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

Question Paper Code: 35703

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2019

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. State Rankine's theory.
2. How will you classify machined design and explain it?
3. What types of stresses are induced in shafts?
4. Under what circumstances flexible couplings are used?
5. Name the possible modes of failure of riveted joints.
6. What is threaded joint?
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 bar of circular cross section is subjected to alternating tensile forces varying from a minimum of 200KN to a maximum of 500KN. It is to be manufactured of material with an ultimate tensile strength of 900Mpa and an endurance limit of 700Mpa. Determine the diameter of bar using safety factors of 3.5 related to ultimate tensile strength and 4 related to endurance limit and stress concentration factor of 1.65 for a fatigue load. Use Goodman straight line as basis for design. (16)

12. (a) 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)

Or

(b) Design a protective type cast iron protective flange coupling to connect two shafts in order to transmit 15 *KW* at 200 *R.P.M*. The maximum torque is 25% more than mean torque. The following permissible stresses may be used:

Permissible shear stress for shaft and key material = 40*MPa*

Permissible shear stress for bolt material = 30*MPa*

Permissible shear stress for the cast iron = 14*MPa*

Permissible crushing stress =2xPermissible shear stress. (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) Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 70 *kN*. The ultimate strength of the material of the rod against tearing is 420 N/mm^2. The ultimate tensile and shearing strength of the pin material are 510 N/mm^2 and 396 N/mm^2 respectively. Determine the tie rod section and pin section. Take factor of safety as 6. (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) Design a cast iron flywheel for a four stroke cycle engine to develop 110 kW at 150 r.p.m. The work done in the power stroke is 1.3 times the average work done during the whole cycle. Take the mean diameter of the flywheel as 3 metres. The total fluctuation of speed is limited to 5 per cent of the mean speed. The material density is 7250 kg / m^3. The permissible shear stress for the shaft material is 40 MPa and flexural stress for the arms of the flywheel is 20 MPa. (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)

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