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10MR42

Fourth Semester B.E. Degree Examination, June/July 2015
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. Define and explain the superposition theorem as applicable to a system of forces acting on a mechanism. **(06 Marks)**

b. In a 4-link mechanism shown in Fig. Q1 (b), a clockwise torque of 30 Nm is applied on the link BC, and a force F of 200 N is applied at point E on link CD as shown. The link lengths are AB = 75 mm, BC = 100 mm, CD = 120 mm, CE = 60 mm and AD = 200 mm. Determine the torque on the link AB for static equilibrium. **(14 Marks)**

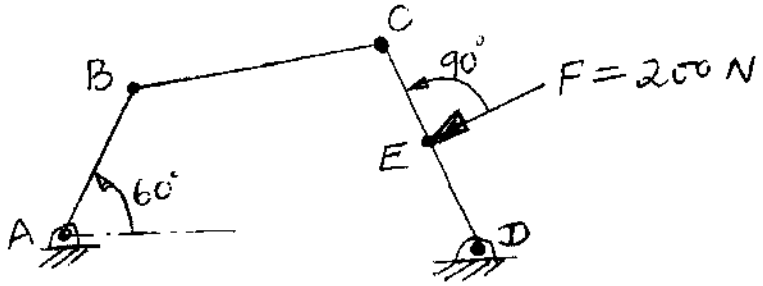

Fig. Q1 (b)

2 a. Explain D'Alemberts principle and state why it is used. **(06 Marks)**

b. A punching press is required to punch 40 mm diameter holes in a plate of 30 mm thickness at the rate of 4 holes per minute. It requires 6 Nm of energy per square millimeter of sheared area. The punch has a stroke length of 100 mm. The speed of the flywheel drops from 320 rpm to 280 rpm. If the radius of gyration of flywheel is 1 m, find i) the power of the motor, and ii) Mass of the flywheel. **(14 Marks)**

3 a. State the laws of dry friction. **(04 Marks)**

b. Derive an expression for frictional torque in a single collar bearing assuming uniform wear condition across the bearing surface. **(06 Marks)**

c. An open belt drive is required to transmit 10 kW from a motor running at 600 rpm. Diameter of the driving pulley is 250 mm and speed of the driven pulley is 220 rpm. The belt is 12 mm thick and has a mass density of 0.001 g/mm^3. Safe stress in the belt is not to exceed 2.5 N/mm^2. The two shafts are 1.25 m apart. If the coefficient of friction is 0.5, determine the width of the belt. **(10 Marks)**

4 a. What is meant by static and dynamic unbalance in machinery? Also, comment on why two masses in different planes are necessary to rectify the dynamic unbalance. **(10 Marks)**

b. Four masses m_1, m_2, m_3 and m_4 are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively. The angles between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balance mass required if its radius of rotation is 0.2 m. **(10 Marks)**

PART – B

5 a. Explain the direct and reverse crank method of analysis to determine the unbalanced forces in radial engines. **(06 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) the unbalanced primary and secondary forces, ii) the unbalanced primary and secondary couples with reference to the central plane of the engine. **(14 Marks)**

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

b. In a spring loaded governor of Hartnell type, the mass of each ball is 1 kg, the length of vertical arm of bell crank lever is 100 mm and that of horizontal arm is 50 mm. The distance of fulcrum is 80 mm from the axis of rotation of governor. The extreme radii of rotation of the balls are 75 mm and 112.5 mm. The maximum equilibrium speed is 5% greater than the minimum equilibrium speed which is 360 rpm. Find the initial compression of the spring and the equilibrium speed corresponding to the radius of rotation of 100 mm. **(12 Marks)**

7 a. With the help of neat illustrations explain the effect of Gyroscopic couple of a ship under, i) Steering ii) Pitching and iii) Rolling. Assume that the axis of the rotor (axis of spin) is vertical and the rotor rotates in clockwise direction when viewed from the top. **(08 Marks)**

b. A disc of 5 kg mass with radius of gyration 70 mm is mounted at mid-span of a horizontal shaft of length 200 mm. The disc spins at 1000 rpm clockwise direction when viewed from the right bearing. If the shaft processes about the vertical axis at 30 rpm in counter clockwise direction when viewed from the top, determine the reactions at each bearing due to the mass of the disc and gyroscopic effect. **(12 Marks)**

8 For a symmetrical tangent cam operating roller follower, the least radius of cam is 30 mm and the roller radius is 17.5 mm. The angle of ascent is 75°, the total lift is 17.5 mm and the speed of the cam is 600 rpm. Calculate

i) Principal dimensions of the cam.

ii) Acceleration of the follower at the beginning of the lift, where straight flank merges into the circular 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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