Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(S), DECEMBER 2019

Course Code: ME304

Course Name: DYNAMICS OF MACHINERY

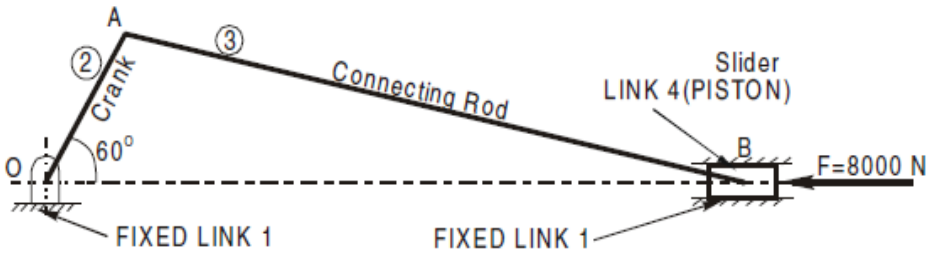
Max. Marks: 100 Duration: 3 Hours

PART A

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

1 The dimensions of a four-link mechanism are: AB = 400mm, BC = 600mm, CD = 500mm, AD = 900 mm and ∠DAB = 60º. AD is the fixed link. E is a point on the link BC such that BE = 400mm and CE = 300mm (BEC clockwise). A force of 150 ∠45º N acts on DC at a distance of 250mm from D. Find the required input torque on the link AB for static equilibrium of the mechanism. (10)

2 A Slider-crank mechanism as shown in figure is given below. The force acting on slider is 8000 N. Calculate the driving torque. The dimensions of links are: OA = 200 mm ; AB = 800 mm and ∠BOA = 60º (10)



3 Derive an expression for the velocity and acceleration of a piston of a slider crank mechanism and the inertia force due to reciprocating mass. (10)

4 In a vertical IC engine, the connecting rod is 4.5 times the crank. The mass of the reciprocating parts is 1.20kg and the stroke of the piston is 140mm. The engine runs at 2000 rpm. If the net load on the piston due to gas pressure is 2kN when the crank has turned through an angle of 60º from the top dead centre, determine the (10)

(i) Thrust in the connecting rod, (ii)Thrust on the piston walls, (iii)Tangential force on the crank pin, (iv)Torque on the crankshaft

PART B

Answer any three full questions, each carries 10 marks.

5 A shaft carries four masses A, B , C and D of magnitude 250kg, 350kg, 480kg and 250kg respectively and revolving at radii 64mm, 60mm, 50mm, and 64mm in planes measured from A at 300mm, 400mm, and 700mm. The angles between the cranks measured anticlockwise are A to B 45º, B to C 70º, C to D 120º. The balancing masses are placed in planes P and Q. The distance between the planes A and P is 100mm, between P and Q is 400mm and between Q and D is 200mm. If the balancing mass Q revolve at a radius of 100 mm, and balance mass P revolve at a radius of 150mm, find their magnitudes and angular positions. (10)

6 A single cylinder engine is producing 25hP at 4000rpm with 2000 explosions per minute. The fluctuation of speed not to exceed 1% on either side. Find the dimensions of a solid flywheel so that the hoop stress does not exceed 10MPa. Assume that the work done during the power stroke is 1.4 times work done during the cycle. Density of flywheel material is 7200kg/m^3. (10)

7 The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45m and a speed of 3000 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: **1.** when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h. **2.** when the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees. (10)

8 A racing car weighs 20kN. It has a wheel base of 2m, track width 1m and height of C.G. 300 mm above the ground level and lies midway between the front and rear axle. The engine flywheel rotates at 3000 r.p.m. clockwise when viewed from the front. The moment of inertia of the flywheel is 4 kgm^2 and moment of inertia of each wheel is 3 kgm^2. Find the reactions between the wheels and the ground when the car takes a curve of 60m radius towards right at 60km/h, taking into consideration the gyroscopic and the centrifugal effects. Each wheel radius is 300mm. (10)

PART C

Answer any four full questions, each carries 10 marks.

9 From fundamentals derive the expression for logarithmic decrement for a free damped longitudinal vibration system. (10)

10 Derive the formula for natural frequency of free undamped longitudinal vibration using any 2 methods. Also derive formula for natural frequency of free transverse vibration. (10)

11 a) A machine of mass 75kg is mounted on springs and is fitted with a dashpot to damp out vibrations. There are three springs each of stiffness 10N/mm and it is found that the amplitude of vibration diminishes from 38.4 mm to 6.4 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine : **1.** The resistance of the dashpot at unit velocity. **2.** The ratio of the frequency of the damped vibration to the frequency of the undamped vibration. **3.** The periodic time of the damped vibration. (10)

12 A shaft 1.5 m long, supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external diameter 75 mm and internal diameter 40 mm. The density of the shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft. (10)

13 A steel shaft 1.5m long is 95 mm in diameter for the first 0.6 m of its length, 60mm in diameter for the next 0.5n of the length and 50 mm in diameter for the remaining 0.4m of its length. The shaft carries two flywheels at two ends, the first having mass of 900kg and 0.85 m radius of gyration located at the 95mm diameter end and the second having a mass of 700kg and 0.55m radius of gyration located at the end. Determine the location of the node and the natural frequency of free torsional vibration of the system. The modulus of rigidity of shaft material may be taken as 80GN/m^2 (10)

14 What do you understand by vibration pickups? With neat diagram explain the working of a seismometer. (10)

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