10.

(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER MAIN EXAMINATIONS

FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN ELECTRICAL AND COMMUNICATIONS ENGINEERING

COURSE CODE: ECE 325

COURSE TITLE: SIGNAL AND SYSTEMS

DATE: FRIDAY, APRIL, 29TH, 2022 **TIME: 3:00 – 5:00 PM**

INSTRUCTIONS TO CANDIDATES

Question ONE (1) is compulsory
Answer Any Other TWO (2) questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

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QUESTION ONE

a. State and express three properties of convolution. 6 marks

b. Outline the following using suitable expressions.
   i. Correlation of power signals.
   ii. Power spectral density. 6 marks

c. If $f_1(t) \rightleftharpoons F_1(\omega)$
   $f_2(t) \rightleftharpoons F_2(\omega)$
then $f_1(t) \otimes F_2(t)\ f_2(\omega) \rightleftharpoons F_1(\omega)\ F_2(\omega)$ 8 marks

d. (i) Define what is meant by a signal.
   (ii) Distinguish between linear time invariant and time-invariant signals. 6 marks

e. State what is meant by system representation. 4 mark

QUESTION TWO

a. State Four conditions of function f(t) used in applying the Fourier series representations inside the internal $-T/2 \leq t \leq T/2$ 10 marks

b. Derive that the input x(t) is convolved with the impulse h(t) then the time response will be as expressed $y(t) = \int_{\infty}^{p} h(t)x\ (t-\tau)d\tau$ 10 marks

QUESTION THREE

a. Distinguish the following pairs of classes of signals.
   i. Periodic signals and non-periodic signals.
   ii. Deterministic signals and random signals. 3 marks
   iii. Energy signals and power signals. 3 marks

b. Prove that if in time shifting the Fourier transform is $f(t) \rightleftharpoons F(\omega)$
   Then for a constant time shift "to" the transform will be as follows:-
   $F(t\text{-}to) \rightleftharpoons F(\omega)\ e^{-2\pi ft}$ 11 marks

QUESTION FOUR

a. With the aid of suitable frequency responses describe the operation of the following filters:
   i. Ideal high –pass filter.
   ii. Ideal band-pass filter.
   iii. Ideal band stop filter.

b. Derive to show that the Fourier transform of the output LTI is:
   $Y(\omega) = H(\omega)\ X(\omega)$
   When $y(t) = \int_{\infty}^{\infty} h(\tau)x\ (t-\tau)dt$ 5 marks

c. If $x_1(t)$ and $x_2(t)$ are real –valued energy signals then write:
   i. An expression for crosscorrelation 3 marks
   ii. A expression for autocorrelation 2 marks
   iii. Write three properties of correlation functions 3 marks

QUESTION FIVE

a. If it is given that
   $f(t) = e^{-3t}\ x(t)$ is passed through a filter whose cut off frequency is $\omega_c = 1$ radian /second: Prove that this input signal is an energy signal 8 marks

b. The trigonometric Fourier series is given as f(t) $a_o + 2\sum_{n-1}^{\infty}\ a_n \cos n\omega t + b_n \sin n\omega t$
   Represents a rectangular pulse with a duration of τ and a period T; the amplitude of the pulse is A. Analyse and show that the series may be expressed as:

   $$f(t) = \frac{A\tau}{T} + \frac{2A\tau}{T}\sum \frac{\sin n\omega\tau/2}{n\omega\tau/2}\cos n\omega t$$ 12 marks