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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: ES CLUSTER (EEE/ECE/EIE/ETE/MD) **Duration: 3 hrs.**
Course Code: 19ES4CCSAS **Max Marks: 100**
Course: SIGNALS AND SYSTEMS **Date: 19.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) Define and sketch the continuous time Unit impulse and the Unit Ramp signals. **04**

b) i) Plot the continuous time signal $x(t)$ defined by **04**

$$x(t) = \begin{cases} \frac{t}{T}, & -\frac{T}{2} \le t \le \frac{T}{2} \\ 1, & t \ge \frac{T}{2} \\ 0, & t < -\frac{T}{2} \end{cases}$$

ii) Compute and plot the derivative of the signal defined by **04**
$x(t) = u(t) - u(t-a)$ *where* $a > 0$.

c) Analyze and evaluate the average power or energy of the following signals.

i) $x(t) = rect\left(\frac{t}{T_o}\right)$ **04**

ii) $x(t) = cos\omega_o(t) * rect\left(\frac{t}{T_o}\right)$ **04**

OR

2 a) For the discrete time sequence defined by **08**

$$x(n) = \begin{cases} 1, & -1 \le n \le 2 \\ \frac{1}{2}, & 3 \le n \le 4 \\ 0, & elsewhere \end{cases}$$

Evaluate the following
$i) x(n)\, u(2-n)$ $ii) x(n-1)\, \delta(n-3)$ and
$iii)$ *even and odd components of* $x(n)$.

b) Analyze whether the given signal is energy or power signal and justify the same. **08**

i) $x(n) = e^{j\left[\left(\frac{\pi}{3}\right)n + \left(\frac{\pi}{2}\right)\right]}$ ii) $x(n) = u(n) - u(n-6)$

c) Mention the conditions to be satisfied by a system in terms of impulse response to be **04**
i) Stable ii) Causal iii) Invertible and iv) Memory less.

UNIT - II

3 a) Consider the RC passive Low pass filter shown in Fig.3a and verify whether it is stable or unstable by analysing its impulse response. **06**

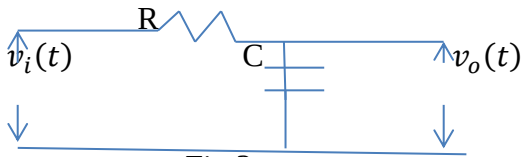

Fig.3a

b) Determine whether the systems described by the following equations are linear. If not give the suitable condition for linearity. **02**

i) $y(n) = ax(n) + b$

ii) $y(t) = \frac{1}{12}x(t) - \frac{5}{6}$ **04**

c) Consider the system with following input-output relation **04**
$y(n) = (1 + (-1)^n)x(n)$ where, x[n] is the input and y[n] is the output. Identify whether the system is
(i) Invertible and time invariant (ii) Invertible and time varying
(iii) Non-invertible and time invariant
(iv)Non-invertible and time varying.
Justify your answer.

d) Implement the system described by the following difference equation using direct form –I. **04**

$$y(n) + \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = 2x(n) + 3x(n-1)$$

UNIT - III

4 a) Determine the response of an LTI system with impulse response **10**

$h(n) = (1, -2, 3)$ for the input $x(n) = \begin{cases} 2, & n = -2,0,1 \\ 3, & n = -1 \\ 0, & elsewhere. \end{cases}$

Using graphical method.

b) Calculate the output of an LTI system having impulse response **10**
$h(t) = e^{-t}$, $t \geq 0$, for the input $x(t) = u(t)$.

OR

5 a) Evaluate the response of an LTI system with impulse response **10**
$h(n) = (1, \underset{\uparrow}{2}, 2, 1)$ for the input $x(n) = (4, 2, 1, 3)$. Using graphical method.

b) Determine the convolution of $x(t) = u(-t + 2)$ and **10**
$h(t) = [u(t + 2) - u(t - 1)]$ .Using the graphical method.

UNIT - IV

6 a) Determine the Discrete Time Fourier Series representation of a periodic signal **08**
$x(n) = sin\left(\frac{4\pi}{21}n\right) + cos\left(\frac{10\pi}{21}n\right) + 1$. Sketch the magnitude and Phase spectrum.

b) Find the DTFT of the following signals **04**
i) $x(n) = (0.5)^{n+2}u(n)$ ii)) $x(n) = \delta(6 - 3n)$

c) i) Compute the Fourier Transform of the function $x(t)$ shown in the Fig.6c using appropriate property of the Transform. **04**

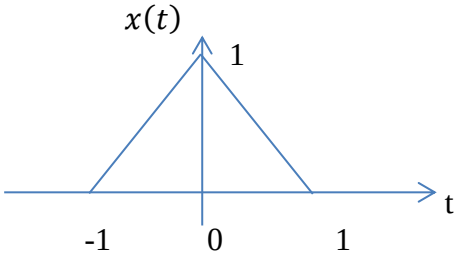

Fig.6c

ii) Apply the convolution theorem and determine the inverse Fourier Transform of **04**

$X(\omega) = \frac{1}{(a+j\omega)^2}$.

UNIT - V

7 a) i) Find the inverse Z Transform of $X(z) = \frac{z}{(z-1)(z-2)}$ using the convolution property of the Z Transform. **04**

ii) Find the discrete time sequence associated with **03**

$X(z) = \frac{1}{1-z^{-4}}$, ROC, $|Z| > 1$.

b) i) Determine the output of a system with impulse response **04**

$$h(n) = \begin{cases} \left(\frac{1}{2}\right)^n, 0 \le n \le 2 \\ 0, elsewhere \end{cases}$$

and input $x(n) = \delta(n) + \delta(n-1) + 4\delta(n-2)$ using Z Transform.

ii) For the difference equation $y(n) + b^2 y(n-2) = 0$, $for\ n \ge 0$, where initial conditions are $y(-1) = 0$ and $y(-2) = -1$. **06**

Prove that $y(n) = b^{n+2} cos\left(\frac{n\pi}{2}\right)$ using Z transform.

c) List the properties of ROC of the Z Transform. **03**

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