Question Paper

Exam Date & Time: 16-Dec-2022 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

THIRD SEMESTER B.TECH. (ELECTRONICS AND COMMUNICATION ENGINEERING) EXAMINATIONS - DECEMBER 2022
SUBJECT : ECE 2155 - SIGNALS AND SYSTEMS

Marks: 50 **Duration: 180 mins.**

Answer all the questions.

1A) Sketch the waveforms for the following signals (4)

a. $x(t) = u(t+1) - 2u(t) + u(t-1)$

b. $x(t) = -u(t+3) + 2u(t+1) - 2u(t-1) + u(t-3)$

1B) Identify whether the following signals are energy signals or power signals. Calculate their energy and power (3)

a. $x(t) = \begin{cases} 1, & -\frac{\tau}{2} < t < \frac{\tau}{2} \\ 0, & \text{otherwise} \end{cases}$

b. $x(t) = u(t)$

1C) Identify if the following signals are periodic. If they are periodic, calculate the fundamental period (3)

a. $x[n] = 10\cos\frac{7}{15}\pi n$

b. $x[n] = 20\cos(\frac{4\pi}{31}n + \frac{\pi}{5})$

2A) Determine the response of the system described by (4)

$y[n] = \frac{1}{3}\{x[n+1] + x[n] + x[n-1]\}$ to the input signal, $x[n] = \begin{cases} 3 & -2 \le n \le 2 \\ 0 & otherwise \end{cases}$

2B) Determine the step response of the LTI system whose impulse response is (3)

$h(t) = u(t-1) - 2u(t-2) + u(t-3)$

2C) Justify whether the following system is linear, time invariant, causal and memoryless: (3)

$y[n] + 2y[n-1] = x[n+1].$

3A) Use the defining equation for DTFT to evaluate the spectrum of $x[n] = \left(\frac{1}{3}\right)^{|n|}$. (4)

Sketch the same.

3B) Apply necessary properties to identify the time domain representation of the following frequency domain representation. (3)

$$X(j\omega) = \left(\frac{e^{j3(\omega-1)}}{1+\frac{j(\omega-1)}{2}}\right)$$

3C) Given $x(t) = \frac{d}{dt}\left(3te^{-3t}u(t)\right)$. Evaluate the Fourier transform of x(t). (3)

4A) Use FT to evaluate the response of the continuous time system having impulse response (4)

$h(t) = 2\cos(4\pi t)\frac{\sin(\pi t)}{\pi t}$ to the input given by $x(t) = 0.5 + \cos(1.5\pi t) + \cos(3.5\pi t)$

4B) Certain discrete time system is described by the difference equation (3)

$$y[n] - \frac{1}{4}y[n-1] - \frac{1}{8}y[n-2] = x[n] + \frac{3}{4}x[n-1] - \frac{1}{8}x[n-2].$$

Determine frequency response and impulse response of the system.

4C) The continuous time signal $x(t) = \cos(\omega_o t)$ is sampled (impulse sampling) with sampling interval T=0.5sec. Sketch the spectrum of the sampled signal for $-7\pi \le \omega \le 7\pi$ when (3)

(i) $\omega_o = \pi$ (ii) $\omega_o = 2\pi$ (iii) $\omega_o = 3\pi$.

5A) The difference equation of the LTI system is given by: (4)

$$y[n] = 0.5y[n-1] + x[n].$$

Determine: (i) system function (ii) unit impulse response for the stable system (iii) Sketch the pole-zero plot and indicate the ROC for the system function.

5B) Determine Z-Transform of the signal and indicate the ROC. (3)

$$x[n] = -n\left(-\frac{1}{2}\right)^n u[-n-1] * \left(\frac{1}{4}\right)^{-n} u[-n].$$

5C) Consider the following transfer function: (3)

$$H(S) = \frac{S^2+2S-3}{S^2+3S+2}$$

i) Determine impulse response for the system to be both stable and causal.

ii) Determine inverse system. Does both stable and causal inverse system exist? Justify the answer.

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