Reg No.:_____ Name:_____

03000ME304052401

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S, FE) / S4 (PT) (S,FE) Examination May 2024 (2015 Scheme)

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) Explain the virtual work method of static force analysis and Describe the effects of friction on the forces the members of a slider crank mechanism. (6)

b) What are the conditions of equilibrium of a body under the action of (4)

i. two forces,

ii. three forces

iii. two forces and a torque

2 In four bar link mechanism with the following dimensions AD = 600mm AB = 500mm, BC = 900mm and DC = 800mm, a force of 85 N acting at 150° to the horizontal at point E on link DC such that DE = 400 mm. Calculate the torque required on link AB such that link AB has turned through an angle of 120°. (10)

3 a) State and explain D'Alembert's Principle. (4)

b) Derive expressions for correction couple and turning moment at crank shaft due to correction torque. (6)

4 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)

PART B

Answer any three full questions, each carries 10 marks.

5 Four masses A, B, C and D carried by a rotating shaft at radii 80mm, 100mm, 160mm and 120mm respectively are completely balanced. Masses B, C and D are 8 kg, 4 kg and 3 kg respectively. Determine the mass A and the relative angular positions of the four masses if the planes are spaced 500mm apart. (10)

6 The effective turning moment exerted by two stroke engine at a crank shaft is represented by $T = 5000 + 1000 \sin 2\theta - 1000 \cos 2\theta$ (N-m) where θ is the inclination of the crank at inner dead centre. The mass of flywheel is 500 kg and its radius of gyration is 60 cm. The engine speed is 500 rpm. Assuming external resistance as constant, determine: i) the power developed and ii) percentage fluctuation of speed. (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, that 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 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)

PART C

Answer any four full questions, each carries 10 marks.

9 a) Define the terms (4)

i. Natural Vibrations

ii. Damped Vibrations

iii. Forced Vibrations

iv. Resonance

b) A beam of length 12 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 = 205×10^3 N/mm^2. (6)

10 The mass of an electric motor is 122 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 (10)

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.

11 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)

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

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

14 a) Explain torsionally equivalent shaft and derive an expression for it. (6)

b) Write brief notes on vibration isolation. (4)

****