367653(37)

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

(New Scheme)

(Mechatronics Branch)

MACHINE DESIGN-II

Time Allowed : Four hours

Maximum Marks : 80

Minimum Pass Marks : 28

*Note : Part (a) is compulsory and solve any **one** from (b) and (c). Use of design data book is permitted. Use suitable data if missing.*

Unit-I

1. (a)   What is nipping in a spring? Discuss its role.   2

(b) A semi-elliptic multi-leaf spring is used for the suspension of the rear axle of a truck. It consists of two extra full-length leaves and ten graduated-length leaves including the master leaf. The centre to centre distance between the spring eyes is 1.2 m. The leaves are made of steel 55Si2Mo90 (S_{yt} = 1500 N/mm^2 and E = 20700 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 pre-stressed so as to equalize stresses in all leaves. Determine :

(i) the cross-section of leaves; and

(ii) the deflection at the end of the spring   14

(c) An automotive engine develops maximum torque at a speed of 1000 rpm. At this speed the power developed by engine is 25 kW. The engine is equipped with a single plate clutch having two pairs of friction surfaces. The mean diameter of the friction discs is 190 mm and the coefficient of friction is 0.35. Six springs with a spring index of 6. Provide the necessary axial force. The springs are made of patented and cold drawn steel wires

of Grade 2 (G = 81370 N/mm^2). The permissible shear stress can be taken as the 50% of the ultimate tensile strength. Determine the wire diameter of the spring.   14

Unit-II

2. (a) What is interference in gears? How can you overcome it?   2

(b) A pair of spur gear with 20° pressure angle consists of a 25 teeth pinion meshing with a 60 teeth gear. The module is 5 mm while the face width is 45. The pinion rotates at 500 r.p.m. The gears are made of steel and heat treated to a surface hardness of 220 BHN. Assume that dynamic load is accounted by means of the velocity factor. The service factor and the factor of safety are 1.75 and 2 respectively. Calculate :

(i) wear strength of gears;

(ii) the static load that the gears can transmit without pitting; and

(iii) rated power that can be transmitted by gears.   14

(c) Design a pair of spur gears to transmit 20 hp at a pinion speed of 1500 rpm. Transmission ratio is to be 3. Select proper materials for the drive. 14

Unit-III

3. (a) How the helix angle differentiate helical gear from spur gears? 2

(b) A pair of parallel helical gears consists of 24 teeth pinion rotating at 10,000 r.p.m. and supplying 2.5 kW power to a gear. The speed reduction is 4:1. The normal pressure angle and helix angle are 20° and 23° respectively. Both gears are made of hardened steel (S_{ut} = 600 N/mm^2). The service factor and the factor of safety are 1.5 and 2 respectively. The gears are finished to meet the accuracy of Grade 6. (1) Taking face width ten times the normal module and assuming the pitch line velocity to be 10 m/s estimate the normal module. (2) Determine the dynamic load using 'Spotts' equation and find out the effective load for the above dimensions. What is the corrected factor of safety for bending (3) Specify surface

hardness for the gears assuming a factor of safety of 2 for wear consideration. 14

(c) Design a bevel gear drive to transmit 7 kW at 1600 rpm for the following data : Gear ratio = 3, material for pinion and gear = C45 steel life = 10,000 hours. 14

Unit-IV

4. (a) Why is rolling contact bearing called as anti-friction bearings? 2

(b) A single-row deep groove ball bearing has a dynamic load capacity of 40500 N and operates on the following work cycle :

(i) radial load of 500 N at 500 r.p.m. for 25% of the time;

(ii) radial load of 1000 N at 700 r.p.m. For 50% of the time; and

(iii) radial load of 7000 N at 400 r.p.m. for the remaining 25% of the time.

Calculate the life of the bearing in hours. 14

(c) The following data is given for a 360° hydrodynamic bearing : radial load 3.2 kN journal speed = 1490 r.p.m. Journal diameter = 50 mm bearing length 50 mm radial clearance = 0.05 mm viscosity of lubricant = 25 cP. Assuming that the total heat generated in the bearing is carried by the total oil flow in the bearing. Calculate :

(i) the coefficient of friction;

(ii) power lost in friction;

(iii) minimum oil film thickness;

(iv) flow requirement in 1/min; and

(v) temperature rise. 14

Unit-V

5. (a) What is Creep? How does it affect the design of a belt drive? 2

(b) A V-belt drive is required for a 15 kW, 1440 r.p.m. electric motor, which drives a centrifugal pump running at 360 for a service of 24 hour per

day. From space consideration, the centre distance should be approximately 1 m.

Determine :

(i) belt specification

(ii) number of belts

(iii) correct centre distance, and

(iv) pulley diameters. 14

(c) A stone crushing machine receives power from a motor rated at 50 kW at 1800 rpm by means of flat belts. The pulley diameters are 200 mm and 700 mm. Centre distance between the two pulleys is 4000 mm. Design the belt drive if the direction of rotation of two pulleys are opposite to each other. 14