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06ME53

Fifth Semester B.E. Degree Examination, Dec.2013/Jan.2014

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. State the conditions for a link 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. In the Fig.Q1(b) a four bar mechanism is shown. Calculate the required value of T_2 and various forces on links for the equilibrium of the system.

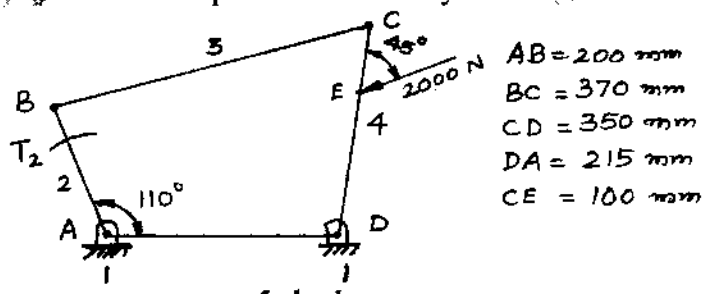

Fig.Q1(b) **(14 Marks)**

2 a. Prove that maximum fluctuation of energy is given by C = 0.02 qE where E = mean K.E. of flywheel, q = total percentage fluctuation of speed. **(06 Marks)**

b. A machine punching 38 mm diameter holes in a 32 mm thick plates does 6 Nm of work per square mm of sheared area. The punch has a stroke of 100 mm and punches 6 holes per minute. The maximum speed of flywheel at its radius of gyration is 28 m/s. Find the weight of the flywheel so that speed at the same radius does not fall below 25 m/s. Also determine the power of motor driving this machine. **(14 Marks)**

3 a. Derive the expression for frictional torque in flat collar bearing considering (i) uniform pressure, (ii) uniform wear. **(10 Marks)**

b. A leather flat belt is required to transmit 15 kW from a pulley of 1200 mm effective diameter running at 300 rpm. The angle of contact is spread over 5/12 of circumference and coefficient of friction between belt and pulley is 0.30. The safe stress in the belt is 1.5 MPa and mass density of leather belt is 1000 kg/m^3. If thickness of the belt is 10 mm, determine width of the belt, taking centrifugal tension into account. **(10 Marks)**

4 a. Explain briefly static and dynamic balancing of rotating masses. **(06 Marks)**

b. A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and at radii of rotation of 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. the balancing masses are to be placed in planes X and Y. The distance between A and X is 100 mm, between X and Y is 400 mm, between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitude and angular positions. **(14 Marks)**

PART – B

5 a. State the conditions of balance in a multi cylinder In-line engine. **(06 Marks)**

b. A four crank engine has the two outer cranks set at 120° to each other and their reciprocating masses are each 400 kg. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. If the engine is to be in complete primary balance, find the reciprocating mass and the relative angular positions for each of the inner cranks. If the length of each crank is 300 mm, the length of each connecting rod is 1.2 m and the speed of rotation is 240 rpm, what is the maximum secondary unbalanced force? **(14 Marks)**

6 a. Define sensitiveness, stability, effort and power. **(06 Marks)**

b. A porter governor has equal arms of length each 250 mm long and all the arms are pivoted at a distance of 40 mm from the axis of rotation. The mass of each ball is 3 kg and mass of the sleeve is 20 kg. The balls rotate at a radius of 150 mm at minimum speed and at a radius of 200 mm at maximum speed. Determine the range of speed. **(14 Marks)**

7 a. Explain the effect of gyroscopic couple on an aeroplane negotiating a curve. **(06 Marks)**

b. A rear engine four wheeled vehicle is traveling along a track of 110 m radius. Each of the four road wheels has a moment of inertia of 2.5 kgm^2 and an effective diameter of 0.6 m. The rotating parts of the engine have a moment of inertia of 1.5 kgm^2. The engine axis is parallel to the rear axle and the crank shaft rotates in the same sense as road wheels. The gear ratio of engine to the back wheel is 4 to 1. The vehicle has a mass of 2200 kg and its centre of gravity is 0.5 m above the road surface. The width of the track of the vehicle is 2.0 m. Determine load on each wheel and limiting speed to avoid over turning of the vehicle, if the vehicle takes a left turn. **(14 Marks)**

8 a. Derive the expressions for displacement, velocity and acceleration of follower when the roller is in contact with straight flank with usual notations. **(10 Marks)**

b. In a symmetrical tangent cam operating a roller follower, the least radius of the cam is 30 mm and roller radius is 17.5 mm. The angle of ascent is 75° and the total lift is 17.5 mm. The speed of the cam shaft is 600 rpm. Calculate: i) The principal dimensions of the cam. ii) The acceleration of the follower at the beginning of the lift, where straight flank merges into the circular nose and at the apex of the nose. Assume that there is no dwell between ascent and descent. **(10 Marks)**

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