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

Question Paper Code: 35703

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 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. 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. State three conditions where tap bolts are used.
6. What is threaded joint?
7. What is nipping in a leaf spring?
8. What is surge in springs?
9. What is known as self-acting bearing?
10. Define connecting rod.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) A cast iron pulley transmits 10 *kW* at 400 *rpm*. The diameter of the pulley is 1.2*m* and it has four straight arms of elliptical cross-section, in which the major axis is twice the minor axis. Determine the dimensions of the arm if the allowable bending stress is 15 *MPa*. (8)

(ii) An unknown weights falls through 10*mm* onto a collar which is rigidly attached to the lower end of a vertical bar 3*m* long and 600 mm^2 cross section. The maximum instantaneous extension is 2*mm*. What is the corresponding stress and the value of the weight? Take $E = 200\ kN/mm^2$. (8)

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) 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 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) Design a cotter joint to connect two mild steel rods for a pull of 30 kN. The maximum permissible stresses are 55 MPa in tension ; 40 MPa in shear and 70 MPa in crushing. Draw a neat sketch of the joint designed. (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) Design a close coiled helical compression spring for a service load ranging from 2250 *N* to 2750 *N*. The axial deflection of the spring for the load range is 6 *mm*. Assume a spring index of 5. The permissible shear stress intensity is 420 *MPa* and modulus of rigidity, $G = 84\ kN/mm^2$. Neglect the effect of stress concentration. Draw a fully dimensioned sketch of the spring, showing details of the finish of the end coils. (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) A single row deep groove ball bearing operating at 2000 r.p.m. is acted by a 10 kN radial load and 8 kN thrust load. The bearing is subjected to a light shock load and the outer ring is rotating. Determine the rating life of the bearing. (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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