TECHNICAL UNIVERSITY OF MOMBASA

University Examinations 2013/14

THIRD YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EME 2308: MECHANICS OF MACHINES II NOVEMBER/DECEMBER 2013 TIME: 2 HOURS

INSTRUCTIONS:

This paper contains FIVE questions

Attempt any THREE

All questions carry equal marks

Q.1

(a) A mass of 50 kg is suspended from a spring of stiffness 15kN/m of extension. When the mass is slightly displaced from equilibrium, it vibrates freely with amplitude of 18 mm.

Find the periodic time, frequency, velocity and acceleration of the mass when displaced 8 mm from the equilibrium position.

Find also the time interval in passing from this position to the position of maximum displacement

(b) A flywheel is suspended by resting the inside of the rim on a horizontal knife edge so that the wheel can swing in a vertical plane. The flywheel has a mass of 50 kg. The knife edge is parallel to and 450 mm from the axis of the wheel. The periodic time of free vibrations is 1.8 seconds.

Assuming that the center of mass is in the axis of the flywheel, find the radius of gyration about this axis. Also find the torque required to increase the speed of the flywheel at a uniform rate from 60 to 600 revs per min. in 5.2 seconds, when the wheel is revolving about its axis.

Q.2

(a) Deduce the equation of motion for the system shown in fig.Q.2 and give expressions for the following:

1. Roots of equation of motion
2. Damped frequency
3. Critical damping force

(b) A machine of mass 500 kg is mounted on flexible supports, causing the supports to deflect by 5 mm. The supports exert a total damping force equal to15% of the critical, the damping being proportional to velocity of motion. With the machine running at 500 revs./min, an amplitude of 5 mm is measured.

Calculate:

1. Natural frequency of the machine
2. Critical damping force
3. Damping constant
4. Maximum value of disturbing force operating within the machinery

Q.3

(a) In a viscous damped vibrating system, the suspended body is mass 75 kg and the stiffness of the spring suspension is 8.1kN/m. The damping force is proportional to velocity and is equal to 600N at velocity of 1 m/s. A periodic external force of 225cosωt is applied directly to the suspended body, ω being variable.

Determine the maximum possible value of vibration amplitude and the frequency at which it occurs.

Q.4

(a) A shaft running in bearings X and Y has two concentrated masses of 7 and 12kg rigidly fixed to it as shown in fig.Q.4. The masses and the axis of the shaft are all in the same plane. Find the reactions at the bearings when the shaft runs at 15revs/sec. Neglect dead weight.

(b) In order to avoid load on bearings during rotation of the shaft, a mass is fixed to the shaft at radius 125 mm as shown in hidden details. Find the magnitude of the mass and the distance of its plane from bearing X

Q.5

(a) A motor is mounted on one end of a shaft and a pinion B on the other end and the pinion is in mesh with gear wheel C, giving a speed reduction of 5. The moment of inertia of A, B and C are 120, 20 and 200kg m2 respectively, and the torsion stiffness of the shaft is 2.7 k Nm per degree of twist.

Derive an expression for the natural frequency of torsion vibration of the equivalent two mass- system, and its value.