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10AE53

Fifth Semester B.E. Degree Examination, Dec.2016/Jan.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. With usual notations, explain the principle of virtual work, considering a slider crank mechanism. **(06 Marks)**

b. Onto link 6 of the mechanism given in Fig. Q1(b), a 100N vertical force is acting. Calculate the amount of the torque required on the crank AB to keep the mechanism in static equilibrium, using the graphical approach. **(14 Marks)**

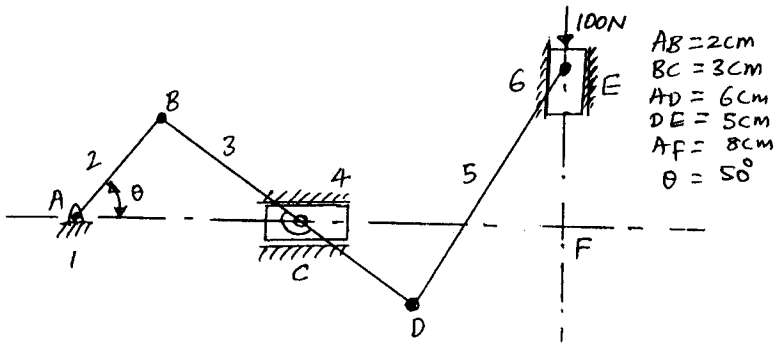

Fig. Q1(b)

2 a. Obtain an expression for energy stored in flywheel. **(05 Marks)**

b. A shaft fitted with a flywheel rotates at 250 rpm and drives a machine. The torque of machine varies in a cyclic manner over a period of 3 revolutions. The torque rises from 750 N-m to 3000 N–m uniformly during $\frac{1}{2}$ revolution and remains constant for the following revolution. It then falls uniformly to 750 N-m during the next $\frac{1}{2}$ revolution and remains constant for one revolution, the cycle being repeated thereafter. Determine the power required to drive the machine and percentage fluctuation in speed, if the driving torque applied to the shaft is constant and the mass of the flywheel is 500 kg with radius of gyration of 600mm. **(15 Marks)**

3 a. Derive an expression for frictional torque in a flat collar bearing assuming uniform pressure. **(06 Marks)**

b. An open belt drive connects two pulleys 1.2m and 0.5 m diameter, on parallel shafts 4 meters apart. The mass of the belt is 0.9 kg per meter length and the maximum tension is not to exceed 2000 N. The coefficient of friction is 0.3. The 1.2 m pulley, which is the driver, runs at 200 rpm. Due to belt slip on one of the pulleys, the velocity of the driven shaft is only 450 rpm. Calculate the torque on each of the two shafts, the power transmitted, and power lost in friction. What is the efficiency of the drive? **(14 Marks)**

4 a. Explain the balancing of a single rotating mass by a single mass rotating in the same plane. **(04 Marks)**

b. A shaft has three eccentrics, each 75 mm diameter and 25 mm thick, machined in one piece with the shaft. The central planes of the eccentric are 60 mm apart. The distance of the centers from the axis of rotation are 12 mm, 18 mm, and 12 mm and their angular positions are 120° apart. The density of metal is 700 kg/m^3. Find the amount of out-of-balance force and couple at 600 rpm. If the shaft is balanced by adding two masses at a radius 75 mm and at distances of 100 mm from the central plane of the middle eccentric, find the amount of the masses and their angular positions. **(16 Marks)**

PART – B

5 a. Explain how balancing of radial engines are carried out using direct and reverse crank method. **(05 Marks)**

b. The Cranks and connecting rods of a 4–cylinder in–line engine running at 1800 rpm are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1 – 4 – 2 – 3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine : i) unbalanced primary and secondary forces, if any, and ii) unbalanced primary and secondary couples with reference to central plane of the engine. **(15 Marks)**

6 a. Obtain an expression for effort of the porter governor without considering obliquity effect. **(05 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 150 mm 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. **(15 Marks)**

7 a. Derive an expression for angle of heel of a motor cycle to avoid skidding. **(06 Marks)**

b. A rear engine automobile is travelling along a track of 100 meters mean radius. Each of the four road wheels has a moment of inertia of 2.5 kg-m^2 and an effective diameter of 0.6m. The rotating parts of the engine have a moment of inertia of 1.2 kg-m^2. The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The ratio of engine speed to back axle speed is 3 : 1. The automobile has a mass of 1600 kg and has its centre of gravity 0.5m above road level. The width of the track of the vehicle is 1.5m. Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface. Assume that the road surface is not cambered and centre of gravity of the automobile lies centrally with respect to the four wheels. **(14 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 is 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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