MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY ORDINARY EXAMINATION

2020/2021 ACADEMIC YEAR

THIRD YEAR **SECOND** SEMESTER EXAMINATION FOR, BACHELOR OF SCIENCE IN ELECTRICAL & ELECTRONICS ENGINEERING

EES 314– SIGNALS AND SYSTEMS

DURATION:2 HOURS

Instructions to candidates:

1. Answer question One and Any Other Two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

a) Consider two continuous time sinusoidal signals $x_1(t) = A_1 \sin(2\pi f_1 t + \phi_1)$ and $x_2(t) = A_2 \sin(2\pi f_2 t + \phi_2)$

Determine:

i. The conditions under which the sum signals $x(t) = x_1(t) + x_2(t)$ is also periodic

ii. The fundamental period of the signal $x(t)$as a function of the relevant parameters of $x_1(t)$and $x_2(t)$ (6marks)

b) A system is described by $y(t) = [\cos t]x(t)$. Determine whether or not the system is

i. Linear

ii. Time Variance

iii. Casual (6marks)

c) Two systems are described by their impulse response as $h_1(t) = 2e^{-t}u(t)$ and $h_2(t) = 4e^{-2t}u(t)$. Determine the overall impulse response if

i. The systems are connected in parallel

ii. The systems are connected in series (6marks)

d) Determine the zero state response of a stable LTI continuous system with a frequency response

$$H(s) = \frac{1}{s+2}$$

and the input is $x(t) = e^{-t}u(t)$ using Fourier transform techniques

(6marks)

e) The unit step response of a continuous time LTI system is

$$y(t) = (2 - 4e^{-t} + 2e^{-2t})u(t)$$

Find the differential equation for this system (6marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

a) State and hence prove the Parseval's theorem (6marks)

b) Determine the exponential Fourier series coefficient aid graph on line spectrum for the multi-tone signals

$$x(t) = \cos(2\pi[10f_0]t) + 0.8\cos(2\pi[f_0]t)\cos(2\pi[10f_0]t)$$

(6marks)

c) The right sided exponential signal is given by $x(t) = e^{-at}u(t)$.

i. Determine the Fourier transform of the signal
ii. Sketch both its magnitude and phase response (8marks)

QUESTION THREE (20 MARKS)

a) Determine the Laplace transform of the signal

$$x(t) = \cos(\omega t)u(t)$$

(5marks)

b) Consider two signals given by $x_1(t) = e^{-t}u(t)$and $x_2(t) = \delta(t) - e^{-2t}u(t)$

Determine $x(t) = x_1(t) * x_2(t)$ using Laplace transform techniques (5marks)

c) Consider a second order differential equation

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t)$$

Assume the above equation represents a system with input $x(t)$and output $y(t)$. Determine:

i. The impulse response $h(t)$
ii. The unit step response $s(t)$ of the system (10marks)

QUESTION FOUR (20 MARKS)

a) State Nyguist sampling criterion (2marks)
b) Consider a right sided exponential signal $x(t) = e^{-100t}u(t)$ .This signal is to be impulse sampled. Determine and graph the spectrum of the impulse sampled signal $x_s(t)$for sampling rates $f_s = 400Hz$ (7marks)
c) An LTI system has the impulse function $h(t) = e^{-2t}u(t)$.Determine whether the system is stable or not. (3marks)
d) Obtain a complete solution for an LTI system described by

$$\frac{dy(t)}{dt} + 2y(t) = x(t)$$

for $x(t) = Ke^{3t}u(t)$ (8marks)