TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2304: MECHANICS OF MACHINES II

END OF SEMESTER EXAMINATION

SERIES:DECEMBER2016

TIME:2HOURS

DATE: Pick DateDECEMBER 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This pa per consists of **FIVE** questions. Attempt **any THREE questions**.

Do not write on the question paper.

Question ONE

a) List **FIVE** causes of vibration (5 Marks)

b) An accelerometer indicates that the acceleration of a body is sinusoidal at a frequency of *40 Hz* . If the maximum acceleration is *100 m/s* ^{2} find the amplitude of the displacement and the maximum velocity.. (5 marks)

c) Determine the natural frequency of the system given in figure 1. Let $k = 10$ *N*/m and $m = 50$ *Kg.* (10 Marks)

Question TWO

a) A mass of *10 Kg* when suspended from a spring, causes a static deflection of *0.02 m* .Find the natural frequency.. (5 marks)

b) Derive the equation of motion for the system shown in figure 2. Use D'Alermbert's principle. (5marks)

c) A spring mass damper system has a mass of 6 kg, spring stiffness of 120 N/m and damping coefficient of 6 N s/m. Determine;

i. Frequency of damped oscillation (5 marks)

ii. No of cycles after which the initial amplitude is reduced to 50%. (5 marks)

Question THREE

A centrifugal pump, with a mass of *50 kg* and rotational speed of *3000 rpm*, is mounted in the middle of a simply supported beam of length *100 cm*, width *20 cm* and thickness *0.5 cm*. The damping ratio of the system (beam) can be assumed as $\xi = 0.05$. The impeller (rotating part) of the pump has a mass of *5 kg* with an eccentricity of *1 mm*. If the maximum deflection of the beam is constrained to be less than the available rattle space of *3 mm*, determine whether the support of the pump is adequate. Ignore the mass of beam(20 marks)

Let $k = \frac{48EI}{L^3}$, $E = 207\ X\ 10^9 Pa$

Question FOUR

a) A rigid rotor has all its unbalance in one plane and can be considered to consist of three masses. $M_1 = 6\ Kg\ \ < 0°$,$M_2 = 5\ Kg\ \ < 170°$, and $M_3 = 10\ Kg\ \ < -75°$. The radii at which these masses located are *20, 10, 12 cm* respectively. Determine the balancing mass required at a radius of *10 cm.* Specify the location of this mass with respect to the first mass. (10 marks)

b) Twenty number of *1 cm* diameter holes are to be punched every minute in a *1.5 cm* steel plate whose resistance to shear is *353.16 MPa*. The actual punching takes place one fifth of the interval between two successive operations. The speed of the flywheel is *300 rpm*. Design a suitable cast iron rimmed flywheel with the coefficient of fluctuation of speed = *0.01* and the maximum velocity of the rim equal to *60 m/s*. (10 marks)

Question FIVE

a) In a spring controlled governor, the controlling force is a straight line. The mass of each ball is *10 kg*. When the balls are *40 cm* apart, the controlling force is *1200 N* and when *25 cm* apart, it is *450 N*. Find the speed when the ball are *30 cm* apart. (10 marks)

b) A trolley car of mass 5*000 Kg* with *4* wheels runs on rails which are *2 m* a part and travels around z curve *50 m* radius at speed *50 km/h* . There is no super elevation of any of the rails. Each wheel of the trolley is of *40 cm* radius and of the two axles is driven an engine at a speed five times the rotation of the wheels in an opposite direction. The mass of inertia of each wheel is *20 kgm* ^{2} . Each motor with shaft and gear pinion has a mass moment of inertia *15 kgm* ^{2} . The center of gravity of the car is about *80 cm* above the rail level. Calculate the vertical gyroscopic reaction on the wheels. (10 marks)

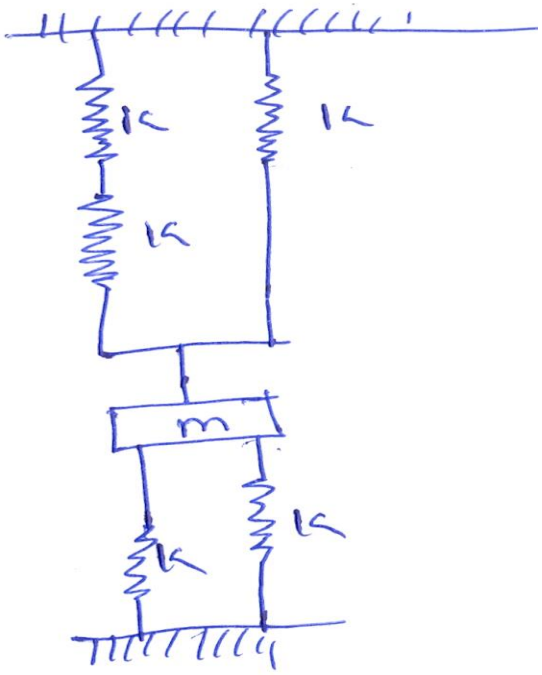

FIGURE 1

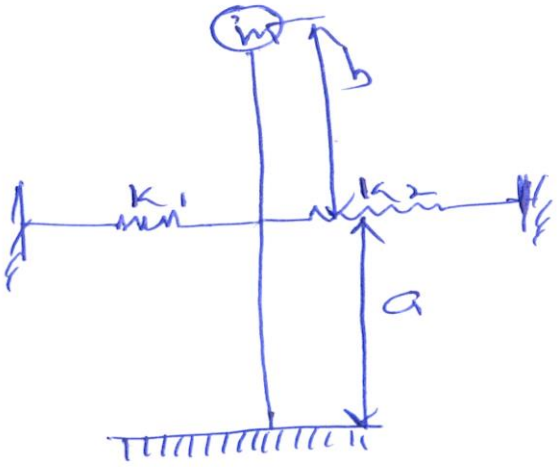

FIGURE 2