CBCS SCHEME

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15EC44

Fourth Semester B.E. Degree Examination, Aug./Sept.2020
Signals and Systems

Time: 3 hrs. Max. Marks: 80

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. Explain how the continuous-time signals are classified into even and odd signals. Derive the equations for decomposing the given signal into even and odd components. Find the even and odd components of the signal: $x(t) = e^{-2t}\cos(t)$. **(06 Marks)**

b. Derive the condition under which a discrete time signal $x(n) = \cos(2\pi f_o n)$ is periodic. Determine whether the signal $x(n) = \cos(2\pi n) + \sin(3\pi n)$ is periodic or not. If periodic, find its fundamental period. **(06 Marks)**

c. Sketch the signal: $x(t) = r(t + 1) - r(t) - r(t - 2) + r(t - 3)$ **(04 Marks)**

OR

2 a. Explain how continuous-time non-periodic signals are classified as energy or power signals. Classify the given signal x(t), and determine its energy or average power $x(t) = e^{-3t}u(t)$. **(06 Marks)**

b. Signal x(n)is shown in Fig.Q.2(b). Draw $y(n) = x(-3n + 2)$. **(06 Marks)**

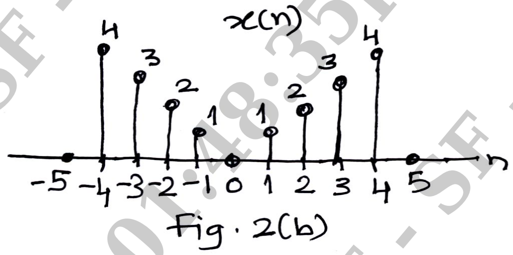

Fig.Q.2(b)

c. Determine if the system given by $y(t) = x(t/2)$ is i) Linear ii) Time-invariant iii) Causal and iv) Stable. Here, $|x(t)| < M_x$ **(04 Marks)**

Module-2

3 a. Derive the equation to determine the output of a linear time-invariant discrete-time system having impulse response h(n) and input x(n). Graphically illustrate with an example taking $x(n) = \{\underset{\uparrow}{1}, 2, 3\}$ and $h(n) = \{\underset{\uparrow}{3}, 2, 1\}$. **(08 Marks)**

b. A continuous-time LTI system has impulse response $h(t) = e^{-2t}u(t)$. Compute the output of the system for input signal $x(t) = u(t) - u(t - 5)$. **(08 Marks)**

OR

4 a. Prove that output of a linear time-invariant continuous-time system can be determined by computing the convolution integral of input signal and impulse response. Illustrate with an example taking $x(t) = u(t)$ and $h(t) = u(t)$. **(08 Marks)**

b. A discrete-time LTI system has impulse response $h(n) = 0.5^n u(n)$. Determine the output of the system for the input $x(n) = u(n) - u(n - 10)$. **(08 Marks)**

Module-3

5 a. A discrete-time periodic signal is given by: $x(n) = \cos\left(\frac{6\pi n}{17} + \frac{\pi}{3}\right)$. Determine its DTFS representation. **(08 Marks)**

b. Impulse response of an LTI system is given by $h(t) = \cos(\pi t).u(t)$. Determine if the system is causal and stable. **(04 Marks)**

c. Determine the step response of a system whose impulse response is given by: $h(n) = (-0.5)^n\, u(n)$. **(04 Marks)**

OR

6 a. A continuous time periodic signal is given by: $x(t) = \text{Sin}\,(3\pi t) + \cos\,(4\pi t)$. Determine its Fourier series representation. **(08 Marks)**

b. Determine the step response of a system whose impulse response is given by: $h(t) = t.u(t)$. **(04 Marks)**

c. The impulse response of a system is given by:
$h(n) = \sin\,(\pi n/3)\,[u(n) - u(n-4)]$. Determine if the system is causal and stable. **(04 Marks)**

Module-4

7 a. Obtain the Fourier transform of the signal $x(t) = e^{-at}\, u(t)$. Plot its magnitude and phase spectra, taking $a = 1$. **(08 Marks)**

b. State and prove the time-shift property of DTFT. **(04 Marks)**

c. Obtain the Fourier Transform of a rectangular pulse given by $x(t) = \begin{cases} 1, & -T < t < +T \\ 0, & \text{otherwise} \end{cases}$ **(04 Marks)**

OR

8 a. Find the DTFT of $x(n) = -a^n\, u(-n-1)$, where 'a' is real. **(06 Marks)**

b. Find the DTFT of $x(n) = (1/2)^n\, u(n-4)$ using the properties of DTFT. **(06 Marks)**

c. State and prove frequency shift property of continuous time Fourier Transform. **(04 Marks)**

Module-5

9 a. Determine the Z-transform of the signal:
$x(n) = \cos(\Omega_0 n).u(n)$, and plot its ROC. **(08 Marks)**

b. State the properties of region of convergence of Z-transform of a signal. **(04 Marks)**

c. Find the inverse Z-transform of the following by long division method:

$x(z) = \frac{z}{z-a}$, ROC : $|z| > a$ **(04 Marks)**

OR

10 a. The difference equation of a discrete time LTI system is given by:
$y(n) = 0.5y(n-1) + x(n)$
Determine: i) System function ii) Pole-zero plot of the system function iii) Impulse response of the system. **(08 Marks)**

c. Determine the inverse z-transform of

$$X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$$

For i) $|z| > 1$ ii) $|z| < 0.5$ iii) $0.5 < |z| < 1$ **(08 Marks)**

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