Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: ME304

Course Name: DYNAMICS OF MACHINERY (ME, MP, AU, PE)

Max. Marks: 100 Duration: 3 Hours

PART A

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

1 The applied load on the piston of an offset slider-crank linkage shown in Fig.1 is 100 N, and the coefficient of friction between the slider and the guide is 0.27, using graphical method determine the magnitude and sense of torque τ_2 applied on OA for the static equilibrium of the linkage. (10)

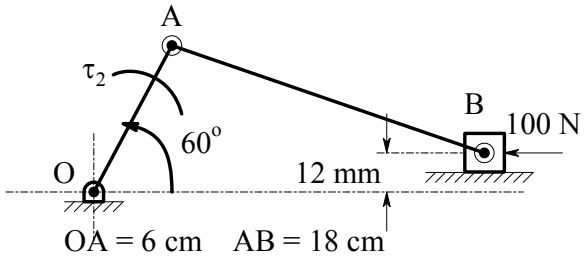

Fig. 1

2 Fig. 2 shows a four bar linkage on which various forces acting and their directions are shown. Determine the magnitude and direction of the torque applied on the link O_1A to keep the equilibrium of the linkage. Also determine the magnitude and direction of the forces transmitted to the frame of the linkage. Use Matrix method. (10)

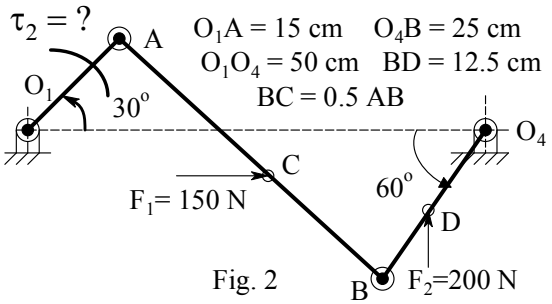

Fig. 2

3 Two 20° straight bevel gears have a module pitch of 4mm, and 24 and 48 teeth respectively. The tooth face width is 50 mm. The pinion rotates at 1000 rpm and transmits 5 kW. The shafts are at 90°. Determine the components of the gear force and show these on a sketch of the gears. (10)

4 In Fig. 3 a slider crank linkage is shown, in which various accelerations are shown (10)

and. The crank OA is running in the CCW direction. The mass of the connecting rod AB is 4 kg and moment of inertia about its mass centre G is 0.052 kg-m^2 and mass of the slider is 2.5 kg. Assume that the crank OA is weightless. Determine the magnitude and direction of the torque to be applied on the crank to balance the inertia effects of the linkage

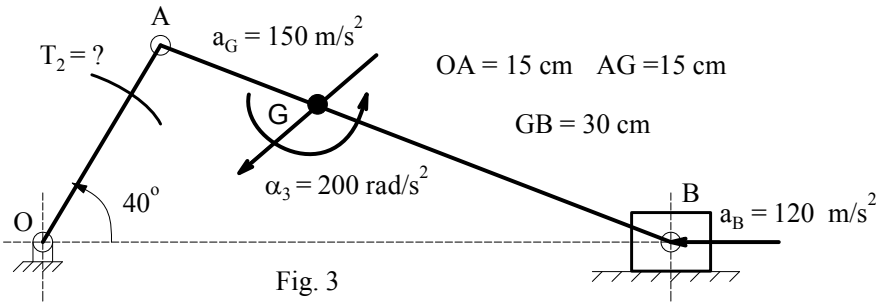

Fig. 3

PART B

Answer any three full questions, each carries 10 marks.

5 A constant torque 2.5 kW motor drives a riveting machine. The mass of the moving parts, including the flywheel is 125 kg at 70 cm radius. One riveting operation absorbs 10,000J of energy and takes 1.2 seconds. Speed of the flywheel is 240 rpm before riveting. Determine (1) No. rivets closed per hour and (2) the reduction in speed after the riveting operation. (10)

6 A shaft carries four rotating masses A of 5 kg, B of m_B kg, C of 4.5 kg, and D of 3.5 kg in this order from left to right. The effective radius of rotation of these masses from the left are respectively 30 cm, 40 cm, 35 cm and 25 cm. The plane of rotation of A and B are 35 cm apart and that between Band C are 45 cm apart. The angle between the A and C is 120^o. (10)

Determine (i) the angle between A and B and that between A and D.

(ii) Distance between the planes of revolution of C and D,

(iii) the mass m_B, so that the system is incomplete balance

7 The turbine rotor of a ship weighs 550 kN and has a radius of gyration of 0.45m rotating at 2500 rpm in a CW direction when viewed from the aft. Ship pitches through a total angle of 12^o. Assuming that the motion is being simple harmonic with a period of 15 second, determine (1) the maximum gyroscopic couple on the holding down bolts of the turbine and using the vector diagram, find the direction of yaw when the bow rises. (10)

8 Each road wheel of a motor cycle is of 60 cm diameter and has a moment of inertia of 1.2 kg-m^2. The motor cycle and the rider together weighs 250 kg and the combined centre of gravity is 65 cm above the ground level when the motor cycle is (10)

upright. The moment of inertia of the rotating parts of the engine is 0.18 kg-m^2. The engine rotates 4.5 times the speed of the road wheel in the same sense. Find the angle of heel necessary when the motor cycle is taking a turn of 40 m radius at a speed of 70kmph

PART C

Answer any four full questions, each carries 10 marks.

9 a) By neglecting the mass of the slender uniform rod is shown in Fig. 4(a), determine the natural frequency of free vibration of the mass for small oscillations (5)

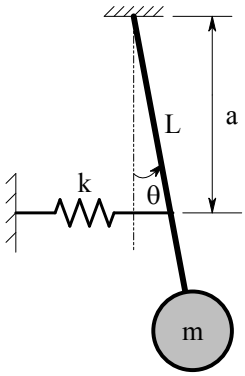

Fig. 4 (a) An oscillating pendulum

b) Find the frequency of the oscillations of the system shown in Fig. 4(b). The roller rolls on the surface without slipping. (5)

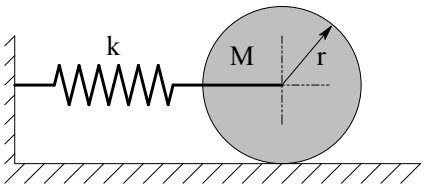

Fig. 4(b) A Cylinder rolling on a floor

10 A mass of 4.5 kg, hangs from a spring and makes damped vibration. The time of 50 complete oscillations is found to be 18 seconds and the ratio of first down ward displacement to the sixth is found to be 2.5. (10)

Find (i) the natural frequency of the system,
(ii) the stiffness of the spring in KN/m,
(iii) the damping coefficient in N-s/m,
(iv) the critical damping coefficient.

11 An electric motor weighing 100 kg is supported on isolators having a damping factor of 0.2. It runs at a speed of 1500 rpm and has a rotating unbalance of 10 kg-cm. What should be the stiffness of the isolators if the forces transmitted to the foundation is to be less than 10 % of the unbalanced force (10)

12 A rotor has a mass of 12 kg and mounted midway on a 24 mm diameter horizontal shaft supported at ends by bearings. The bearings are 1 m apart. The shaft rotates at (10)

2400 rpm. If the centre of mass of the rotor is 0.11 mm away from the geometric centre of the rotor due to certain manufacturing defects. Find the amplitude of steady state vibration. Take E = 200GPa

13 A centrifugal pump rotating at 400 rpm is driven by an electric motor at 1200 rpm through a single stage reduction gearing. The moment of inertia of the pump impeller and the motor are 150 kg-m^2 and 450 kg-m^2 respectively. The lengths of the pump shaft and the motor shaft are 500 mm and 200 mm and their diameters are 100 mm and 50 mm respectively. Neglecting the inertia of the gears, find the frequency of torsional oscillations of the system, and draw the mode shape. Take $G = 82\ GPa$ (10)

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

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