TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
BSc. Mechanical Engineering
EMG 2412: VIBRATIONS
SUPPLIMENTARY EXAMINATION
SERIES: September 2018
TIME: 2 HOURS

Instruction to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FOUR** questions. Attempt any **THREE** questions.
Maximum marks for each part of a question are as shown.
Do not write on the question paper.

Question ONE

a) A harmonic motion has an amplitude of *0.03 m* and a frequency of *45 Hz.* Determine the time period, maximum velocity and maximum acceleration. (10 Marks)

b) Find the equivalent spring constant and the natural frequency of the system in figure 1.
Let $k_1 = k_2 = k_3 = k_4 = k_5 = k_6 = 3\ kN/m,\ m = 7\ kg$ (10 Marks)

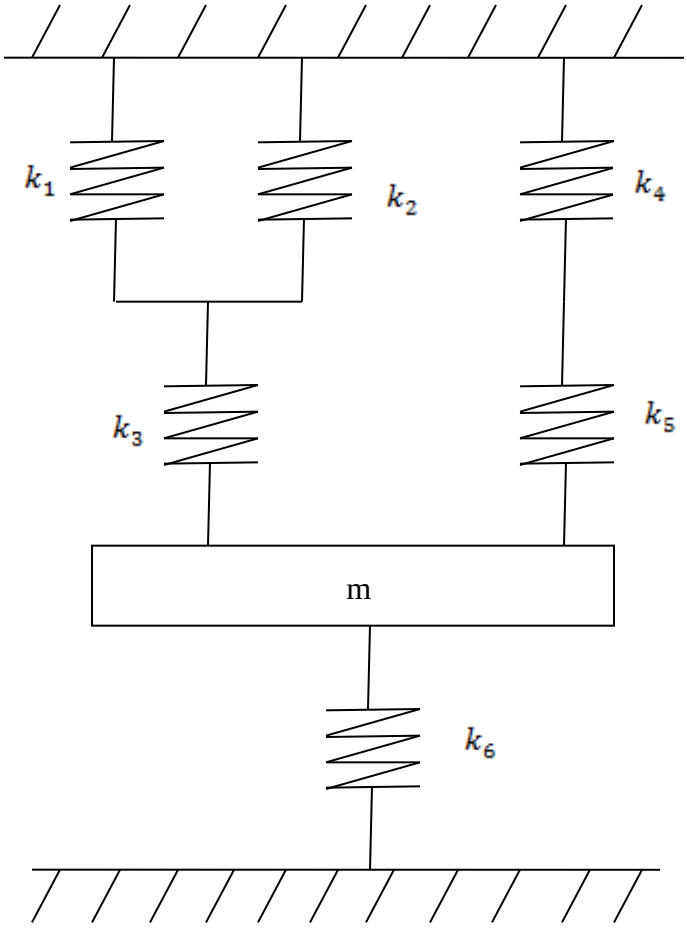

Figure 1

Question TWO

a) Develop an expression for the amplitude for a rotating body with unbalanced mass. (10 Marks)

b) A single cylinder vertical petrol engine of total mass *320 kg* is mounted upon a steel chassis and causes a vertical static deflection of *2 mm*. The reciprocating parts of the engine have a mass of *24 kg* and move through a vertical stroke of *150 mm* with simple harmonic motion. A shock absorber attached to the system offers a resistance of *490 N* at a velocity of *0.3 m/s*. Determine ;

i. The speed of driving shaft at resonance (3 Marks)

ii. The amplitude of steady state vibration when the driving shaft of the engine rotates at *480 rpm.* (7 Marks)

Question THREE

(a) Find the expression for natural frequencies of figure 2. (10 Marks)

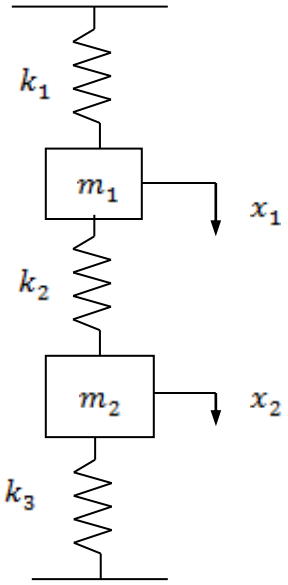

Figure 2

(b) The weight of a reciprocating machine is *450 N* and runs at a constant speed of *3600 rpm*. After being installed, it was found that the forcing frequency is too close to the natural frequency of the machine. What dynamic vibration absorbers should be added if the nearest natural frequency of the system should be at least 20 % from the impressed frequency? (10 Marks)

Question FOUR

a) Develop an expression for the critical speed of a light shaft with a single disc without damping. (10 Marks)

b) A vertical shaft, *10 mm* in diameter, rotates in bearings with a span of *600 mm* and carriers a disc of mass 15 kg midway between the two bearings. The mass centre of the disc is *0.3 mm* away from the geometric axis. If modulus of elasticity $E = 200\ GPa$ and the stress on the shaft is not to exceed $70\ Mpa$. Determine the critical speed or whirling speed of the shaft (10 Marks)

Question FIVE

a) Determine the natural frequency of system shown in Figure 3 using Rayleigh's method. Let $E = 200 \times 10^9\ N/m^2$ and $I = 4 \times 10^{-7}\ m^4$. (10 marks)

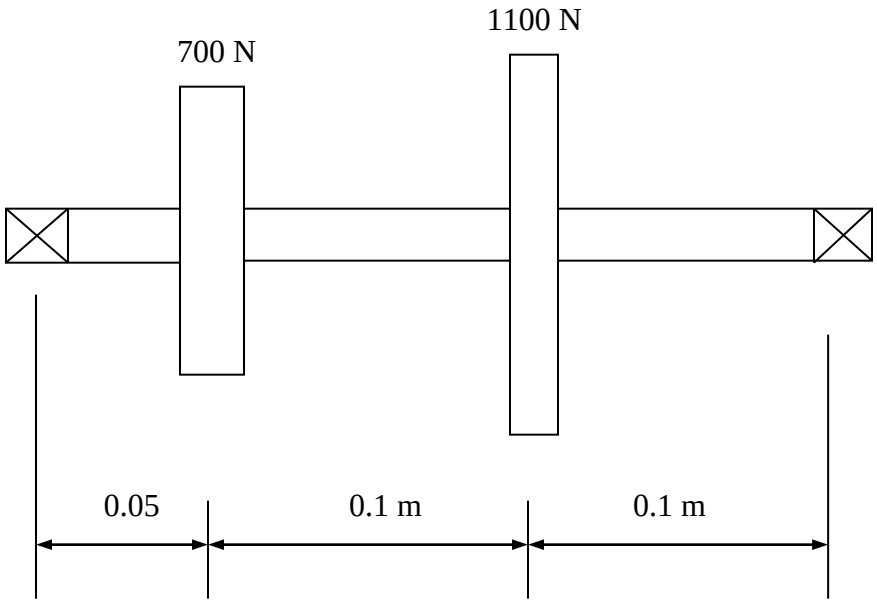

Figure 3

b) Find the fundamental natural frequency of Figure 4 using Dunkerley method. Let $E = 200 \times 10^9\ N/m^2$ and $I = 4 \times 10^{-7}\ m^4$. (10 Marks)

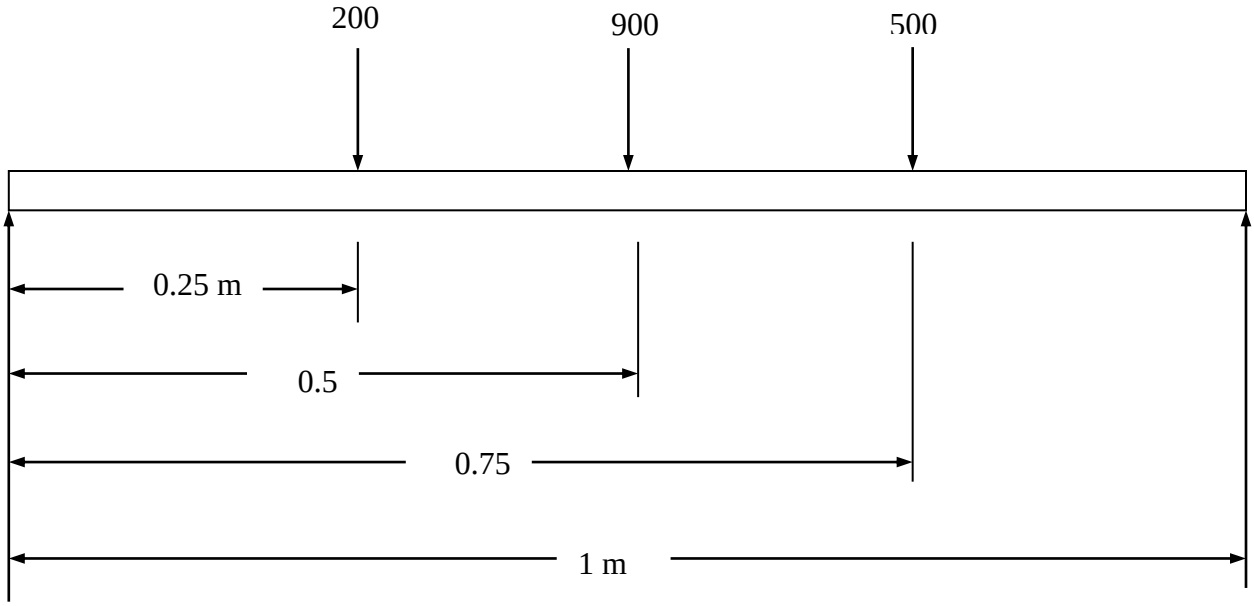

Figure 4