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10MR42

Fourth Semester B.E. Degree Examination, June/July 2017
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 principle of virtual work. (02 Marks)
 b. What are the conditions for a body to be in equilibrium under the action of two force, three forces and two forces and a torque? (06 Marks)
 c. A slider-crank mechanism with the following dimensions is acted upon by a force $F = 2 \text{ kN}$ at B as shown in Fig. Q1 (c). $OA = 100 \text{ mm}$, $AB = 450 \text{ mm}$. Determine the input torque T on the link OA for the static equilibrium of the mechanism for the given configuration. (12 Marks)

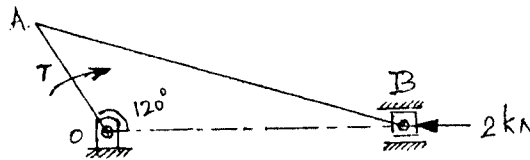


Fig. Q1 (c)

- 2 a. State and explain D'Alembert's principle. (03 Marks)
 b. What are turning-moment diagrams? Why are they drawn? (03 Marks)
 c. The turning-moment diagram for a multi-cylinder engine has been drawn to a vertical scale of $1 \text{ mm} = 650 \text{ N-m}$ and a horizontal scale of $1 \text{ mm} = 4.5^\circ$. The areas above and below the mean torque line are $-28, +380, -260, +310, -300, +242, -380, +265$ and -229 mm^2 . The fluctuation of speed is limited to $\pm 1.8\%$ of the mean speed which is 400 rpm . The density of the rim material is 7000 kg/m^3 and width of the rim is 4.5 times its thickness. The hoop stress in the rim material is limited to 6 N/mm^2 . Neglecting the effect of the boss and arms, determine the diameter and cross section of the fly wheel rim. (14 Marks)
- 3 a. Derive an expression for frictional torque in a flat pivot bearing. Assume uniform wear. (08 Marks)
 b. Two parallel shafts, connected by a crossed belt, are provided with pulleys 480 mm and 640 mm in diameters. The distance between the center lines of the shafts is 3 m . Find by how much the length of the belt should be changed if it is desired to alter the direction of rotation of the driven shaft. (12 Marks)
- 4 a. What is meant by static and dynamic unbalance in machinery? How can the balance be done? (04 Marks)
 b. A shaft supported in bearings that are 1.6 m apart projects 400 mm beyond bearings at each end. It carries three pulleys one at each end and one at the centre of its length. The masses of the end pulleys are 40 kg and 22 kg and their centres of mass are at 12 mm and 18 mm respectively from the shaft axes. The mass of the centre pulley is 38 kg and its centre of mass is 15 mm from the shaft axis. The pulleys are arranged in a manner that they give static balance. Determine the (i) Relative angular positions of the pulleys. (ii) Dynamic forces developed on the bearings when the shaft rotates at 210 rpm . (16 Marks)

PART – B

- 5 The stroke of each piston of a six cylinder two stroke in-line engine is 320 mm and the connecting rod is 800 mm long. The cylinder center lines are spaced at 500 mm. The cranks are at 60° apart and the firing order is 1-4-5-2-3-6. The reciprocating mass per cylinder is 100 kg and the rotating parts are 50 kg per crank. Determine the out-of-balance forces and couples about the mid plane if the engine rotates at 200 rpm. (20 Marks)
- 6 a. Explain : (i) Sensitiveness (ii) Isochronism and (iii) Controlling force in a governor. (06 Marks)
- b. In a porter governor, each of the four arms is 400 mm long. The upper arms are pivoted on the axis of the sleeve, where as the lower arms are attached to the sleeve at a distance of 45 mm from the axis of rotation. Each ball has a mass of 8 kg and the load on the sleeve is 60 kg. What will be the equilibrium speeds for the two extreme radii of 250 mm and 300 mm of rotation of the governor balls? (14 Marks)
- 7 a. Explain the gyroscopic effect on a ship under the following conditions : (i) Steering to the right when looking from rear (ii) Pitching with the bow (front) rising when viewed from rear (iii) Rolling. In all the above three cases assume the rotor to rotate in clockwise direction. (09 Marks)
- b. Each road wheel of a motor cycle has a mass moment of inertia 2 kg-m^2 . The rotating parts of the engine of the motor cycle has a moment of inertia 0.2 kg-m^2 . The speed of the engine is 5 times the speed of the wheel and is in the 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 500 mm, the motor cycle is travelling at 15 m/sec on a curve of 30 m radius. Determine the following and state its effect on the two wheeler, wherever necessary : (i) Gyro couple, centrifugal couple, overturning couple, balancing couple in terms of angle of heel and (ii) Angle of heel. (11 Marks)
- 8 For a symmetrical tangent cam operating a roller follower, the least radius of the cam is 30 mm and roller radius is 15 mm. The angle of ascent is 60° , the total lift is 15 mm and the speed of the cam shaft is 300 rpm. Calculate (i) Principal dimensions of the cam (ii) Acceleration of the follower at the beginning of the lift, where the roller just touches the nose and at the apex of circular nose. Assume that there is no dwell between ascent and descent. (20 Marks)

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