(Knowledge for Development)

KIBABII UNIVERSITY

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UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

SPECIAL/SUPPLEMENTARY EXAMINATIONS

YEAR THREE SEMESTER TWO

FOR THE DEGREE OF COMPUTER SCIENCE

COURSE CODE: CSC 354E

COURSE TITLE: SIGNALS AND SYSTEMS II

DATE: 21/11/22 TIME: 02.00 P.M - 04.00 P.M

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY OTHER TWO (2) QUESTIONS

QUESTION ONE [30 MARKS]

a) Outline the importance of Laplace transforms in signals and systems [2mks]

b) Find the Laplace of the following signals:

i) $f(t) = \frac{3}{4}$ [2mks]

ii) $f(t) = e^{0.5t}$ [2mks]

iii) $f(t) = 2t^2$ [2mks]

iv) $f(t) = \sin 0.3t$ [2mks]

v) $f(t) = \cos 0.5t$ [2mks]

c) Outline **FIVE** properties of Laplace transforms [4mks]

d) Using the properties of Laplace transforms, find Laplace transforms of the following functions:

i) $f(t) = e^{2t}t^3$ [2mks]

ii) $f(t) = e^{0.4t}\sin 3t$ [2mks]

iii) $f(t) = e^{2t}(t^3 + 5)$ [2mks]

e) Outline the relationship between Z-transform and Fourier transform [2mks]

f) Find the Z-transform of the following sequences

i) $x[n] = \frac{2}{3}$ [2mks]

ii) $x[n] = \frac{1}{3}\delta[n]$ [2mks]

iii) $x[n] = \frac{2}{5}\delta[n-3]$ [2mks]

QUESTION TWO [20 MARKS]

a) By inspection, find the inverse Z-transform of $X(Z) = 3 - 2Z^{-1} + 4Z^{-3}$ [2mks]

b) Determine the z-transform for each of the following sequences. Plot the pole-zero plot and indicate the region of convergence.

i) $x[n] = \delta[n+3]$ [6mks]

ii) $x[n] = \left(\frac{1}{4}\right)^2 u[2-n]$ [8mks]

c) Find the zeros of the following sequences:

$$h[n] = \delta[n] + \frac{1}{4}\delta[n-1] - \frac{1}{2}\delta[n-2]$$ [4mks]

QUESTION THREE [20 MARKS]

a) Suppose we are given the following five facts about a particular system S with impulse response $h[n]$ and z-transform $H[Z]$:

1. $h[n]$ is real
2. $h[n]$ is right sided
3. LimH(Z)=1 as z tends to infinity
4. $H(Z)$ has two zeros
5. $H(Z)$ Has one of its poles at a non-real location on the circle defined by $|z| = \frac{3}{4}$

   i) Is S causal? [4mks]

   ii) Is S stable? [4mks]

b) With a relevant example describe the region of convergence (ROC) of z-transform. [2mks]

c) We are given the following five facts about a discrete-time signal $x[n]$ with Z-transform X(Z):

1. $x[n]$ is real and right-sided
2. $X[Z]$ has exactly two poles
3. $X[Z]$ has two zeros at the origin
4. $X[Z]$ has a pole at $z = \frac{1}{2}e^{j\pi/3}$
5. $X[1] = \frac{8}{3}$

Determine $X[Z]$ and specify its region of convergence (ROC) [10mks]

QUESTION FOUR [20 MARKS]

a) Find the inverse Laplace transforms of the following transforms:

   i) $X[s] = \left\{ \frac{4}{s^2 + 3)} \right\}$ [3mks]

   ii) $X[s] = \left\{ \frac{s+2}{s^2 - 16)} \right\}$ [3mks]

b) Find the inverse z-transform and draw the pole-zero plot of the following transform:

$$X[z] = \left\{ \frac{1}{(1 - \frac{1}{4}Z^{-1})(1 - \frac{1}{2}Z^{-1})} \right\}, \qquad ROC : |z| > \frac{1}{2}$$ [10mks]

c) With appropriate example outline two properties of z-transform [4mks]

QUESTION FIVE [20 MARKS]

a) Solve the initial value problem by Laplace transform,

i) $y'' - y' - 12y = 2, \quad y(0) = 1, \quad y'(0) = 2$ [8mks]

ii) $y'' - y' - 2y = e^{2t}, \quad y(0) = 0, \quad y'(0) = 1$ [8mks]

b) Find the z-transform of $y[n] = \{1, 0, 0, \frac{1}{8}, 0, 0, \frac{1}{8^2}, \ldots$ and its ROC. [4Marks]

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