CBCS SCHEME

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18EE54

Fifth Semester B.E. Degree Examination, July/August 2021
Signals and Systems

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

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.

1 a. Describe the classification of signals. **(06 Marks)**

b. A continuous signal X(t) shown in Fig Q1(b). Sketch the odd and even signal of X((t).

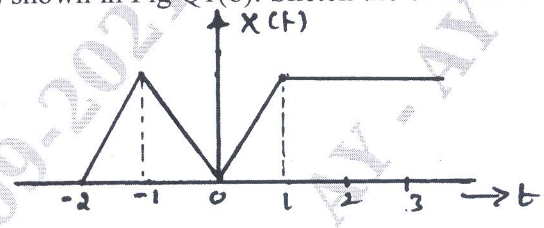

Fig Q1(b) **(06 Marks)**

c. Determine the whether the signals are periodic or non-periodic

i) $X((t) = \cos(2\pi t)\sin(4\pi t)$

ii) $X((n) = \cos\left(\frac{\pi n}{2}\right) + \sin\left(\frac{\pi n}{4}\right)$. **(08 Marks)**

2 a. Determine the following signals are energy or power signals.

i) $X(t) = \begin{cases} t, & 0 < t < 1 \\ 2 - t & 1 \le t \le 2 \\ 0 & \text{otherwise} \end{cases}$ ii) $X(n) = \left(\frac{1}{2}\right)^n u(n)$ **(06 Marks)**

b. Let y(t) and x(t) are given in Fig Q2(b) sketch the following signal.
$z(t) = X((2t) * y(0.5t + 1)$

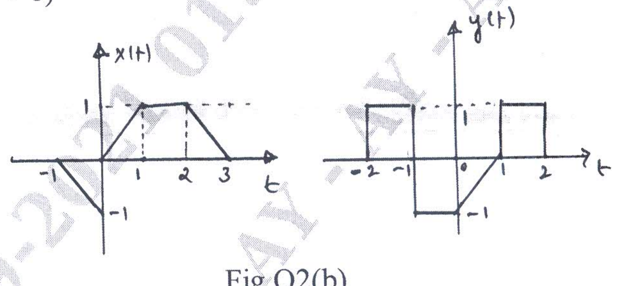

Fig Q2(b) **(06 Marks)**

c. Determine whether the following signals are linear, memoryless, causal, stable and time invariance.

i) $y(n) = X((n^3)$ ii) $y(t) = \frac{d}{dt}[e^{-t}X(t)]$. **(08 Marks)**

3 a. Compute the convolution of the sequences
$X(n) = \alpha^n u(n)$ $y(n) = \beta^n u(n)$
When $\alpha \# \beta$ and $\alpha = \beta$ **(06 Marks)**

b. Obtain the convolution of the two signals. Also sketch the result. Given

$h(t) = \begin{cases} 1 & \text{for } 1 < t < T \\ 0 & \text{otherwise} \end{cases}$ $X(t) = \begin{cases} t\ ; & 0 < t < 2T \\ 0 & \text{otherwise} \end{cases}$ **(08 Marks)**

c. Determine the natural response of the system described by the following differential equation

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t) + 3\frac{dx(t)}{dt} \text{ with initial condition are } y(0) = 0, \left.\frac{dy(t)}{dt}\right|_{t=0} = 1$$

(06 Marks)

4 a. A continuous time LTI system is represented by impulse response. Determine whether the system is stable, causal and memory.
i) $h(n) = a^n u(n+2)$ ii) $h(t) = e^{2t}u(t-1)$. **(06 Marks)**

b. Draw the direct form I and direct form II implementation of y

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

(06 Marks)

c. Determine the forced response of the system described by difference equation

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = 2x(n) \text{ with input } x(n) = 2u(n).$$

(08 Marks)

5 a. What are the properties of continuous time Fourier transform? State and prove Parsavel's theorem. **(08 Marks)**

b. Find the Fourier transform of $x(t) = t\, e^{-2t}u(t)$. Draw magnitude and phase spectra. **(06 Marks)**

c. Compute the Fourier transform for the signal x(t). Shown in Fig Q5(c).

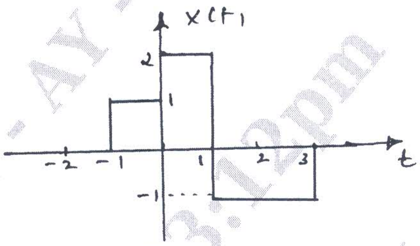

Fig Q5(c) **(06 Marks)**

6 a. Using partial fraction expansion, determine the inverse Fourier transform

$$x(jw) = \frac{5jw + 12}{(jw)^2 + 5jw + 6}.$$

(06 Marks)

b. Find the Fourier transform of the following signal using appropriate properties
$x(t) = \text{Sin}(\pi t)\, e^{-2t}\, u(t)$. **(06 Marks)**

c. Find the frequency response and impulse response of the system describe by the differential equation $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = -\frac{dx(t)}{dt}$. **(08 Marks)**

7 a. Describe the following properties of DTFT
i) Frequency differentiation ii) Linearity iii) Scaling iv) Modulation. **(08 Marks)**

b. Evaluate the DTFT of the signal $x(n) = \left(\frac{1}{2}\right)^n u(n-4)$. **(06 Marks)**

c. Using appropriate properties, find the DTFT of the following signal

$$x(n) = \text{Sin}\left(\frac{\pi}{4}n\right)\left(\frac{1}{4}\right)^n u(n-1).$$

(06 Marks)

8 a. Find the inverse DTFT of

$$x(e^{jw}) = \frac{6}{e^{-j2\Omega} - 5e^{-j\Omega} + 6}.$$ **(06 Marks)**

b. Obtain the frequency and impulse response of the system having the output y(n) for the input x(n) as given below.

$$x(n) = \left(\frac{1}{2}\right)^n u(n)$$

$$y(n) = \frac{1}{4}\left(\frac{1}{2}\right)^n u(n) + \left(\frac{1}{4}\right)^n u(n)$$ **(08 Marks)**

c. Obtain the difference equation for the system with frequency response.

$$H(e^{jw}) = 1 + \frac{e^{-jw}}{\left(1 - \frac{1}{2}e^{-j\Omega}\right)\left(1 + \frac{1}{4}e^{-j\Omega}\right)}.$$ **(06 Marks)**

9 a. Determine the Z-transform of $x(n) = -u(-n-1) + \left(\frac{1}{2}\right)^n u(n)$. Find the ROC and pole-zero location of x(z) in the Z-pole. **(06 Marks)**

b. What are the properties of Z-transform? Determine the : i) Multiplication by an exponential ii) Translation iii) Multiplication by ramps. **(08 Marks)**

c. Find the Z-transform of the following

i) $x(n) = na^n u(n-3)$

ii) $x(n) = u(-n)$ **(06 Marks)**

10 a. Find the discrete-time sequence x(n) which has Z-transform

$$x(z) = \frac{-1 + 5z^{-1}}{1 - \frac{3}{2}z^{-1} + \frac{1}{2}z^{-2}}.$$ With ROC i) $|z|>1$ ii) $|z| < \frac{1}{2}$. **(06 Marks)**

b. A causal system has input x(n) and output y(n). Find the impulse response of the system if

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

$$y(n) = \delta(n) - \frac{3}{4}\delta(n-1)$$ **(06 Marks)**

c. Solve the difference equation

$y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + x(n-1)$. The initial conditions are $y(-1) = 1$, $y(-2) = -1$ with the input $x(n) = 3^n u(n)$. **(08 Marks)**

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