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CBCS SCHEME

USN

17EE54

Fifth Semester B.E. Degree Examination, July/August 2022
Signals and Systems

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Check whether the signal shown in Fig.Q.1(a) is energy or power signal. Hence determine the corresponding value. **(10 Marks)**

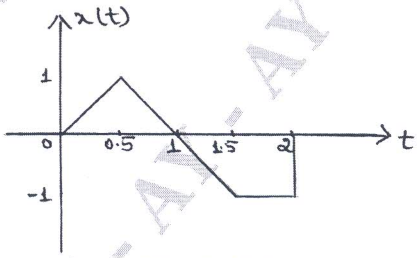

Fig.Q.1(a)

b. State whether the following signals are periodic or not. If periodic determine the fundamental time period.

i) $x(t) = \cos(2t) + \sin(3t)$.

ii) $x[n] = \sin\left(\frac{\pi}{3}n\right) \cdot \cos\left(\frac{\pi}{5}n\right)$. **(06 Marks)**

c. Define signals and systems. **(04 Marks)**

OR

2 a. Sketch the following signal:
$x(t) = r(t+2) - r(t+1) - r(t-2) + r(t-3)$.
Hence determine the even and odd components of x(t). Also sketch the even and odd components of x(t). **(08 Marks)**

b. A continuous time signal x(t) is shown in Fig.Q.2(b). Sketch and label each of the following signals i) $x(-t+3)$ ii) $x(t/2-2)$ iii) $x(-2t-1)$. **(06 Marks)**

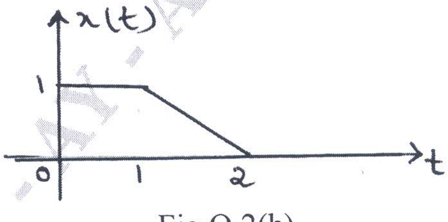

Fig.Q.2(b)

c. For system described by $y(t) = e^{at}\,x(t)$. Determine whether the system is i) Linear ii) Time-invariant iii) Stable. **(06 Marks)**

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Module-2

3 a. An LTI system has an impulse response $h(t) = u(t - 2)$. If the input applied to the system is $x(t) = u(t + 1)$. Evaluate the response of the system. Also sketch the response of the system. **(08 Marks)**

b. The impulse response of an LTI system is $h[n] = \{1, \underset{\uparrow}{2}, 1, -1\}$. Evaluate the response of the system if the input signal is $x[n] = \{\underset{\uparrow}{1}, 2, 3, 1\}$. **(06 Marks)**

c. The impulse response of discrete time LTI system is $h[n] = (1/2)^n u[n]$. Determine whether the system is i) Memoryless ii) Causal iii) Stable. **(06 Marks)**

OR

4 a. Determine the step response for the LTI system represented by the impulse response $h(t) = \frac{1}{4}[u(t) - u(t-4)]$. **(04 Marks)**

b. Evaluate the complete response of the system represented by the differential equation

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

The input $x(t) = 4.e^{-3t} u(t)$.

The initial conditions $y(0) = 3; \frac{dy(0)}{dt} = 4$. **(10 Marks)**

c. Sketch the direct form-I and direct form – II realization of the system represented by the difference equation

$$y[n] + \frac{1}{2}y[n-1] - \frac{1}{3}y[n-3] = x[n] + 2x[n-2].$$ **(06 Marks)**

Module-3

5 a. State and prove the following properties in continuous time Fourier transform:
i) Time shift ii) frequency Differentiation. **(08 Marks)**

b. Evaluate the Fourier transform of $x(t) = e^{at} u(-t)$. **(06 Marks)**

c. Determine the inverse Fourier transform of

$$X(jw) = \frac{5jw + 12}{(jw)^2 + 5jw + 6}.$$ **(06 Marks)**

OR

6 a. The transfer function of a system is $H(jw) = \frac{16}{4 + jw}$. Find the time domain response $y(t)$; for the input $x(t) = u(t)$. **(10 Marks)**

b. A continuous time LTI system is described by the differential equation $\frac{d}{dt}y(t) + 2y(t) = x(t)$. Using Fourier transform, evaluate the output $y(t)$ for the input $x(t) = e^{-t} u(t)$. **(10 Marks)**

Module-4

7 a. State and prove the following properties in DTFT: i) Linearity ii) Time Reversal. **(08 Marks)**

b. Evaluate the DTFT of $x[n] = u[n] - u[n-6]$. **(06 Marks)**

c. Using appropriate property, evaluate the DTFT of the signal $x[n] = (1/2)^n u[n-2]$. **(06 Marks)**

OR

8 a. Determine the frequency response of a discrete time LTI system represented by the impulse response $h[n] = (1/2)^n u[n]$. **(06 Marks)**

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

c. Using appropriate property, evaluate DTFT of $x[n]=\sin\left(\frac{\pi}{4}n\right)\left(\frac{1}{4}\right)^n u[n-1]$. **(08 Marks)**

Module-5

9 a. Evaluate Z-transform of $x[n] = -u[-n-1] + (1/2)^n u[n]$. Depict the ROC and location of poles and zeros of X(z) in z-plane. **(10 Marks)**

b. Determine the inverse Z-transform of the sequence

$$X(z)=\frac{z}{3z^2-4z+1} \text{ for the following ROC}$$

i) $|z|>1$ ii) $|z|<\frac{1}{3}$ iii) $\frac{1}{3}<|z|<1$ **(10 Marks)**

OR

10 a. Mention the properties of Region of convergence. **(04 Marks)**

b. State and prove the following properties of Z-transform:
i) Time shift ii) Time Reversal. **(08 Marks)**

c. Solve the difference equation using unilateral Z-transform
$y[n]-\frac{3}{2}y[n-1]+\frac{1}{2}y[n-2]=x[n]$ with initial conditions y[-1] = 4, y[-2] = 10. The input $x[n]=\left(\frac{1}{4}\right)^n u(n)$. **(08 Marks)**

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