KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (MANUFACTURING ENGINEERING)

EMM 311: MECHANICS OF MACHINES II

DATE: Tuesday, 17th April, 2012 TIME: 8.00 a.m. – 10.00 a.m.

INSTRUCTIONS:

- The paper consists of **FOUR** questions
- Answer any **THREE** questions.
- Each question carries 20 marks.

QUESTION ONE

a) State the FOUR laws of simple pendulum that obeys the principles of simple harmonic motion. (4 marks)

b) Show that when a rigid body is suspended vertically as shown in Fig. 1.0 and it oscillates with a small amplitude under the action of the force of gravity. Its time periodic (tp) is given by:

$$2\pi\sqrt{\frac{KG^2+h^2}{gh}}$$

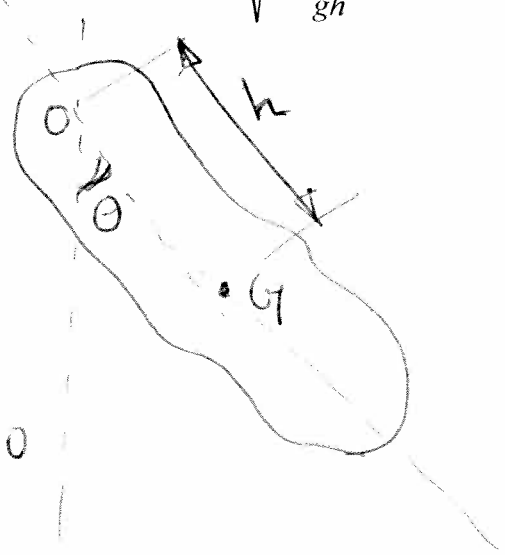

Fig 1.0

G = centre of gravity

(8 marks)

c) A uniform thin rod, as shown in Fig. 2.0 has a mass of 1kg and carries a concentrated mas of 2.5kg at B. The rod is hinged at A and is maintained in the horizontal position by a spring of stiffness 1.8 KN/m at C. Calculate the frequency of oscillation, neglecting the effect of the mass of the spring.

(8 marks)

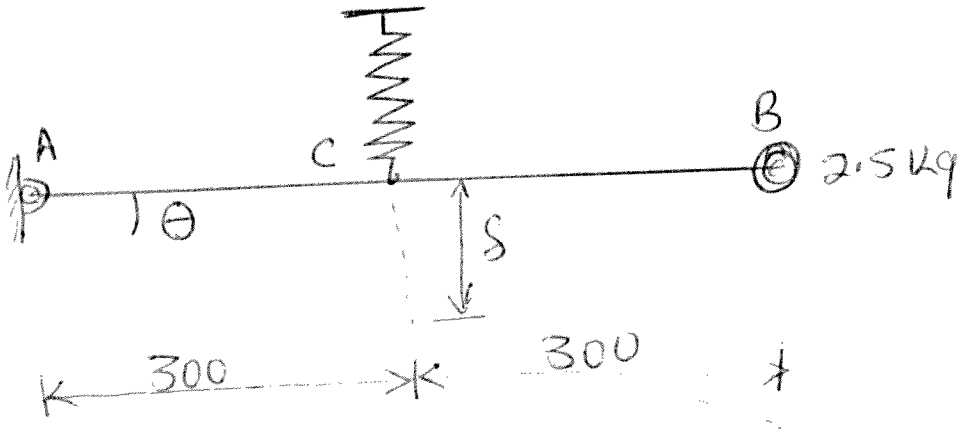

Fig 2.0

QUESTION TWO

a) A shaft carries Four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18kg and 12.5kg respectively, and each has an eccentricity of 60mm. The masses at A and D have an eccentricity of 80mm. The angle between the masses at B and C is 100^{o} and that between the masses at B and A is 190^{o} both being measured in the same direction. The axial distance between the planes A and B is 100mm and that between B and C is 200mm. If the shaft is in complete dynamic balance:

Determine:

i) the magnitude of the masses at A and D

ii) the distance between planes A and D

iii) the angular position of the mass at D

(14 marks)

b) With an aid of sketch illustrate three types of vibratory motion and give a practical example in each case. (6 marks)

QUESTION THREE

a) Describe the following three types of free vibrations:

i) Longitudinal vibration

ii) Transverse vibration

iv) Torsional vibration

(3 marks)

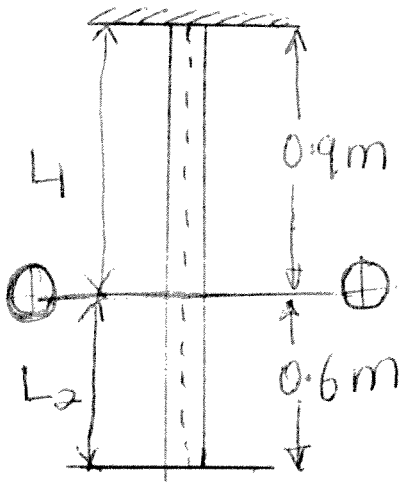

Fig 3.0

b) A flywheel is mounted on a vertical shaft as shown in Fig. 3.0. The both ends of the shaft are fixed and its diameter is 50mm. The flywheel has a mass of 500kg. Calculate the natural frequencies of longitudinal and transverse vibrations.

take $E = 200\ GN/m^2$

(9 marks)

c) A shaft 50mm diameter and 3 meters long is simply supported at the ends and carries three loads of 1000N, 1500N and 750N at 1m, 2m and 2.5m from the left support. The Young's modulus for shaft material is 200 GN/m^2. Calculate the frequency of transverse vibrations.

(8 marks)

QUESTION FOUR

a) The measurements on a mechanical vibrating system show that it has a mass of 8kg and that the springs can be combined to give an equivalent spring of stiffness 5.4 n/mm. If the vibrating system have a dashpot attached which exerts a force of 40N and when the mass has a velocity of 1mls

Determine:

i) Critical damping co-efficient

ii) Damping factor

iii) Logarithmic decrement

iv) Ratio of two consecutive amplitudes

(6 marks)

b) A mass of 10kg is suspended from one end of a helical spring, the other end being fixed. The stiffness of the spring is 10N/mm. The viscous damping causes the amplitude to decrease to one-tenth of the initial value in four complete oscillations. If a periodic force of 150 ws 50t N is applied at the mass in the vertical direction. Calculate the amplitude of the forced vibration. What is its value of resonance? (12 marks)