



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: DECEMBER 2016

TIME: 2 HOURS

DATE: Pick Date DECEMBER 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt **any THREE** questions.

Do not write on the question paper.

Question ONE

- List FIVE uses of vibration (5 Marks)
- A harmonic motion has a frequency 15 Hz and its maximum velocity is 5 m/s . Find its amplitude, time period and maximum acceleration. (5 marks)
- Determine the natural frequency of the system given in figure 1. Let $k = 10 \text{ N/m}$ and $m = 50 \text{ Kg}$. (10 Marks)

Question TWO

- An electric switch gear is supported by a crane through a steel cable of length 4 m and diameter 0.01 m . If the natural time period of axial vibration of the switch gear is found to be 0.1 s . Find the mass of the switch gear. Let 207 MPa (5 marks)
- Derive the equation of motion for the system shown in figure 2. Use D'Alembert's principle. (5 marks)

- c) The mass of spring – mass – dashpot system is displaced by a distance of 0.07 m from the equilibrium position and released. Find the equation of motion for the system for the cases when
- $\zeta = 1$ (5 Marks)
 - $\zeta = 0.6$ (5 Marks)

Question THREE

- a) A system having rotating unbalance has a total mass of 20 Kg. The unbalance of 0.5 Kg rotates with a radius of 0.02 m. It has been observed that at a speed of 1000 rpm, the system and the eccentric mass have a phase difference 90 degrees and the corresponding amplitude is 0.02 m. Determine;
- The natural frequency of the system (7 marks)
 - The damping factor (3 marks)
 - The amplitude at 1500 rpm (7 marks)
 - The phase angle at 1500 rpm (3 marks)

Question FOUR`

- a) A rigid rotor has all its unbalance in one plane and can be considered to consist of three masses. $M_1 = 8 \text{ Kg} < 0^\circ$, $M_2 = 3 \text{ Kg} < 170^\circ$, and $M_3 = 8 \text{ Kg} < -75^\circ$. The radii at which these masses located are 22, 9, 14 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) A single cylinder four stroke petrol engine develops a power of 25 hp at a mean speed of 300 rpm . The work done during suction and exhaust strokes can be neglected. While the work done by the gases during explosion stroke is three times the work done on the gases during compression. Determine the size of a suitable flywheel to prevent a fluctuation on speed greater than 2 %. The flywheel diameter may be taken as 1.5 m . Assume that the torque curve to be vertical upto the average torque line at the beginning and completion of the explosion stroke. (10 marks)

Question FIVE

- a) In a spring controlled governor, the controlling force is a straight line. The mass of each ball is 12 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 3000 Kg automobile has four wheels each 80 Kg and radius of gyration 0.4 m . The centre of gravity of the vehicle is 0.5 m above the road level and track is 1.5 m . It has a rear mounted engine whose rotating parts has a mass moment of inertia 10 Kgm^2 and rotate in the same sense as the road wheels. The gear ratio of engine to road wheels is 5 . Calculate the limiting speed when the vehicle takes a turn on a curve track 200 m radius. (10 marks)

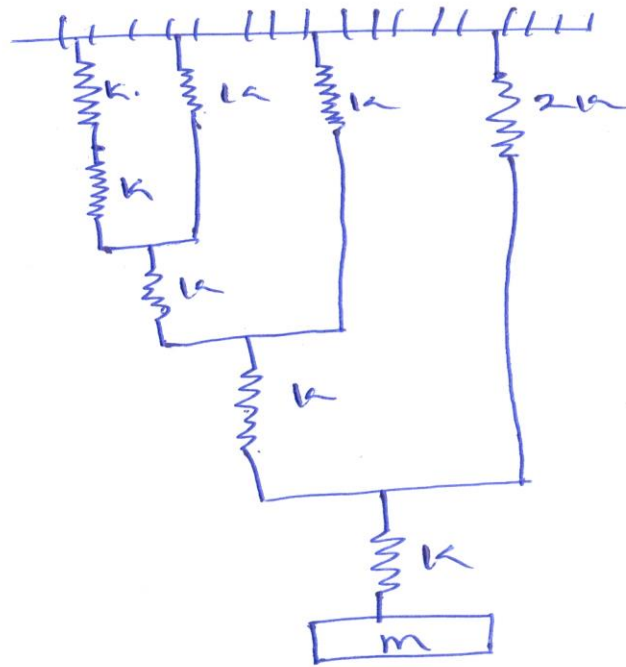


Figure 1

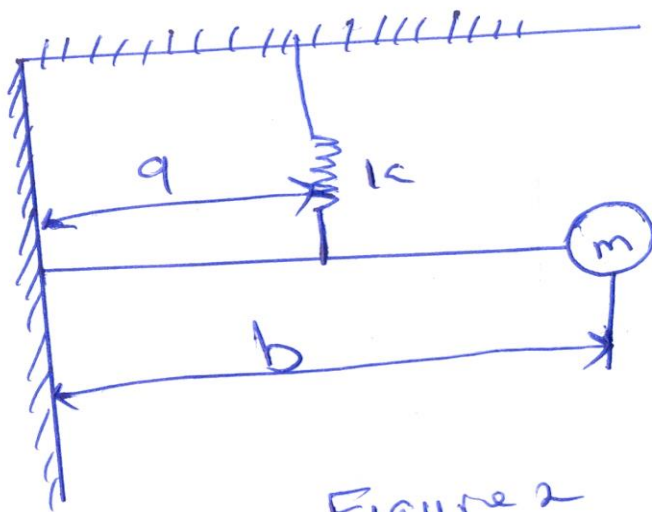


Figure 2