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10ME54

Fifth Semester B.E. Degree Examination, May 2017
Dynamics of Machines

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. State the conditions for a member to be in equilibrium
   i) When two forces act
   ii) When three forces act
   iii) When two forces and a torque act. **(06 Marks)**

b. For the four bar mechanism shown in Fig.Q1(b), find the required value of T_2 and various pin forces on the links for the equilibrium of the system. **(10 Marks)**

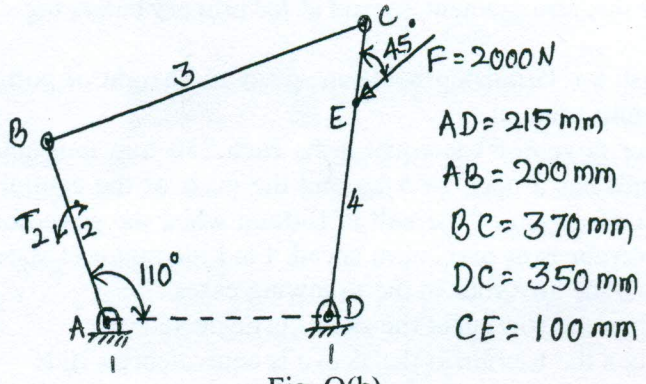

Fig. Q(b)

c. What is "principle of virtual work"? Explain. **(04 Marks)**

2 a. Explain D'Alemberts principle and state its significance. **(05 Marks)**

b. In a single–acting four–stroke engine, the work done by the gases during the expansion stroke is three times the work-done during the compression stroke. The work done during the suction and exhaust strokes is negligible. The engine develops 14 kW at 280 rpm. The fluctuation of speed is limited to 1.5% of the mean speed on either side. The turning – moment diagram during the compression and the expansion strokes may be assumed to be triangular in shape. Determine the inertia of the flywheel. **(15 Marks)**

3 a. Derive an expression for frictional torque in a flat pivot bearing. Assume uniform pressure across the bearing surface. **(06 Marks)**

b. A belt drive is required to transmit 10 kW from a motor running at 600 rpm. The belt is 12 mm thick and has a mass density of 0.001 gm/mm^3. Safe stress in the belt is not to exceed 2.5 N/mm^2. Diameter of the driving pulley is 250 mm whereas the speed of the driven pulley is 220 rpm. Two shafts are 1.25m apart. The coefficient of friction is 0.25. Determine the width of the belt. **(14 Marks)**

4 a. Explain static and dynamic balance of a system of revolving masses. **(06 Marks)**

b. A 3.6m long shaft carries 3 pulleys, two at its two ends and 3rd pulley at the midpoint. The two end pulleys have masses 79 and 40 kg respectively and their CG are 3 mm and 5 mm from the axis of shaft respectively. The middle pulley has a mass of 50 kg and its CG is 8 mm. The pulleys are so keyed to the shaft that the assembly is in static balance. The shaft rotates at 300 rpm in two bearings, 2.4m apart, with equal overhangs on either side find :

i) Relative angular position of the pulleys

ii) Dynamic reaction on the two bearings. **(14 Marks)**

PART – B

5 a. Prove that the resultant unbalanced force is minimum when half of the reciprocating masses are balanced by rotating masses i.e., when C = ½ . **(06 Marks)**

b. In a four cylinder engine the two outer cranks are 120° to each other and their reciprocating mass are each 100 kg. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 450 mm. Length of each crank is 300 mm and length of each connecting rod is 1200 mm. Speed of engine is 240 rpm. Find :

i) The reciprocating masses and relative angular positions for each of the inner cranks

ii) The unbalanced secondary forces and couples if any, measured about the central plane for this arrangement arrived at for primary balancing. **(14 Marks)**

6 a. Establish a relationship between speed and height of porter governor, taking friction on the sleeve into account. **(08 Marks)**

b. A porter governor has equal arms each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the range of speed, sleeve lift, governor effort and power of the governor in the following cases :

i) When the friction at the sleeve is neglected

ii) When the friction at the sleeve is equivalent to 10 N. **(12 Marks)**

7 a. With neat sketches, explain the effect of gyroscopic couple on pitching, steering and rolling of a ship. **(06 Marks)**

b. Each wheel of a four wheel, rear engine automobile has a moment of inertia of 2.4 kg-m^2 and an effective diameter of 660 mm. The rotating parts of the engine have moment of inertia of 1.2 kg-m^2. The gear ratio of engine to back axle is 3 : 1. The engine axis is parallel to rear axle and the crank shaft rotates in the same sense as the road wheel. The mass of the ventricle is 2200 kg and the centre of mass is 550 mm above the road level. The track width of the vehicle is 1.5m. Find the limiting speed of the vehicle around a curve with 80 m radius so that all the four wheels maintain contract with the road surface. **(14 Marks)**

8 For a symmetrical tangent cam operating a roller follower, the least radius of cam is 30 mm and roller radius is 15mm. The angle of ascent is 60°, the total lift is 15mm and the speed of the cam shaft is 300 rpm. Calculate :

i) Principal dimension of cam [i.e., the distance between the cam centre and nose centre, nose radius and angle of contact of cam with straight flank]

ii) Acceleration of the follower at the beginning of the lift, where the roller just touches the nose [i.e., flank merges into the nose] and at the apex of the circular nose. Assume that there is no dwell between ascent and descent. **(20 Marks)**

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