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10AE53

Fifth Semester B.E. Degree Examination, June/July 2018
Dynamics of Machines

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What are free body diagrams of a mechanism? How they are helpful in finding various forces acting on the various members of the mechanism? Explain with an example. **(08 Marks)**

b. A four bar mechanism with the following dimensions are acted upon by a force 80 N at 150° as shown in Fig. Q1 (b), AD = 50 mm, AB = 40 mm, BC = 100 mm, DC = 75 mm, DE = 35 mm. Determine the input torque T on the link AB for the static equilibrium of the mechanism for the given configuration. Also determine all constraint forces. **(12 Marks)**

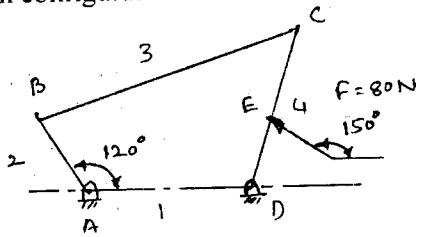

Fig. Q1 (b)

2 a. Derive the relation for the coefficient of fluctuation of speed in terms of maximum fluctuation of energy and kinetic energy of the fly wheel at mean speed. **(08 Marks)**

b. In a machine the intermittent operation demands the torque to be applied as follows. During the first half revolution the torque increases uniformly from 800 N-m to 3000 N-m. During the next one revolution the torque remains constant. During next one revolution torque decreases uniformly from 3000 N-m to 800 N-m. During last half revoltion the torque remains constant. Thus the cycle is completed in four revolutions. The motor to which the machine is coupled exerts constant torque at a mean speed of 250 rpm. A fly wheel of mass 1800 kg and radius of gyration 500 mm is fitted to the shaft. Determine the following : (i) Power of the motor (ii) Total fluctuation of speed of the machine shaft. **(12 Marks)**

3 a. Derive the relation $\frac{T_1}{T_2} = e^{\mu\theta}$ for a belt drive with usual notation. **(08 Marks)**

b. In an open belt drive the diameters of the larger pulley and the smaller pulley are 1.2 m and 0.8 m respectively. The smaller pulley rotates at 320 rpm. The centre distance between the shafts is 4 m, when stationary the initial tension in the belt is 2.8 kN. The mass of the belt is 1.8 kg/m and the coefficient of friction between the belt and pulley is 0.25. Determine the power transmitted. **(12 Marks)**

4 a. Why is balancing necessary for rotors of high speed engines? Discuss in detail how to balance a single rotating mass when balance mass is not rotating in the same plane **(08 Marks)**

b. A shaft is rotating at a uniform speed. Four masses m_1, m_2, m_3 and m_4 of magnitude 300 kg, 450 kg, 360 kg and 390 kg respectively are attached rigidly to a shaft. The masses are rotating in the same plane. The corresponding radii of rotation are 200 mm, 150 mm, 250 mm and 300 mm respectively. The angles made by these masses with the horizontal are 0°, 45°, 120° and 255° respectively. Find

(i) The magnitude of the balancing mass.

(ii) Position of balance mass if radii of rotation is 200 mm. **(12 Marks)**

PART – B

5 In a spring loaded Hartnel type governor, the mass of each ball is 4 kg and lift of the sleeve is 50 mm. The governor begins to float at 240 rpm, when the radius of the ball path is 110 mm. The mass mean working speed of the governor is 20 times the range of the speed when friction is neglected. The length of the ball arm and roller arms of the bell crank lever are 120 mm and 100 mm respectively. The pivot centre of the governor and axis of the governor are 140 mm apart. Determine the initial compression of the spring, taking into account of obliquity of ball and roller arms. **(20 Marks)**

6 a. Explain in details the procedure of balancing multicylinder radial engine by direct and reverse crank method. **(08 Marks)**

b. Fig. Q6 (b) shows a 60° V engine having two cylinders placed symmetrically. The two connecting rods are coupled directly to a single crank. The stroke is 100 mm and length of each connecting rod is 165 mm. The mass of reciprocating parts per cylinder is 1.5 kg. Determine the values of primary force when the crank is rotating at a speed of 2000 rpm is clockwise direction. **(12 Marks)**

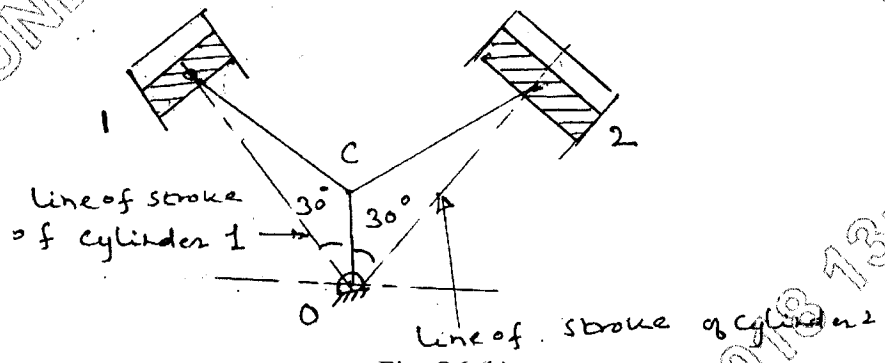

Fig. Q6 (b)

7 a. Explain the terms spin and precession. How do they differ from each other? Also derive an expression for gyroscopic couple. **(10 Marks)**

b. A ship has a propeller of mass of inertia 2000 kg-m^2. The propeller rotates at a speed of 360 rpm is clockwise direction looking from stern. Determine

(i) Gyroscopic couple and its effect when ship moves at 30 km/hr and steers to the left at a radius of 200 m.

(ii) Maximum gyroscopic couple and its effect when ship pitches and moving up having amplitude 10° and time period 20 seconds. The motion occurs with SHM. **(10 Marks)**

8 A tangent cam with straight working faces tangential to a base circle of 120 mm diameter has a roller follower of 48 mm diameter. The line of stroke of the roller follower passes through the axis of the cam. The nose circle radius of the cam is 12 mm and the angle between the tangential faces of the cam 90°. If the speed of the cam is 180 rpm. Determine the acceleration of the follower, when

(i) During the lift, the roller just leaves the straight flank.

(ii) The roller is at the outer end of its lift i.e. at the top of the nose. **(20 Marks)**

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