BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

00692

Term-End Examination
December, 2011

BME-024 : MECHANICAL ENGINEERING DESIGN

Time : 3 hours *Maximum Marks : 70*

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

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1. (a) Discuss the important properties of materials that are used in design of machine elements. Define factor of safety with suitable examples. 7

(b) Mention at least two ferrous and two non ferrous materials that are used in making machines. What properties make them suitable for the application ? Which of the material can be improved by treatment ? 7

2. (a) A shaft of circular section of dia. d is subjected to (i) torque, M_t (ii) B.M, M and (iii) combination of M and M_t. Write expressions for equivalent bending moment and equivalent torque in each case. How are these expressions obtained ? 6

(b) A circular section shaft is subjected to a B.M $M = 101$ Nm and a torque, $M_t = 89$ Nm. If shaft is made up of steel of ultimate tensile strength $\sigma_u = 450\ N/mm^2$, find its diameter. You can assume that ultimate shearing strength $= \frac{1}{2}\sigma_u$. Use a factor of safety of 3. 8

3. (a) What do you understand by fatigue of materials. Draw characteristic fatigue curve and define fatigue strength. What factors affect fatigue strength. 7

(b) Calculate the effective fatigue strength of a steel shaft of 100 mm dia. The ultimate tensile strength of steel is 1000MPa. The shaft is ground finished with $K_{sf} = 1.2$. The size factor $Ks = 1.48$. There is no stress concentration ($K_f = 1$). The shaft is subjected to max. bending stress of 200 MPa and min. bending stress of 100 MPa. Use Goodman hypothesis. 7

4. For exerting a force of 55 kN when applied torque is 600 Nm a square threaded screw is used. The power end is provided with a thrust bearing. The permissible stresses in the screw are : tension and compression, 80 MPa, shear, 50M Pa respectively. The permissible pressure between steel thread and 14

cast iron nut is 13.0 MPa. The permissible shearing stress in CI is 23 MPa. The co-efficient friction between nut and screw is 0.13. Determine the dimensions of screw and nut and efficiency of the system.

Use the value from (for square threads) :

d_1	-	33	35	37
p_F	-	8	8	8
d	-	40	43	44

5. (a) Describe and show different type of welded joints. How the strength of weld joint is calculated ? In how many ways welding joints may be loaded ? **6**

(b) A steel plate of 12 mm thickness and 155 mm width is welded to another plate of same thickness in a compound weld. The plate along its length is loaded by a force, P which is equal to tensile strength of the plate, with a factor of safety of 2.5 on ultimate tensile strength. Calculate the length of the fillet weld and show the weld on diagram. Ultimate tensile strength of plate material is 400 MPa. If the load is likely to vary between $P_{min} = \frac{P}{2}$ and $P_{max} = P$, find by what amount the weld length should be increased. **8**

6. (a) Describe different arrangements of belt drive. What materials are used for flat belts ? Where would you use fabric or canvas belt ? 4

(b) Two flat pulleys of dia. 500 mm each are connected by a flat belt whose alternate tensile strength is 22 N/mm^2. The two ends are jointed in factory with efficiency of 90%. Modulus of elasticity of belt material is 125N/mm^2. The coefficient of friction between belt and pulley is 0.3. 220 mm wide belt transmits 24 kW power at pulley rpm of 250. Specific weight of belt is 9800 N/m^3. Find thickness of belt. Take a factor of safety of 3. 10

7. (a) If H kW power is transmitted by a gear of pitch circle dia of d at N rpm, show that the tangential force on gear is $19100 \frac{H}{Nd}$ newtons. Also show that the normal force between two teeth in contact is $\frac{19100}{\cos \alpha} \frac{H}{Nd}$ and radial force is $19100 \tan \alpha \frac{H}{Nd}$. α = pressure angle of gear teeth. 7

(b) A pair of gears in which pinion rotates at 950 rpm is transmitting 25 kW of power. The velocity ratio is 2.807 and sum of teeth on pinion and gear, $Z_p + Z_w = 99$. The module of teeth is 2.25 mm and ratio of face width to module is 20. Find the bending stress at the root of the tooth. Use 7

$$Y = 0.154 - \frac{1.23}{Z} + \frac{3.38}{Z^2},$$

and load concentration factor $K = 1.5$.

8. (a) Define viscosity (absolute or dynamic) of a fluid, give its units and show on a graph how does viscosity vary with temperature. What kind of bearing-journal combination was assumed by Petroff for calculation of coefficient of friction in bearing. 7

(b) A journal bearing has $L/D = 1$ and journal runs at 100 rpm. The lubricant is SAE oil operating at 40°C with $\mu = 80 \times 10^{-3}$ Pa.s. Bearing dia. is 25 mm with clearance of 0.05mm. Calculate power loss using Petroff's relation. If the speed of shaft is likely to increase by 5%, find by what amount frictional power will change. 7