Reg. No. : | | | | | | | | | | |

Question Paper Code: 31753

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

Fifth Semester

Mechanical Engineering

01UME503 – DESIGN OF MACHINE ELEMENTS

(Approved Design Data book is permitted)

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. What are the various phase of design process?
2. Differentiate between repeated stress and reversed stress.
3. Why is maximum shear stress theory used for shaft?
4. Define the term critical speed.
5. List the advantages of fine thread over course thread.
6. Name the possible modes of failure of riveted joints.
7. What is surge in springs?
8. Define the coefficient of fluctuation of energy for flywheel.
9. What is known as self-acting bearing?
10. Define the terms Radial clearance and Eccentricity ratio for hydro dynamic journal bearing.

PART - B (5 x 16 = 80 Marks)

11. (a) A cantilever beam of circular cross section is fixed at one end and subjected to completely reversed force of 10*kN* at the free end. The force is perpendicular to the axis of the beam. The distance between free and fixed ends is 100*mm*. The beam is made of steel with ultimate tensile strength of 540 *MPa*. And tensile yield strength of 320*MPa*. The construction of the cantilever is such that there is no stress concentration. The size factor, surface finish factor and reliability factor are 0.85, 0.8, and 0.868 respectively. The operating temperature is 50^0C for which the temperature factor is 1.010. If the diameter of the beam is 35*mm* determine the life of the beam. (16)

Or

(b) A pulley is keyed to a shaft midway between two bearings. The shaft is made of cold drawn steel for which the ultimate strength is 550 *MPa* and the yield strength is 400 *MPa*. The bending moment at the pulley varies from -150 *N-m* to +400 *N-m* as the torque on the shaft varies from -50 *N-m* to +150 *N-m*. Obtain the diameter of the shaft for an indefinite life. The stress concentration factors for the keyway at the pulley in bending and in torsion are 1.6 and 1.3 respectively. Take the following values: Factor of safety = 1.5; Load correction factors = 1.0 in bending, and 0.6 in torsion; Size effect factor = 0.85; Surface effect factor = 0.88. (16)

12. (a) A shaft is supported by two bearings which are 1100 *mm* apart. The shaft carries two belt pulleys *A* and *B*. The pulley *A*, of diameter 620 *mm*, is keyed at 400 *mm* to the right of left bearing and drives a pulley directly below it with the maximum belt tension of 2.75 *kN*. The pulley *B*, of diameter 400 *mm*, is keyed at 200 *mm* to the left of right bearing and is driven by an electric motor placed horizontally to the right. The angle of lap for the pulleys is 180^0 and the coefficient of friction between the belt and pulley is 0.3. The shaft is made of steel with an ultimate tensile strength of 300 N/mm^2 and tensile yield strength of 190 N/mm^2. If K_b and K_t are 3.0 and 2.5 respectively, design the shaft. (16)

Or

(b) Design a rigid type of flange coupling to connect two shafts. The input shaft transmits 37.5 *kW* power at 180 *rpm* to the output shaft through the coupling. The service factor for the application is 1.5. Select suitable material for various parts of the coupling. (16)

13. (a) A steel bolt of *M*16x2 is 300mm long carries an impact load of 5000 *Nm*. If the threads stop adjacent to the nut and $E = 2.1 \times 10^5$ *MPa*. (i) find the stress in the root area, (ii) find the stress if the shank area is reduced to root area. What can be inferred from the above? (16)

Or

(b) A cylindrical beam of size 60 *mm* is attached to support by a complete circumferential fillet weld of 6 *mm*. Find (i) torque and (ii) bending moment that can be applied if limiting shear stress is 140 *MPa*. (16)

14. (a) A rail wagon of mass 20 *tonnes* is moving with a velocity of 2 *m/s*. It is brought to rest by two bumpers with springs of 300 *mm* mean coil diameter. The maximum deflection of spring is 250*mm*. The allowable shear stress in the spring material is 600*MPa*. Design the springs for the bumpers. (16)

Or

(b) A four-stroke single cylinder gas engine runs at a constant load and delivers 25 *kW* at 300 *rpm*. The maximum fluctuation of energy per cycle may be taken as 0.65 times the useful work per cycle. Design a suitable rim flywheel of rectangular section to limit the variation of speed during the cycle to ±2% of the mean speed. The flywheel is made of cast iron. (16)

15. (a) Load on a hydrodynamic full journal bearing is 30 *kN*. The diameter and speed of the shaft are 150 *mm* and 1200 *mm* respectively. Diametral clearance 0.2 *mm*. Sommerfield number is 0.631. L/D ratio 1:1. Calculate temperature rise of oil, quantity of the oil, and amount of heat generated. (16)

Or

(b) Select a single row deep groove ball bearing for a radial load 4000*N* axial load of 5000*N*, operating at a speed of 1600*rpm*. For an average life of 5 years at 10 hours per day. Assume uniform and steady Load. (16)

———————