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10AE53

Fifth Semester B.E. Degree Examination, May 2017
Dynamics of Machinery

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. With neat sketch, state and explain principle of virtual work. **(06 Marks)**

b. A four link mechanism is acted upon by forces shown in Fig.Q.1(b). Determine the torque T_2 to be applied on link 2 to keep the mechanism in equilibrium AD = 50mm, AB = 40mm, BC = 100mm, DC = 75mm, DE = 35mm. **(14 Marks)**

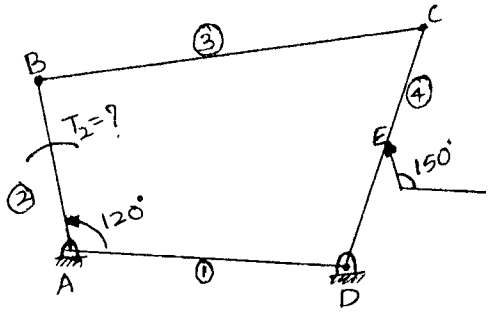

Fig.Q.1(b)

2 a. Briefly explain the following:
i) D' Alembert's principle.
ii) Total fluctuation of speed.
iii) Co-efficient of fluctuation of energy. **(06 Marks)**

b. A machine has to carry out punching operation at the rate of 10 holes/min. It does 6 Nm of work per mm^2 of sheared area in cutting 25mm diameter hole in 20mm thick plate. A flywheel is fitted to the machine shaft which is driven by a constant torque motor. The fluctuation of speed is between 180rpm to 200rpm and actual punching takes 1.5sec. Frictional losses are equivalent to 1/6 of WD during punching operation find.
i) Power required to drive the punching machine.
ii) Mass of fly wheel if radius of gyration is 450mm. **(14 Marks)**

3 a. Derive an expression for frictional torque in a flat collar bearing assuming uniform pressure. **(06 Marks)**

b. A conical pivot bearing supports a vertical shaft of 200mm diameter. It is subjected to a load of 30kN. The angle of cone is 120° and the coefficient of friction is 0.025. Find the power lost in friction when the speed is 140rpm. Assuming i) Uniform pressure; ii) Uniform wear. **(06 Marks)**

c. A leather belt is required to transmit 15kW from a pulley of 1200mm effective diameter running at 300rpm. The angle of contact is spread over 5/12 of circumference and co-efficient of friction between belt and pulley rim is 0.3. If the safe working stress for the belt material is 1.5MPa and mass of leather is 1000 kg/m^3 and thickness of belt is 10mm. Determine the width of the belt taking centrifugal tension into account. **(08 Marks)**

4 a. Explain how a single rotating mass is balanced by balancing masses in different planes. **(06 Marks)**

b. A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18kg and 12.5kg respectively and each has an radius of 60mm. The masses at A and D have an radius of 80mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190° both being measured in the same direction. The axial distance between the planes A and B is 100mm and that between B and C is 200mm. If the shaft is in complete dynamic balance. Determine: i) The magnitude of the masses at A and D; ii) The distance between planes A and D; iii) The angular position of the mass at D. **(14 Marks)**

PART – B

5 a. Explain direct and reverse crank method of balancing. **(10 Marks)**

b. The reciprocating mass per cylinder in a 60° V-twin engine is 1.5kg. The stroke and connecting rod length are 100mm and 250mm respectively. If the engine runs at 2500 rpm. Determine the maximum and minimum values of the primary and secondary forces resultant? **(10 Marks)**

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

b. In a hartnell governor the length of ball and sleeve arms are 12 and 10cm respectively. The distance of fulcrum of the bell crank lever from the governor axis is 14cm. Mass of each governor ball is 4kg. When the governor runs at the mean speed of 300rpm. the ball arm is vertical and sleeve arm is horizontal. For an increase of speed of 4% the sleeve moves 10mm upward. Neglecting friction. Find:

i) Minimum equilibrium speed if total sleeve movement is 20mm.
ii) Spring stiffness.
iii) Sensitiveness of governor.
iv) Spring stiffness if governor is to be isochronous at 300rpm. **(12 Marks)**

7 a. Derive an expression for gyroscopic couple. **(06 Marks)**

b. Explain the effect of gyroscopic effect of steering on ship. **(08 Marks)**

c. Each road wheel of a motor cycle has a moment of inertia of 2kgm^2. The rotating parts of the engine of the motor cycle has a moment of inertia of 0.2kgm^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 200kg and its C.G. is 500mm above ground level. The diameter of the wheel is 500mm. The motor cycle is travelling at 15 m/sec on a curve of 30m radius. Determine:
i) Gyro couple, centrifugal couple, over turning couple and balancing couple in terms of angel of heel; ii) Angel of heel. **(06 Marks)**

8 a. Derive an expression for determining the displacement velocity and acceleration of the follower when flat face of the follower has contact on the circular flank. **(10 Marks)**

b. The following particulars relate to a symmetrical circular cam operating a flat faced follower least radius = 16mm, nose radius = 3.2mm. Distance between cam shaft centre and nose centre = 25mm. Angle of action of cam = 150° and cam shaft speed = 600rpm. Assuming that there is no dwell between the ascent and descent, determine the lift of the valve the flank radius and the acceleration and retardation of the follower at a point where circular nose merges into circular flank. **(10 Marks)**

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