Code: 9A14503 R09

B.Tech III Year I Semester (R09) Supplementary Examinations, May 2013

PRINCIPLES OF MACHINE DESIGN

(Mechatronics)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) Enumerate the most commonly used engineering materials and state at least one important property and one applications of each.

(b) A cylindrical shaft made of steel of yield strength 700 MPa is subjected to static loads consisting of bending moment 10 kN-m and a torsional moment 30 kN-m. Determine the diameter of the shaft using two different theories of failure and assuming a factor of safety of 2. Take E = 210 GPa and Poisson's ratio = 0.25.

2 (a) What are the methods of reducing stress concentration?

(b) A shaft of 600 mm length is simply supported at its ends. It is subjected to a central concentrated cyclic load that varies from 20 to 40 kN. Determine the diameter of the shaft by taking a factor of safety of 2, size correction factor of 0.8, and surface correction factor of 0.9. The material properties are ultimate strength = 600 MPa, yield strength = 350 MPa and endurance limit = 300 MPa. Fatigue stress concentration factor = 1.5.

3 (a) When the fillet weld is called as transverse fillet weld and parallel fillet weld? Explain.

(b) Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm^2. Assume joint efficiency as 75%, allowable tensile stress in the plate 90 MPa, compressive stress 140 MPa, and shear stress in the rivet 56 MPa.

4 (a) Define equivalent torsional moment and equivalent bending moment. State when these two terms are used in the design of the shafts.

(b) A line shaft is driven by means of a motor a motor placed vertically below it. The pulley on the line shaft is 1.5 meter in diameter and has belt tensions 5.4 kN and 1.8 kN on the light side and slack side of the belt respectively. Both these tensions may be assumed to be vertical. If the pulley is overhang from the shaft, the distance of the centre line of the pulley from the centre line of the bearing being 400 mm, find the diameter of the shaft. Assuming maximum allowable shear stress of 42 MPa.

5 (a) Explain one method of avoiding the tendency of a compression spring to buckle.

(b) A helical tension spring is used in the spring balance to measure the weights. One end of the spring is attached to the rigid support while the other end, which is free, carries the weights to be measured. The maximum weight attached to the spring balance is 1500 N and the length of the scale should be approximately 100 mm. The spring index can be taken as 6. The spring is made of oil-hardend and tempered steel wire with ultimate tensile strength of 1360 N/mm^2 and modulus of rigidity of 81370 N/mm^2. The permissible shear stress in the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate: (i) Wire diameter (ii) Mean coil diameter (iii) Number of active coils (iv) Required spring rate and (v) Actual spring rate.

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6 (a) Explain with help of neat sketches, the type of various flat belt drives.

(b) A crossed belt drive is to transmit 10 KW at 1200 rpm of the smaller pulley which is 250 mm is diameter. The velocity ratio is 2 and centre distance is 1.2 m. It is desired to use a 6 mm thick leather belt with coefficient of friction equal to 0.25. It the permissible stress for the belt material is 2 N/mm^2, determine the width of the belt. Take the mass density of the belt material as 1000 kg/m^3.

7 (a) How the gears are classified and what are the various terms used in spar gear terminology?

(b) The following particulars of single reduction spar gear are given. Gear ratio = 10:1, distance between the centers = 660 mm approximately; pinion transmits 500 KW at 1800 rpm; involute teeth of standard proportions (addendum = m) with pressure angle of 22.5; permissible normal pressure between teeth = 175 N per mm of width. Find:
(i) The nearest standard module if no interference is to occur.
(ii) The number of teeth on each wheel.
(iii) The necessary width of the pinion and
(iv) The load on the bearings of the wheels due to power transmitted.

8 (a) Differentiate between hydrodynamic and hydrostatic lubrications.

(b) The following data is given for a 360 hydrodynamic bearing: radial load = 10 kN, journal speed = 1440 rpm, unit bearing pressure = 1000 KPa, clearance ratio (r/c) = 800, viscosity of lubricant = 30 m Pas. Assuming that the total heat generated on the bearing is carried by the total oil flow in the bearing, calculate:
(i) Dimensions of bearing.
(ii) Coefficient of friction.
(iii) Power lost in friction.
(iv) Total flow of oil.
(v) Side leakage and
(vi) Temperature rise.

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