = 150 MPa. *10*

3. (a) With the help of a neat sketch, discuss the forces acting on bevel gear. *4*

(b) A shaft is supported in ball bearings which are placed 200 mm apart. The shaft carries a straight tooth spur gear of 20° pressure angle at a distance of 50 mm from right hand bearing between the supports. 4 kW of power is transmitted by the shaft at 90 rpm. The pitch circle diameter of the gear is 125 mm which receives power from a pinion placed in the same vertical plane above the gear and power is taken off from right hand through a coupling. The shaft is made in steel for which ultimate tensile strength is 700 MPa and permissible bending stresses in pulsating and reversible bending loading respectively are 110 and 65 MPa. These permissible values take care of stress concentration, size and surface finish. Find the diameter of the section where gear is fitted on shaft through a key, using both bending and torsional equivalent. *10*

4. (a) Derive the expression for frictional torque transmitted between the two plates using uniform rate of wear theory as

$$M_{if} = \frac{1}{2} \mu P (r_o - r_i).$$

where all the terms have their usual meaning. *4*

(b) A heavy duty bearing required to carry a radial load of 19 kN has the following dimensions :

$D_o = 215$, $D_i = 100$, $r_i = r_o = 18{\cdot}161$,

$D = 34{\cdot}925$, $d_i = 122{\cdot}556$, $d_o = 192{\cdot}434$ (all measurements are in mm.), $n = 8$. Calculate the basic static capacity and dynamic capacity of the bearing. *10*

5. (a) With the help of a neat sketch, describe the shoe block brake with method of applying force on shoe. *4*

(b) A single phase series wound AC motor drives a heavy blower through V-belt. The rpm of motor is 1500 while the blower rotates at 490 rpm. The pitch diameters of driving and driven sheaves are respectively 100 and 300 mm. The power of electric motor is 7500 W. The blower works continuously for 8 hours. Select V-belt and number of belts. The centre distance is 220 mm. *10*

6. A pair of gears made in medium carbon forged steel is required to transmit 24 kW with pinion moving at 900 rpm and velocity ratio being 2·807. The sum of number of teeth on pinion and gear shall be 99. The gears are to be surface hardened to hardness of 50 RC. Design the pinion and gear assuming that face width is 25 times module of the gear for medium power. Design against bending and check for surface failure. For medium carbon steel hardened on surface, take σ_u or σ_{cu} = 26 RC. *14*

7. Design a screw jack to lift 10,000 kg through a height of 200 mm. Assume σ_u = 400 MPa, τ_u = 200 MPa, σ_y = 300 MPa, p_b = 10 MPa. The outer diameter of bearing surface is 1·6 d_1 and inner diameter of bearing surface is 0·8 d_1. Coefficient of friction between collar screw and C.I. is 0·2. Coefficient of friction between steel screw and bronze nut is 0·15. Take factor of safety of 5 for screw and nut, but take a factor of safety of 4 for operating lever. *14*

8. Attempt any ***two*** of the following : *2×7=14*

(i) Discuss five heat treatment processes.

(ii) Determine the extreme diameters of shaft and hole, if the nominal diameter is 10 mm for a transition fit H7/n6. Also calculate the largest clearance and interference.

(iii) With the help of a neat sketch, describe the worm and worm wheel arrangement with various dimensions and forces acting on it.