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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth Semester B.Tech Degree Regular and Supplementary Examination July 2021

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 Determine the required input torque on the crank of slider crank mechanism for the static force equilibrium when the applied piston load is 1500 N. The length of the crank and connecting rod are 40 mm and 100 mm respectively and the crank has turned through 45^0 from the inner dead centre (10)

2 In four bar link mechanism with the following dimensions AD=500mm, AB=400mm, BC=1000mm and DC=750mm, a force of 80 N acting at 150^o to the horizontal at point E on link DC such that DE=350 mm. Calculate the torque required on link AB such that link AB has turned through an angle of 120^o. (10)

3 Single cylinder vertical engine has a bore of 45 mm and a stroke of 50 mm has a connecting rod of 150 mm long. The mass of reciprocating parts is 80 kg. The engine runs at a speed of 2000 rpm. On the expansion stroke with a crank at 20^o from the TDC, gas pressure is 700 kN/mm^2. Determine (a) net force acting on the piston, (b) resultant load on the gudgeon pin (c) thrust on the cylinder walls (10)

4 a) Explain the steps in the dynamic force analysis of a for bar mechanism. (6)

b) What do you mean by an equivalent dynamical system (4)

PART B

Answer any three full questions, each carries 10 marks.

5 A multi-cylinder engine is to run at a speed of 600 rpm. In the T- θ diagram, scale on x-axis is 1mm= 250 Nm and on the y-axis is 1mm=3^o. The areas above and below the mean torque line are +160, -172, +168, -191, +197, -162 (10)

mm^2 respectively. The speed is to be kept within ± 1% of the mean speed. The density of the CI flywheel is 7250 kg/mm^3 and hoop stress is 6Mpa. Assuming the rim contributes 92% of the flywheel effect, determine the dimensions of the rectangular section of the rim assuming the width to be the twice of the thickness

6 A turbine rotor of a ship is of mass 3500kg. It has a radius of gyration of 0.45m and a speed of 3000rpm, clockwise when looking from the stern. Determine the gyroscopic couple and its effect upon the ship; (10)

1. When the ship steering to the left on a curve of 100m radius at a speed of 36km/hr
2. When the ship pitches with the bow rising at an angular velocity of 0.1 rad/sec
3. Ship rolls at an angular velocity of 0.1 rad/sec

7 A shaft with 3 m span between two bearings carries two masses of 10 kg and 20 kg acting at extremities of arms 0.45 and 0.6 m respectively. The planes in which these masses rotate at 1.2 m and 2.4 m respectively from the left end bearing of the shaft. The angle between the arms is 60^0. The speed of the shaft is 200 rpm. If the masses are balanced by two counter masses rotating with shaft acting at radius 0.3 m and placed 0.3 m from each bearing centres. Calculate the balance masses and their orientation with 10 kg mass. (10)

8 A 3000 kg automobile has four wheels each of 80 kg and radius of gyration 0.4 m. The CG of the vehicle is 0.5 m above the ground. the Track is 1.5 m and the wheelbase are 1.4 m. CG lies at the centre of both track and wheelbase distances. Moment of inertia of the engine parts is 10 kgm^2 rotate in the same sense of the wheel. Gear ratio from the engine to the wheel is 5. Calculate the minimum speed to remain the four-wheeler instability, when the vehicle turns towards left with a curved track of 200 m radius (10)

PART C

Answer any four full questions, each carries 10 marks.

9 a) Explain different types of Vibrations. (3)

b) Derive an expression for logarithmic decrement and explain critical damping. (7)

10 a) In a single degree damped vibration system, the suspended mass of 4 kg makes 24 oscillation in 20 seconds. The amplitude decreases to 0.3 of the initial value after 4 oscillations. Find the stiffness of the spring, the logarithmic decrement, damping factor and the damping coefficient (6)

b) Derive the energy method and derive the expression for the natural frequency of the undamped system. (4)

11 A shaft of 40 mm diameter and 2.5 m length has a mass of 15 kg per m length. It is simply supported at the ends and carries three masses 90, 140 and 60 kg at 0.8, 1.5 and 2 m respectively from the left support. Taking E=200GN/m^2, find the frequency of the transverse vibration. (10)

12 A rotor is mounted midway on a 24 mm diameter horizontal shaft supported at the ends by two bearings. The rotor weighs 12 kg and the centre of mass of the rotor is 0.11mm away from the geometric centre of the rotor. The bearings are 1m apart and the shaft rotates at 2400 rpm. Find the amplitude of the steady-state vibrations and the dynamic force transmitted to the bearing. E = 200 GN/m^2. (10)

13 a) What is transmissibility? What is the importance of the term in vibration analysis? (4)

b) Explain the working of accelerometer with neat sketch. (6)

14 Two rotors A and B are attached to the ends of shaft 800mm long. The mass of the rotor A is 150kg and its radius of gyration is 250mm. The corresponding values of rotor B are 200kg and 350mm respectively. The shaft is 70mm in diameter for the first 250mm, 150mm for the next 280mm and 100mm diameter for the remaining length. The modulus of rigidity of the shaft material is 80GN/mm^2. Find the position of the node and frequency of torsional vibrations. (10)

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