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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MAY 2019

Course Code: ME304

Course Name: DYNAMICS OF MACHINERY

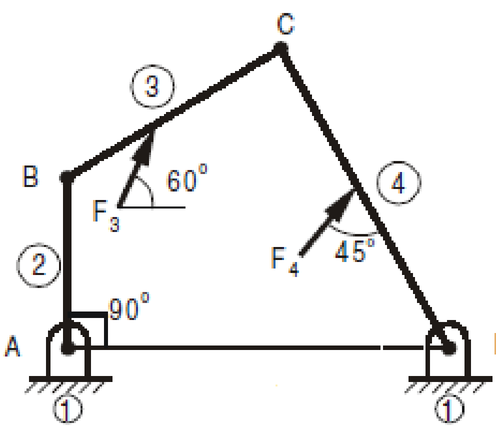
Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks. Marks

1 A four bar mechanism as shown in Figure, is subjected to two forces, F_3 = 2000N at 60° from horizontal at midpoint of link 3 and F_4 = 4000 N at 45° from link 4 at midpoint of link 4. The dimensions of links are as under: (10)

AB = 0.3 m, BC = 0.4 m, CD = 0.45 m and AD = 0.6 m. Perform static force analysis and determine resisting torque on link 2 using superposition method.



2 A slider crank mechanism of crank radius 60mm and connecting rod length 240mm is acted upon by 2kN gas force at its piston. Calculate the torque to be applied on the crank to make the mechanism in static equilibrium, when the crank makes 60^0 with the line of stroke. (4)

3 The piston diameter of an internal combustion engine is 125 mm and the stroke is 220 mm. The connecting rod is 4.5 times the crank length and has a mass of 50kg. The mass of the reciprocating parts is 30kg. The centre of mass of the connecting rod is 170mm from the crank pin centre and the radius of gyration (10)

about an axis through the centre of mass is 148mm. The engine runs at 320 rpm. Find the magnitude and the direction of the inertia forces and the corresponding torque on the crankshaft when the angle turned by the crank is 140° from the inner dead centre.

4 a) State and explain D'Alembert's principle. (5)

b) What do you mean by dynamic equivalent .system? Explain (5)

PART B

Answer any three full questions, each carries 10 marks.

5 a) A three cylinder single acting engine has its cranks set equally at 120° and it runs at 600 r.p.m. The torque-crank angle diagram for each cycle is a triangle for the power stroke with a maximum torque of 90 N-m at 60° from dead centre of corresponding crank. The torque on the return stroke is sensibly zero. Determine (10)

1. Power developed.

2. Coefficient of fluctuation of speed, if the mass of the flywheel is 12 kg and has a radius of gyration of 80 mm

3. Coefficient of fluctuation of energy

4. Maximum angular acceleration of the flywheel.

6 The firing order of a 6 cylinder 4 stroke inline engine is 1-4-2-6-3-5.The stroke is 120mm and the length of each connecting rod is 240mm. The pitch distance between the cylinders centrelines are 100mm each. The reciprocating mass per cylinder is 1kg and the engine runs at 2400rpm. Determine the out-of-balance primary and secondary forces and couples. (10)

7 Find the angle of heel of a two-wheeler negotiating a turn of radius 60m. Combined mass of the vehicle with the rider is 280kg, moment of inertia of engine rotating parts is 0.4kgm^2,taht of each road wheel is 1.2kgm^2, the overall gear ratio is 4, height of C.G. is 0.6m with the rider, vehicle speed is 90km/h (10)

8 A four wheeled motor car of mass 2000 kg has a wheel base 2.5 m, track width 1.5 m and height of centre of gravity 500 mm above the ground level and lies at 1 metre from the front axle. Each wheel has an effective diameter of 0.8 m and a moment of inertia of 0.8 kg-m2. The drive shaft, engine flywheel and transmission are rotating at 4 times the speed of road wheel, in a clockwise (10)

direction when viewed from the front, and is equivalent to a mass of 75 kg having a radius of gyration of 100 mm. If the car is taking a right turn of 60 m radius at 60 km/h, find the load on each wheel.

PART C

Answer any four full questions, each carries 10 marks.

9 a) What is damping factor? (2)

b) In a single degree damped vibration system, a suspended mass of 8 Kg makes 30 oscillation in 18 second. The amplitude decreases to 0.25 of the initial value after 5 oscillations. Determine 1. The stiffness of the spring, 2. Logarithmic decrement, 3. Damping factor and 4. Damping coefficient (8)

10 The mass of an electric motor is 120 kg and it runs at 1500 r.p.m. The armature mass is 35 kg and its C.G. lies 0.5 mm from the axis of rotation. The motor is mounted on four springs of negligible damping so that the force transmitted is one-eleventh of the impressed force. Assume that the mass of the motor is equally distributed among the four springs. Determine: 1. stiffness of each spring; 2. dynamic force transmitted to the base at the operating speed and 3. natural frequency of the system. (10)

11 a) Explain the term 'dynamic magnifier'. What do you understand by transmissibility? (5)

b) A beam of length 10 m carries two loads of mass 200 kg at distances of 3 m from each end together with a central load of mass 1000 kg. Calculate the frequency of transverse vibrations. Neglect the mass of the beam and take I = 109 mm^4 and E = 205×103 N/mm^2. (5)

12 A steel shaft ABCD 1.5 m long has flywheel at its end A and D. The mass of the flywheel A is 600 Kg and has a radius of gyration of 0.6 m. The mass of the flywheel D is 800 Kg and has a radius of gyration of 0.9 m. The connecting shaft has a diameter of 50 mm for the portion AB which is 0.4 m long; and has a diameter of 60 mm for the portion BC which is 0.5 m long ; and has a diameter of 'd' mm for the portion CD which is 0.6 m long. Modulus of rigidity for the shaft material is 80GN/m^2 Determine (10)

1. The diameter 'd' of the portion CD so that the node of the torsional

vibration of the system will be at the centre of the length BC

2. The natural frequency of the torsional vibrations

13 What is whirling speed of a shaft. Prove that the whirling speed for a rotating shaft is the same as the frequency of natural transverse vibration. (5)

Calculate the whirling speed of a shaft 20 mm diameter and 0.6 m long carrying a mass of 1 kg at its mid-point. The density of the shaft material is 40 Mg/m^3, and Young's modulus is 200 GN/m^2. Assume the shaft to be freely supported (5)

14 A single cylinder diesel engine drives a centrifugal pump. The rotating mass of the engine, flywheel and the pump with the shaft is equivalent to a three rotor system. The mass moment of inertia of engine, flywheel and the pump are 0.15, 0.3,and 0.09kgm^2 respectively .The diameter of the shaft is 70mm and the centre distance between engine rotating masses, flywheel and the pump are 1.5m and 1m. Find the natural frequencies of the torsional vibrations, Take G=84kN/mm^2. (10)

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