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10ME54

Fifth Semester B.E. Degree Examination, Dec.2015/Jan.2016
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. Considering slider crank mechanism, state and explain principle of virtual work. **(08 Marks)**

b. A four bar mechanism shown in Fig.Q1(b) is acted upon by a force P = 100 $\angle 120°$ N on link CD. The dimensions of the various links are AB = 40 mm, BC = 60 mm, CD = 50 mm, DA = 30 mm and DE = 20 mm. Determine the magnitude and direction of input torque T_2 on link AB for the static equilibrium of the mechanism.

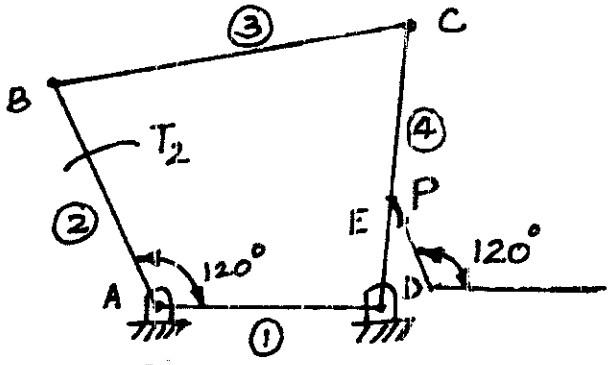

Fig.Q1(b) **(12 Marks)**

2 a. Prove that the maximum fluctuation of energy E_f is given by $E_f = 0.02C_sE$, where E = mean kinetic energy of flywheel, C_s = total percentage fluctuation of speed. **(06 Marks)**

b. A punching machine is operated by an electric motor which supplies a constant torque. The motor delivers 3.68 KW. At the commencement of operation the flywheel of the punching machine has a speed of 300 rpm. The moment of inertia of the flywheel is 60 kgm^2. Each punching operation requires 5600 Nm of energy and actual punching takes 1 second. Find:
i) The number of punchings that can be made in an hour.
ii) The reduction in speed after punching is over. **(14 Marks)**

3 a. Derive the expression for frictional torque in a single flat collar bearing. Assume uniform pressure. **(08 Marks)**

b. A shaft rotating at 300 rpm transmitting 5 KW power to drive another shaft at 500 rpm through a flat belt drive. The belt is 120 mm wide and 15 mm thick. The distance between the centres of shafts is 3m, The effective diameter of smaller pulley is 0.75 m. Calculate the stress in the belt, if it is (i) an open belt drive, (ii) a cross belt drive. Take the coefficient of friction between the belt and pulley is 0.3. **(12 Marks)**

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

b. A shaft carries four rotating masses A, B, C and D which are completely balanced. The masses at A, B and C are 60 kg, 55 kg and 80 kg respectively rotating at equal radii. The distance between B, C and D from A are 500 mm, 600 mm and 1300 mm respectively. Determine the mass at D and angular positions of masses B, C and D with respect to mass A. **(14 Marks)**

PART – B

5 a. A V-twin engine has the cylinder axes at right angles and the connecting rods operate a common crank. The reciprocating mass per cylinder is 10 kg and the crank radius is 80 mm. The length of the connecting rod is 0.4 m. Show that the engine may be balanced for primary forces by means of a revolving mass. If the engine speed is 600 rpm, determine the value of maximum resultant secondary force. **(04 Marks)**

b. A four crank engine has two outer cranks set at 120° to each other and their reciprocating masses are each 400 kg. The distance between planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. If the engine is to be in complete balance, find the reciprocating mass and the relative angular position 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, find maximum secondary unbalanced force. **(16 Marks)**

6 a. Derive the expression for speed of a porter Governor with usual notations, taking friction into account **(08 Marks)**

b. In a porter Governor, the arms and links are each 250 mm long and intersect on the main axis. Each ball weigh 4.5 N and the central load is 20 N. The sleeve is in its lowest position when the arms are inclined at 30° to the axis. The lift of the sleeve is 50 mm. Find force of friction at the sleeve, if the speed ascent from the lowest position is equal to the speed at the beginning of the descent from the highest position. Also find range of speed, all things remaining same. **(12 Marks)**

7 a. Explain the effect of gyroscopic couple on an aeroplane. **(08 Marks)**

b. A rear engine automobile is travelling along a track of 100 m radius. Each of the four wheels has a moment of inertia of 2 kgm^2 and an effective diameter of 0.6 m. The rotating parts of the engine have a moment of inertia of 1.25 kgm^2. The engine axis is parallel to the rear axle and the crank shaft rotates in the same direction as the wheels. The gear ratio of engine to back axle is 3:1. The automobile mass is 1500 kg and its centre of gravity is 0.5 m above the road level. The width of the track of the vehicle is 1.5 m. Determine the limiting speed of the vehicle around the curve for all the wheels to maintain contact with the road surface. **(12 Marks)**

8 a. Derive the expressions for displacement, velocity and acceleration for a circular arc cam operating a flat faced follower when the flat face of the follower has contact on the circular flank. **(10 Marks)**

b. A cam of circular arc type is to operate a flat faced follower of a four stroke engine. The exhaust valve opens 50° before top dead centre and closes 15° after bottom dead centre. The valve lift is 10 mm, base circle radius of cam is 20 mm and nose radius is 3 mm. Calculate the maximum velocity, acceleration and retardation, if cam shaft rotates at 1800 rpm. **(10 Marks)**

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