(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY REGULAR EXAMINATIONS 2021/2022 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF MASTER OF SCIENCE IN STRUCTURAL ENGINEERING

COURSE CODE: CSE 822

COURSE TITLE: ADVANCED STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING

DATE: THURSDAY 28TH APRIL 2022 TIME: 8.00 – 11.00 AM

INSTRUCTIONS:

1. This paper contains **FIVE** questions.
2. Answer any **FOUR** Questions.
3. Marks for each question are indicated in the parenthesis.
4. State clearly any engineering assumptions where necessary.
5. Examination duration is **3 Hours.**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE (*25 MARKS*)

As a structural engineer you are faced with a task of carrying out dynamic analysis of an elevated tank. The brief of the elevated water tank is as follows: full water tank capacity is to be 100,000 liters of water, the elevation is 12m, the supports of the water tank are 4 square hollow clamped steel columns with a width of 100mm and a thickness of 8 mm. Taking the damping ratio in the system to be 0.1, carry out the following:

a) Model the system as a single degree of freedom damped system
b) Determine the response of the tank on an initial transverse displacement of 400 mm.

QUESTION TWO (*25 MARKS*)

Consider a two-degree of freedom mass-spring system shown in Figure Q2. You are required to:

a) Find the natural frequencies and mode shapes.
b) Calculate the response $x_1(t)$ and $x_2(t)$ of both masses for the initial conditions $x_1(0) = 1$ mm, $x_2(0) = 0$ and $v_1(0) = v_2(0) = 0$

QUESTION THREE (*25 MARKS*)

Figure Q3 shows a cam-follower system in which the motion of the valve can be described using Fourier series expansion. You are required to determine the Fourier series expansion of the motion of the valve in the system.

QUESTION FOUR (*25 MARKS*)

a) With illustrations, state methods which engineers can use to predict the maximum amplitude of an earthquake in a given region?
b) Discuss any five (5) principles that have to be taken into account in order to avoid as much as possible damage in buildings as result of an earthquake.

QUESTION FIVE (*25 MARKS*)

Discuss the principle of modal superposition for the solution of a *N*-degree of freedom system.