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**337651(37)**

**B. E. (Sixth Semester) Examination April-May 2021**

**(New Scheme)**

**(Mech. Engg. Branch)**

**MACHINE DESIGN-II**

***Time Allowed : Four hours***

***Maximum Marks : 80***

***Minimum Pass Marks : 28***

***Note : Solve all questions. In each question, parts (a) and (b) are compulsory and solve any one part from (c) and (d). Assume suitable data if required. Use of design data book is permitted.***

**Unit-I**

1. (a) What is surging of springs? How the surge in springs may be eliminated?

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- (b) Prove that in a leaf spring assembly, the stresses in full length leaves are 50% greater than the stresses in graduated leaves. 4
- (c) A helical compression spring made of oil tempered carbon steel, is subjected to a load which varies from 400 N to 1000 N. The spring index is 6 and the design factor of safety is 1.25. If the yield stress in shear is 770 MPa and endurance stress in shear is 350 MPa, find :
- Size of the spring wire,
  - Diameter of the spring,
  - Number of turns of the spring, and
  - Free length of the spring.

The compression of the spring at the maximum load is 30 mm. The modulus of rigidity for the spring material may be taken as 80 kN/mm<sup>2</sup>. 10

- (d) A semi-elliptical laminated vehicle spring is to be designed to carry a load of 6 kN. It consists of seven leaves of 65 mm width of which two leaves are of full length. The overall length of the spring is 1100 mm, while it is attached to the axle by two U-

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bolts, 80 mm apart. The U-bolts hold the central portion of the spring so rigidly that they may be considered equivalent to a band having a width equal to the distance between the bolts. If the permissible bending stress for spring material is 350 MPa, determine :

- Thickness of leaves,
- Deflection of spring,
- Length of leaves, and
- Radius to which leaves should be initially bent. 10

### Unit-II

2. (a) State the standard gear tooth systems which is most widely used in tooth system? 2
- (b) Explain the following terms with reference to gears :
- Beam strength
  - Wear strength
  - Effective load
  - Dynamic load 4

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(c) Derive the Lewis equation for beam strength of a spur gear tooth. State the assumptions made. 10

(d) The following data is given for a spur gear pair made of steel and manufactured by shaping :

Module = 8 mm ;

Centre distance = 380 mm ;

Permissible bending stress for pinion and gear = 60 N/mm<sup>2</sup> ;

Pinion speed = 1500 rpm ;

Gear speed = 450 rpm ;

Face width = 10 × Module ;

Tooth system = 20° full-depth involute ;

Load application factor (or service factor) = 1.5 ;

Factor of safety = 2.0.

Assuming the velocity factor accounts for the dynamic load, calculate the rated power that the gear pair can transmit. Also suggest the surface hardness required. 10

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### Unit-III

3. (a) Define formative or virtual number of teeth on a helical gear. Write the expressions for virtual number of teeth in helical and bevel gears. 2

(b) A pair of straight bevel gears consists of 24 teeth pinion meshing with 40 teeth gear. The module at the large end of the teeth is 5 mm, while the face width is 40 mm. If the axes of the connecting shafts are at right angles to each other, calculate :

(i) the pitch cone distance,

(ii) the pitch cone angles of the pinion and gear,

(iii) the mean radii of the pinion and gear, and

(iv) the back cone radii of the pinion and gear. 4

(c) The following data is given for a pair of helical gears made of steel :

Normal module = 5 mm ;

Face width = 50 mm ;

No. of pinion teeth = 30 ;

No. of gear teeth = 60 ;

Centre distance = 245 mm ;

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Normal pressure angle =  $20^\circ$  ;

Pinion speed = 1000 rpm ;

Permissible bending stress for pinion and gear material =  $150 \text{ N/mm}^2$  ;

Surface hardness = 300 BHN ;

Factor of safety = 2 ;

Service factor = 1.5 ;

Grade of machining = 8.

Determine :

- (i) The helix angle,
- (ii) The beam strength,
- (iii) The wear strength,
- (iv) The maximum static load the gears can transmit, and
- (v) The power transmitting capacity.

Assume velocity factor

$$C_v = \sqrt{\frac{5.6}{5.6 + \sqrt{V}}} \text{ accounts for dynamic}$$

load.

10

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- (d) Derive an expression for beam strength of straight bevel gear tooth. 10

#### Unit-IV

4. (a) What are the types of loads to which the rolling contact bearings are subjected? How rolling contact bearings are designated? 2
- (b) What do you understand by hydrodynamic lubrication? With neat sketch, explain the mechanism of oil-film development in hydrodynamic journal bearings. 4
- (c) A single row deep groove ball bearing is subjected to the work cycle given below :

Fraction of cycle	Radial Load (N)	Thrust Load (N)	Speed (rpm)	Service factor
1/10	2000	1200	400	3.0
1/10	1500	1000	500	1.5
1/5	1000	1500	600	2.0
3/5	1200	2000	800	1.0

If the desired rating life is 15000 hours, select the bearing for a shaft diameter of 75 mm.

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Assume radial and axial load factors to be 1.0 and 1.5 respectively and inner race rotates. 10

(d) The following data is given for a 360° hydrodynamic journal bearing :

Radial load = 10 kN ;

Journal speed = 1450 rpm ;

L/D ratio = 1 ;

Bearing Length = 50 mm ;

Radial clearance = 20 microns ;

Eccentricity = 15 microns ;

Specific gravity of lubricant = 0.86 ;

Specific heat of lubricant = 2.09 kJ/kg°C.

Calculate :

- (i) the minimum oil film thickness ;
- (ii) the coefficient of friction ;
- (iii) the power lost in friction ;
- (iv) the viscosity of lubricant in CP ;
- (v) the total flow rate of lubricant in l/min ;
- (vi) the side leakage, and
- (vii) the average temperature, if make up oil is supplied at 30° C. 10

**Unit-V**

- 5. (a) What are the advantages and disadvantages of V-belt drive over flat belt drive? 2
- (b) Explain how the roller chains are designated. What do you understand by simplex, duplex and triplex chains? Define factor of safety for chain in a chain drive. What is a silent chain? 4
- (c) Design a chain drive to run a blower at 600 rpm. The power to the blower is available from a 8 kW motor at 1500 rpm. The centre distance is to be kept at 800 mm. 10
- (d) A flat belt drive is to be used to drive a reciprocating compressor running at 720 rpm by a 15 kW, 1440 rpm electric motor. The required centre distance is 2 m.  
Select the flat belt for the drive from the manufacturer's catalogue. 10