

Printed Pages – 8

Roll No. : .....

**337651(37)**

**B. E. (Sixth Semester) Examination Nov.-Dec., 2021**

**(New Scheme)**

**(Mech. Engg. Branch)**

**MACHINE DESIGN-II**

***Time Allowed : Three hours***

***Maximum Marks : 80***

***Minimum Pass Marks : 28***

***Note : Part (a) of each question is compulsory.  
Attempt any two parts from (b), (c) and (d)  
part of the question. Design data book is  
permitted. Assume missing data if any.***

**Unit-I**

1. (a) Differentiate closed and open coiled helical spring? 2

[ 2 ]

- (b) Design a closed coiled helical compression spring for the load range is 6 mm, assume a spring index of 5. The permissible shear stress is 420 MPa and modulus of rigidity is 84 kN/mm<sup>2</sup>, neglect the effect of stress concentration. 7
- (c) Design the leaf spring for the following specification: total load = 140 kN; number of spring supported the load = 4; Max. Number of leaves = 10; Span of the spring = 1000 mm; permissible deflection = 80 mm. the young modulus = 200 kN/mm<sup>2</sup> and allowable stress in spring material as 600 MPa. 7
- (d) A truck spring has 12 numbers of leaves, two of which are full length leaves. The spring supports are 1.05 m apart and the central band is to be 5.4 kN with a permissible stress of 280 MPa. Determine the thickness and width of the steel spring leaves. The ratio of the total depth to the width of spring is 3. Also determine the deflection of spring. 7

### Unit-II

337651(37)

[ 3 ]

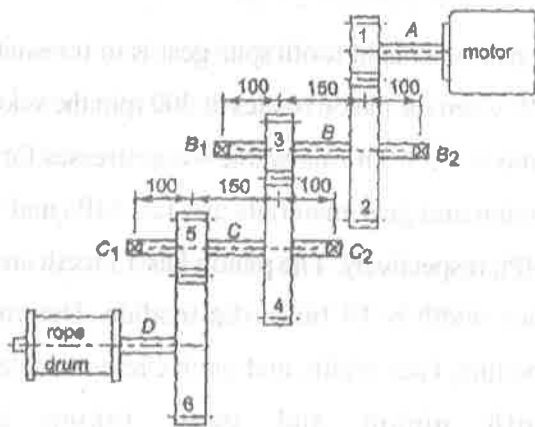
2. (a) Why involute teeth are preferred over cycloidal teeth? 2
- (b) A pair of straight tooth spur gears, having 20 degree involute full depth teeth is to transmit is to transmit 12 kW at 300 rpm of the pinion. The speed ratio is 3: 1. The allowable static stresses for gear of cast iron and pinion of steel are 60 MPa and 105 MPa respectively. Assume the number of teeth of pinion = 16; face width = 14 times module. Determine the module, face width and pitch diameter of gears. Given allowable stress 600 MPa,  $E_p = 200 \text{ kN/mm}^2$  and  $E_g = 100 \text{ kN/mm}^2$ . 7
- (c) A pair of straight tooth spur gear is to transmit 20 kW when the pinion rotates at 300 rpm the velocity ratio is 1 : 3. The allowable static stresses for the pinion and gear materials are 120 MPa and 100 MPa respectively. The pinion has 15 teeth and its face width is 14 times the module. Determine module; Face width, and pitch circle diameter of both pinion and gear, taking into consideration the effect of the dynamic loading. 7

337651(37)

PTO

[ 4 ]

- (d) A train of gears transmitting power from a 10 kW, 1440 rpm motor to a rope drum. The number of teeth on various gears is as follows-  $Z_1 = 20$ ,  $Z_2 = 100$ ,  $Z_3 = 25$ ,  $Z_4 = 150$ ,  $Z_5 = 25$ ,  $Z_6 = 150$ . The module of gears 1 & 2 is 5 mm and that of all the gears is 6 mm. Calculate :
- Torque acting on shafts A, B, C and D.
  - Tangential and radial components of tooth forces between gears 1 & 2, gears 3 & 4 and gears 5 & 6.
  - Resultant reactions at bearing B1 & B2.
  - Resultant reactions at bearings C1 & C2.



337651(37)

[ 5 ]

### Unit-III

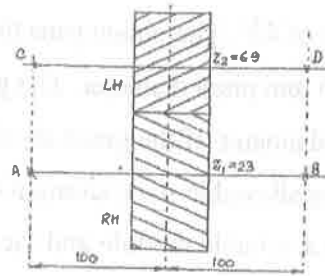
- Discuss the classification of helical gears. 2
  - A pair of helical gear is to transmit 15 kW. The teeth are  $20^\circ$  stub in diametral plane and having helix angle of  $45^\circ$ . The pinion runs at 10000 rpm and has 80 mm pitch diameter. The gear has 320 mm pitch diameter. If the gears are made of cast steel having allowable static strength of 100 MPa; determine a suitable module and face width. 7
  - A pair of cast iron bevel gears connects two shafts at right angles. The pitch diameters of the pinion and gear are 80 mm and 100 mm respectively. The tooth profiles of the gears of  $14\frac{1}{2}^\circ$  composite form. The allowable static stress for both the gears is 55 MPa. If the pinion transmits 2.75 kW at 1100 rpm, find the module and number of teeth on each gear from the stand point of strength and check the design from the standpoint of wear. Take surface endurance limit as 630 MPa and modulus of elasticity for cast iron as  $84 \text{ kN/mm}^2$ . 7
  - A right hand 23 tooth pinion transmits 4 kW at

337651(37)

PTO

[ 6 ]

1440 rpm. The normal pressure angle and helix angle are  $20^\circ$  and  $15^\circ$  respectively. The normal module is 4. Determine the bearing reactions at C and D.



#### Unit-IV

4. (a) Define static and dynamic load carrying capacity of a bearing?

2

(b) Design a journal bearing for a centrifugal pump from the following data:

Load on the journal = 20000 N; Speed of the journal = 900 rpm; Type of oil is SAE 10, for which the absolute viscosity at 55 degree centigrade = 0.017 kg / m-s; Ambient temperature of oil  $15.5^\circ\text{C}$ ; Maximum pressure for the pump =  $1.5 \text{ N/mm}^2$ . Calculate also mass of the lubricating oil

337651(37)

[ 7 ]

required for artificial cooling, if rise of temperature of oil be limited to  $10^\circ\text{C}$ . Heat dissipation coefficient =  $1232 \text{ W/m}^2/\text{C}$ .

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(c) Select a single row deep groove ball bearing for a radial load of 4000 N and an 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.

7

(d) A single-row deep groove ball bearing is subjected to a 30 second work cycle that consists of the following two parts: Part I Part II duration (s) 10 20 radial load (kN) 45 15 axial load (kN) 12.5 6.25 speed (rpm) 720 1440 The static and dynamic load capacities of the ball bearing are 50 and 68 kN respectively. Calculate the expected life of the bearing in hours.

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#### Unit-V

5. (a) What is B4430 Lp designation of V-belt?

2

(b) A simple chain 08B is used to transmit power from a transmission shaft running at 200 rpm to

337651(37)

PTO

another shaft running at 100 rpm. There are 19 teeth in the driving sprocket and the operation is smooth without any shocks. Calculate the power transmitting capacity of the chain drive. 7

(c) It is required to select a flat belt drive for a compressor running at 720 rpm, which is driven by a 25 kW, 1440 rpm motor. Space is available for a centre distance of 3 m. The belt is open-type. 7

(d) A belt drive consists of two V belts in parallel on grooved pulleys of the same size. The angle of groove is 30 degree the cross sectional area of each belt is 750 mm square and coefficient of friction is 0.12. The density of the belt material is 1.2 milligram per metre<sup>3</sup> and the maximum safe stresses is 7 MPa. Calculate the power that can be transmitted between pulleys of 300 mm diameter rotating at 1500 RPM. Find also the shaft speed in RPM at which the power transmitted would be a maximum. 7