Total No. of Questions : 12]

SEAT No. :

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[Total No. of Pages : 5

[4758]-14

T.E. (Mechanical / Automobile Engg.)

THEORY OF MACHINES - II

(2008 Course) (Semester - I) (302043)

Time : 3 Hours] *[Max. Marks :100*

Instructions to the candidates:

1) ***Answer to the two sections should be written in separate answer books.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Derive from first principles an expression for the friction moment of a flat collar bearing assuming **[6]**

i) Uniform pressure, and

ii) Uniform wear.

b) A dry single plate clutch is to be designed for an automotive vehicle whose engine is rated to give 110 kW at 2500 r.p.m. and maximum torque 600 N-m. The outer radius of friction plate is 25% more than the inner radius. The intensity of pressure between the plate is not to exceed 0.07 N/mm^2. The coefficient of friction may be assumed equal to 0.3. The helical springs required by this clutch to provide axial force necessary to engage the clutch are eight. If each spring has stiffness equal to 40 N/mm, determine the initial compression in the springs and dimensions of the friction plate. **[12]**

OR

Q2) a) Explain belt torsion dynamometer with neat sketch. **[6]**

P.T.O.

b) A band and block brake, having 14 blocks each of which subtends an angle of 15° at the center, is applied to a drum of 1 m effective diameter. The drum and flywheel mounted on the same shaft has a mass of 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 30 mm and 120 mm from the fulcrum. If a force of 200 N is applied at a distance of 750 mm from the fulcrum, find: **[12]**

i) Maximum braking torque,

ii) Angular retardation of the drum, and

iii) Time taken by the system to come to rest from the rated speed of 360 r.p.m. The coefficient of friction between blocks and drum may be taken as 0.25.

Q3) The following data relate to a cam operating an oscillating roller follower: - Minimum radius of cam =30 mm, Radius of roller = 10 mm, Length of follower arm = 45 mm, Distance of fulcrum centre from cam centre = 55 mm, Angle of ascent = 90°, Angle of descent = 120°, Angle of dwell between ascent and descent = 60°, Angle of oscillation of follower = 30°. Draw profile of the cam if the follower moves with SHM and returns with uniform acceleration and retardation. **[16]**

OR

Q4) a) What do you mean by Advanced Cam Curves? Explain 4-5-6 polynomial curve. **[6]**

b) Derive expressions for displacement, velocity and acceleration for circular arc cam operating a flat faced follower, when the contact is on the nose. **[10]**

Q5) a) Explain the following terms with neat sketch: **[6]**

i) Precession in Gyroscope,

ii) Reactive Gyroscopic couple,

iii) Axis of spin,

iv) Axis of couple.

b) An aeroplane makes a complete half circle of 50 metres radius, towards left, when flying at 200 km per hr. The rotary engine and the propeller of the plane has a mass of 400 kg and a radius of gyration of 0.3 m. The engine rotates at 2400 r.p.m. clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it. **[10]**

OR

Q6) a) State the different types of governors. What is the difference between centrifugal and inertia type governors? Why is the former preferred to the latter? **[8]**

b) The arms of a Porter governor are 300 mm long. The upper arms are pivoted on the axis of rotation. The lower arms are attached to a sleeve at a distance of 40 mm from the axis of rotation. The mass of the load on the sleeve is 70 kg and the mass of each ball is 10 kg. Determine the equilibrium speed when the radius of rotation of the balls is 200 mm. If the friction is equivalent to a load of 20 N at the sleeve, what will be the range of speed for this position? **[8]**

SECTION - II

Q7) a) What do you understand by the term 'interference' as applied to gears? **[6]**

b) Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth are of involute form; module = 6 mm, addendum = one module, pressure angle = 20^{o}. The pinion rotates at 90 r.p.m. Determine:

i) The number of teeth on the pinion to avoid interference on it and the corresponding number of teeth on the wheel,

ii) The length of path and arc of contact,

iii) The number of pairs of teeth in contact, and

iv) The maximum velocity of sliding.

[10]

OR

Q8) a) Derive an expression for minimum number of teeth on a gear wheel when it is to mesh with a pinion for involute tooth profile. **[8]**

b) A pinion of 20 involute teeth and 125 mm pitch circle diameter drives a rack. The addendum of both pinion and rack is 6.25 mm. What is the least pressure angle which can be used to avoid interference? With this pressure angle, find the length of the arc of contact and the minimum number of teeth in contact at a time. **[8]**

Q9) a) Derive an expression for maximum efficiency in case of spiral gears in terms of spiral angle and angle of friction. **[6]**

b) In a spiral gear drive connecting two shafts, the approximate center distance is 400 mm and the speed ratio = 3. The angle between the two shafts is 50^{o} and the normal pitch is 18 mm. The spiral angle for the driving and driven wheels are equal. Find: **[10]**

i) Number of teeth on each wheel,

ii) Exact center distance, and

iii) Efficiency of the drive, if friction angle = 6^{o}.

OR

Q10)a) A two start worm rotating at 800 rpm drives a 26 teeth worm gear. The worm has a pitch diameter of 54 mm and pitch of 18 mm. If coefficient of friction is 0.06, Find: **[8]**

i) The helix angle of the worm.

ii) The speed of the worm gear.

iii) Centre distance.

iv) The lead angle for maximum efficiency.

v) The efficiency and maximum efficiency.

b) A pair of straight bevel gears has velocity ratio 3:1. The pitch circle diameter of pinion is 100 mm at large end of the tooth. A 7.5 kW power is supplied to the pinion which rotates at 1000 rpm. The face width is 30 mm and pressure angle is 20^{o}. Calculate the tangential, radial and axial components of the resultant tooth force acting on pinion. **[8]**

Q11)a) Explain briefly the differences between simple, compound, and epicyclic gear trains. What are the special advantages of epicyclic gear trains? **[8]**

b) In the epicyclic gear train, as shown in Fig. 1, the driving gear A rotating in clockwise direction has 14 teeth and the fixed annular gear C has 100 teeth. The ratio of teeth in gears E and D is 98: 41. If 1.85 kW is supplied to the gear A rotating at 1200 r.p.m., find: **[10]**

i) The speed and direction of rotation of gear E, and

ii) The fixing torque required at C, assuming 100 percent efficiency throughout and that all teeth have the same pitch.

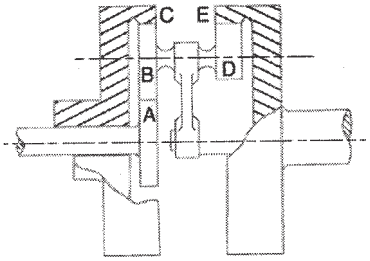

Figure 1

OR

Q12)a) Explain the inertia of geared system. **[6]**

b) In a gear train, as shown in Fig. 13.23, gear B is connected to the input shaft and gear F is connected to the output shaft. The arm A carrying the compound wheels D and E, turns freely on the output shaft. If the input speed is 1000 r.p.m. counter- clockwise when seen from the right, determine the speed of the output shaft under the following conditions: **[12]**

i) When gear C is fixed, and

ii) When gear C is rotated at 10 r.p.m. counter clockwise.

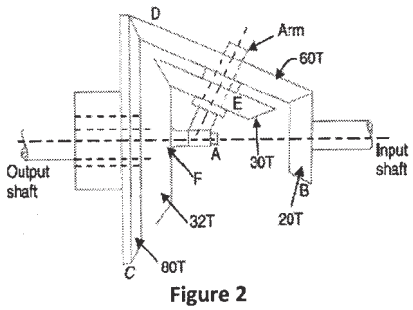

Figure 2

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