CBCS SCHEME

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18EE54

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Signals and Systems

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Distinguish between
   i) Even and Odd signals
   ii) Energy and power signals **(06 Marks)**

b. Check whether the following signals are periodic or not. Determine their fundamental period.
   i) $x(t) = \text{Cos}(\sqrt{2}t) + \text{Cos}(t)$
   ii) $x(n) = 3e^{\frac{j3\pi}{5}\left(n+\frac{1}{2}\right)}$ **(06 Marks)**

c. Sketch and find the energy of the following signals
   i) $x(t) = \begin{cases} t & ; \quad 0 < t < 1 \\ 2-t & ; \quad 1 < t < 2 \\ 0 & ; \quad \text{otherwise} \end{cases}$
   ii) $x(n) = \begin{cases} 1 & ; \quad |n| \le 1 \\ 0 & ; \quad \text{otherwise} \end{cases}$ **(08 Marks)**

OR

2 a. Given the signal $x(n) = (6-n)\{u(n) - u(n-6)\}$ determine and sketch the following signals.
   i) $y_1(n) = x(4-n)$
   ii) $y_2(n) = x(2n-3)$ **(06 Marks)**

b. A continuous time signal x(t) and g(t) is shown in Fig Q2(b) respectively. Express x(t) interms of g(t).

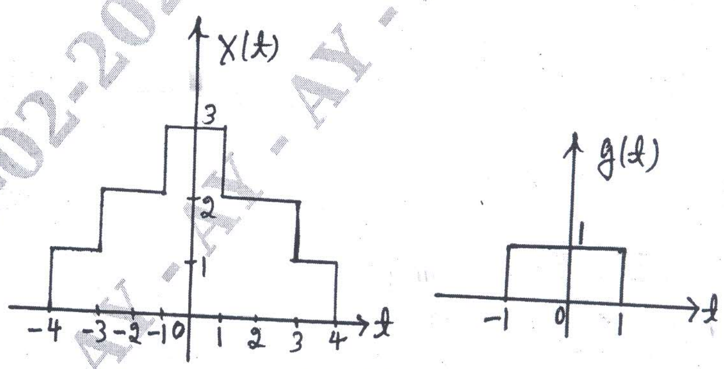

Fig Q2(b) **(04 Marks)**

c. Determine whether the following systems are memoryless, causal, linear, Time invariant and stable i) $y(t) = x^2(t)$ ii) $y(n) = x(-n)$ **(10 Marks)**

Module-2

3 a. Evaluate the convolution sum of $x(n) = \beta^n u(n)$; $|\beta| < 1$ and $h(n) = \alpha^n u(n)$; $|\alpha|<1$. **(08 Marks)**

b. Determine whether the LTI system described by the following impulse responses are memoryless, causal and stable.
   i) $h(t) = e^{2t}u(t-1)$
   ii) $h(n) = 2u(n) - 2u(n-1)$ **(06 Marks)**

c. Determine the forced response for the system given by, $5\frac{dy(t)}{dt} + 10y(t) = 2\times(t)$ with input $x(t) = 2u(t)$. **(06 Marks)**

OR

4 a. Evaluate the convolution integral of $x(t) = u(t+1)$ and $h(t) = u(t-2)$. Also sketch the y(t). **(06 Marks)**

b. Determine the complete response of the system described by the difference equation: $y(n) - \frac{1}{9}y(n-2) = x(n-1)$ with $y(-1) = 1$, $y(-2) = 0$ and $x(n) = u(n)$. **(08 Marks)**

c. Draw the direct form I and direct form II implementations for the difference equation
$y(n) + \frac{1}{2}y(n-1) - y(n-3) = 3\times(n-1) + 2\times(n-2)$ **(06 Marks)**

Module-3

5 a. State and prove following properties of CTFT.
   i) Time differentiation ii) Frequency shift **(08 Marks)**

b. Determine the CTFT of the signal x(t) is shown in Fig Q5(b)

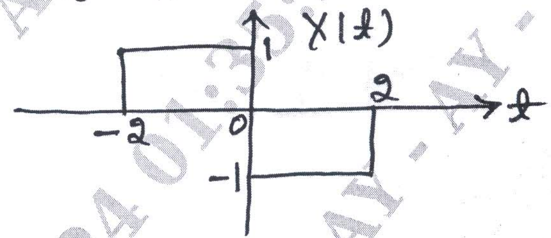

Fig Q5(b) **(04 Marks)**

c. Determine the frequency response and impulse response of the system having the input $x(t) = e^{-t}u(t)$ and output $y(t) = e^{-2t}u(t) + e^{3t}u(t)$. **(08 Marks)**

OR

6 a. State and prove the following properties of CTFT i) Modulation ii) Time shift **(08 Marks)**

b. Determine the Fourier transform of the signal
   $x(t) = e^{-at}u(t)$; $a > 0$. Draw its magnitude and phase spectra. **(06 Marks)**

c. Determine the frequency response and impulse response for system described the differential equation.
$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = \frac{-dx(t)}{dt}.$$ **(06 Marks)**

Module-4

7 a. State and derive the following properties of DTFT. (08 Marks)
i) Time shift ii) Convolution

b. Determine the frequency response and the impulse response of the system having input.
$x(n) = \left(\frac{1}{2}\right)^n u(n)$ and output $y(n) = \frac{1}{4}\left(\frac{1}{2}\right)^n u(n) + \left(\frac{1}{4}\right)^n u(n)$ (08 Marks)

c. Using the appropriate properties, find DTFT of the following signal
$x(n) = \left(\frac{1}{2}\right)^n u[n-2]$ (04 Marks)

OR

8 a. State and derive the following properties of DTFT (08 Marks)
i) Frequency differentiation
ii) Parseval's Theorem.

b. Find the DTFT of the following signals (06 Marks)
i) $x(n) = \sigma(n)$
ii) $x(n) = \alpha^n u(n)$; $|\alpha| < 1$. Draw the magnitude spectrum.

c. Determine the frequency response and the impulse response of the system described by the difference equation. $y(n) + \frac{1}{2}y(n-1) = x(n) - 2x(n-1)$ (06 Marks)

Module-5

9 a. Define ROC. Describe the properties of ROC in Z-plane. (08 Marks)

b. Determine the Z-transform of $x(n) = -u(-n-1) + \left(\frac{1}{2}\right)^n u(n)$, find the ROC and poles locations of x(z) in the z-plane. (06 Marks)

c. A causal system has input $x(n) = \sigma(n) + \frac{1}{4}\sigma(n-1) - \frac{1}{8}\sigma(n-2)$ and output $y(n) = \sigma(n) - \frac{3}{4}\sigma(n-1)$. Find the impulse response of the system. (06 Marks)

OR

10 a. State and derive the following properties of 2 – transform (08 Marks)
i) Time Reversal
ii) Convolution property.

b. Determine the inverse z-transform if $x(z) = \dfrac{\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}$ with ROC's
i) $|z| > \frac{1}{2}$ ii) $|z| < \frac{1}{4}$ iii) $\frac{1}{4} < |z| < \frac{1}{2}$ (08 Marks)

c. Determine whether the system described below is causal and stable. (04 Marks)
$$H(z) = \frac{2z+1}{z^2 + z - \frac{5}{16}}$$

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