CBCS SCHEME

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17EE54

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

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Explain the classification of signals. **(08 Marks)**

b. Find and sketch the even and odd components of the following:

$$x(t) = \begin{cases} t & 0 \le t \le 1 \\ 2-t & 1 \le t \le 2 \end{cases}$$ **(06 Marks)**

c. Check whether the following signals are periodic or not. If periodic, find the fundamental period. i) $x_1(n) = \text{Cos}2\pi n$ ii) $x_2(n) = \text{Cos}2n$. **(06 Marks)**

2 a. Explain the properties of systems. **(06 Marks)**

b. Determine whether the system $y(t) = x(t^2)$ is i) Linear ii) Time-invariant iii) Casual iv) Stable. **(08 Marks)**

c. A continuous time signal x(t) show in Fig.Q.2(c). Draw the signal $y(t) = \{x(t) + x(2-t)\}\, u(1-t)$. **(06 Marks)**

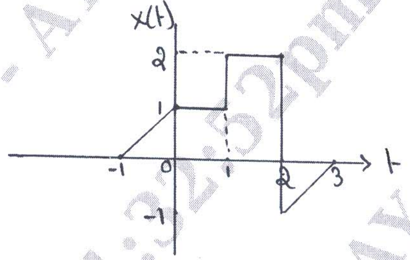

Fig.Q.2(c)

3 a. Derive the equation for convolution integral. **(06 Marks)**

b. A continuous time LTI system with unit impulse response h(t) = u(t) and input $x(t) = e^{-at}\,u(t)$; a > 0, find the output y(t) of the system. **(08 Marks)**

c. A difference equation of a discrete time system is given $y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + \frac{1}{2}x(n-1)$. Draw direct form-I and direct form-II structures. **(06 Marks)**

4 a. Find the 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 $x(n) = u(n)$. **(10 Marks)**

b. Find the total response of the system given by

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 2x(t) \text{ with } y(0) = -1\ ; \left.\frac{dy(t)}{dt}\right|_{t=0} = 1 \text{ and } x(t) = \text{Cos}\, t\, u(t).$$

(10 Marks)

5 a. Find the Fourier transform of rectangular pulse shown below:

$$x(jw) = \frac{1}{(a + jw)^2}$$ (08 Marks)

b. Obtain the Fourier transform of $x(t) = te^{-at}\, u(t)$. (06 Marks)

c. State any six properties of the continuous time Fourier transform. (06 Marks)

6 a. State and prove the following properties of Fourier transform i) Time Shifting Property ii) Parseval's theorem. (10 Marks)

b. The impulse response of a continuous-time LTI system is given by $h(t) = \frac{1}{Rc} e^{-t/Rc}\, u(t)$. Find the frequency response and plot the magnitude and phase response. (10 Marks)

7 a. Find the OTFT of the signal, $x(n) = \alpha^n u(n)$; $|\alpha| < 1$. Draw the magnitude spectrum. (06 Marks)

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

c. Compute the DTFT of the following signals:

i) $x(n) = 2^n u(-n)$ ii) $x(n) = a^{|n|}$; $|a| < 1$ (08 Marks)

8 a. State and prove Parseval's theorem in discrete time domain. (08 Marks)

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

$$x(n) = \left[\frac{1}{2}\right]^n u(n) \; ; \; y(n) = \frac{1}{4}\left[\frac{1}{2}\right]^n u(n) + \left[\frac{1}{4}\right]^n u(n)$$ (06 Marks)

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

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

9 a. Define ROC and explain its properties. (06 Marks)

b. Find the z-transform of the following:

i) $x(n) = \alpha^{|n|}$, $0 < |\alpha| < 1$ ii) $n\left[\frac{1}{2}\right]^n u(n) * \left[\delta(n) + \frac{1}{2}\delta(n-1)\right]$ (08 Marks)

c. Find x(z) if $x(n) = -\alpha^n u(-n-1)$ and find the ROC. (06 Marks)

10 a. Solve the following difference equation using Z-transform $x(n-2) - 9x(n-1) + 18x(n) = 0$. Initial conditions are $x(-1) = 1$, $x(-2) = 9$. (10 Marks)

b. Find inverse z-transform of the following using partial fraction expansion method.

$$X(z) = \frac{\left(1 + 2z^{-1} + z^{-2}\right)}{\left(1 - \frac{3}{2} z^{-1} + \frac{1}{2} z^{-2}\right)}$$ (10 Marks)

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