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B. E. (Sixth Semester) Examination April-May 2020

(New Scheme)

(Mech. Engg. Branch)

MACHINE DESIGN-II

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *Part (a) is compulsory and carries 2 marks. Solve any two from (b), (c) and (d) for 7 marks else any one of (b) and (c) for 14 marks.*

Unit-I

1. (a) Classify Springs. 2

(b) 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 84 kN/mm^2. Neglect the effect of stress concentration. Draw fully dimensioned sketch of the spring. 7

(c) A helical compression spring is made of circular wire, is subjected to an axial force that varies from 2.5 kN to 3.5 kN. The deflection of the spring over this range of the load is approx 5 mm. The spring index can be taken as 5. The spring has square and ground ends. The spring is made of patented and cold drawn steel wire with S_{ut} = 1050 N/mm^2 and modulus of rigidity of 81370 N/mm^2. The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring.

(d) Derive the relation for Nipping of leaf spring. A semi-elliptical leaf spring consists of two extra full-length leaves and ten graduated length leaves

including the master leaf. The centre-to-centre distance between the two eyes of spring is 1.2 m. The leaves are made of steel 55 Si 2 Mo 90 (S_{yt} = 1500 N/mm^2 and E = 207000 N/mm^2) and the factor of safety is 2.5. The spring is to be designed for a maximum force of 30 kN. The leaves are prestressed so as to equalize stresses in all leaves. Determine cross section of the spring and deflection at the end of spring. 7

Unit-II

2. (a) Explain the pitting failure in gear drive. 2

(b) Design a pair of spur gears to transmit 20 kW at a pinion speed of 1440 rpm. The transmission ratio is 4. Material for pinion and gear are 15 Ni 2 Cr 1 Mo 15 and C 45 respectively. 14

(c) Design a pair of spur gears with 20° full depth involute teeth consisting of a 20 teeth pinion meshing with a 50 teeth gear. The pinion shaft is connected to a 22.5 kW, 1450 rpm electric motor. The starting torque of the motor can be taken as 150%

of the rated torque. The material for the pinion is plain carbon steel Fe410 (S_{ut} = 410 N/mm^2) while the gear is made of FG200 (S_{ut} = 200 N/mm^2). The factor of safety is 1.5. Design the gear based on Lewis equation. 14

Unit-III

3. (a) Find the relation among axial force, tangential force and radial force of a helical gear. 2

(b) Design a pair of helical gears to transmit 10 kW at 1000 rpm of the pinion. Reduction ratio of 5 is required. Helix angle 15° and both gears are made of 40 Ni 2 Cr 1 Mo 28 steel. Give details of the drive in a tabular form. 7

(c) Design a pair of helical gears to transmit 38 kW at 1500 rpm of the pinion. Take speed reduction to be 5 and helix angle to be 15 degrees. 7

(d) A pair of bevel gear connects two shafts at right angles. The pitch diameters of pinion and gear are 80 mm and 100 mm respectively. The profiles of the gears 14.5°. Allowable static stress for both

gears 55 MPa. Pinion transmits 2.75 kW at 1100 rpm. Find module and no. of teeth on each gear from the strength and modulus of elasticity for cast iron 84 GN/mm^2. 7

Unit-IV

4. (a) What is hydrodynamic lubrication? 2

(b) A single row deep groove ball bearing no. 6002 is subjected to an axial thrust of 1000 N and a radial load of 2200 N. Find the expected life that 50% of the bearing will complete under this condition. 7

(c) The following data are for a 360° hydrodynamic bearing :

(i) Radial load = 12 kN

(ii) Journal speed = 1440 rpm

(iii) Unit bearing pressure = 1000 kPa

(iv) Clearance ratio (r/c) = 800

(v) Viscosity of lubricant = 30 m PaS

Assuming that the total heat generated in the bearing

is carried by the oil flow in the bearing. Calculate :

(i) Dimensions of bearing

(ii) Coefficient of friction

(iii) Power lost in friction 7

(d) A bearing 0.05 m in diameter and 0.075 m in length supports a shaft running at 900 rpm. The room temperature at 32°C and the bearing temperature is 82°C. The viscosity of the oil used is 0.0128 kg/ms at the operating temperature of 132°C. The diametral clearance is 0.05 mm and the bearing is to operate in still air without any artificial cooling. Determine :

(i) The permissible load on the bearing

(ii) Power loss 7

Unit-V

5. (a) Classify the drives. 2

(b) Design a roller chain drive to connect a 15 kW 1500 rpm electric motor to a centrifugal pump running at 750 rpm. The conditions of operation

are constant load, fixed centre distance, continuous lubrication, continuous running. 7

(c) A compressor is to be activated from 10 kW electric motor. The speed of motor shaft is 970 rpm and that of the compressor is 330 rpm. The compressor operates is two shifts. The minimum centre distance is 550 mm. 7

(d) A 30 kW, 1000 rpm motor transmits power to a stone-crushing machine, which operates at 250 rpm. Select a suitable the flat belt. 7