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10AE53

Fifth Semester B.E. Degree Examination, June/July 2016
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. Explain the principle of virtual work with a neat sketch. **(06 Marks)**

b. Determine the torque 'T_2" and various forces on links for equilibrium of system in Fig. Q1(b) below. **(14 Marks)**

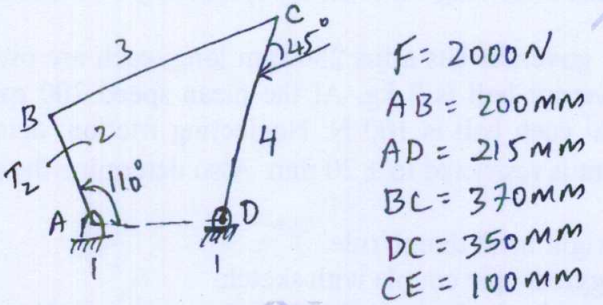

Fig. Q1(b)

2 a. State and explain D'Alembert's principle. **(02 Marks)**

b. Prove that $e_{max} = 0.02qE$, where E = mean K.E of fly wheel, q = total percentage fluctuation of speed. **(06 Marks)**

c. The TMD for an engine consists of 2 isocelis triangles maximum height for each triangle represents turning moment 1000 N-m. The base of each triangle = π radian. If the engine runs at 200 rpm and total fluctuation of speed is not exceed 3%, find :

i) Power of the engine

ii) Mass of rim type fly wheel concentrated at 0.25 m radius neglecting effect of arms and bars. **(12 Marks)**

3 a. Explain slip in belt and its effect on velocity ratio with neat sketch. **(04 Marks)**

b. Derive an expression for effect of centrifugal tension in a flat belt drive. **(04 Marks)**

c. In a thrust bearing, the external and internal diameter of contact surfaces are 300 mm and 200 mm respectively. The total axial load is 100 kN and the intensity of pressure is 250 kN/m^2. The speed of the shaft is 500 rpm and $\mu = 0.05$. Calculate :

i) Number of collars required

ii) Power lost due to friction. **(12 Marks)**

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

b. A shaft carries 4 rotating masses A, B, C, D in this order along the axis. The mass A may be assumed to be concentrated at 160 mm radius, B at 180 mm C at 200 mm and D at 120 mm radius. The masses B, C and D are 40 kg, 30 kg and 50 kg respectively. The planes containing B and C are 300 mm apart. The angular spacing of C and D are 90° and 210° respectively with respect ot B measured in same direction. If the shaft and masses are to be in complete dynamic balance, determine :

i) Mass and angular position of A

ii) Position of planes A and D. **(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. The pistons of a 4 cylinder vertical inline engine reach their upper most position at 90° interval in order of their axial position. Pitch of cylinder = 0.35 m, crank radius = 0.12 m. Length of connecting rod = 0.42 m. The engine runs at 600 rpm. If the reciprocating parts of each engine has a mass of 2.5 kg. Find the unbalanced primary and secondary forces and couples. Take central plane of engine as reference plane. (Analytical method alone). **(14 Marks)**

6 a. Explain the following : i) Hunting ii) stability iii) isochronous governor iv) controlling force. **(04 Marks)**

b. A porter governor has arms 250 mm long, each are pivoted on the axis of rotation mass of each governor ball is 2 kg. At the mean speed 200 rpm, it is found that centrifugal force exerted at each ball is 100 N. Neglecting friction, determine the central load if the sleeve movement is restricted to ± 20 mm. Also determine the range of speed. **(16 Marks)**

7 a. Explain right hand thumb rule. **(02 Marks)**

b. Explain gyroscopic couple with sketch. **(04 Marks)**

c. Each road wheel of a motor cycle has a moment of inertia of 2 kg m^2. The rotating parts of the engine of the motor cycle has a moment of inertia of 0.2 kg m^2. The speed of the engine is 5 times the speed of the wheel and is in same sense. The mass of the motor cycle with rider is 200 kg and its C.G is 500 mm above ground level. The diameter of the wheel is 500 mm. The motor cycle is travelling at 15 m/sec on a curve of 30 m radius. Determine :
i) Gyro couple, centrifugal couple, overturning couple and balancing couple in terms of angle of heels. ii) angle of heel. **(14 Marks)**

8 In a four stoke petrol engine, the crank angle is 4° after TDC when the suction valve opens and 50° after BDC when the suction valve closes. The lift is 10 mm, the nose radius is 2.5 mm and the least radius of the cam 20 mm. The shaft rotates at 600 rpm. The cam is of circular type with a circular nose and flanks while the follower is flat faced. Determine the maximum velocity, maximum acceleration and retardation of the valve. What is the minimum force exerted by the springs to overcome the inertia of moving parts weighing 250 gm? **(20 Marks)**

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