CBCS SCHEME

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18EE54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
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. Describe the classifications of signals. **(06 Marks)**

b. Is the signal shown in Fig.Q1(b) in power or energy signal? Given reasons for your answer and further determine its energy or power.

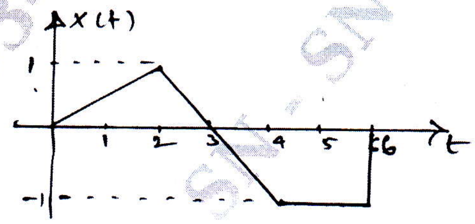

Fig.Q1(b) **(06 Marks)**

c. Determine whether the following signal are periodic, if periodic determine the fundamental period :

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

ii) $x(n) = \cos(\frac{1}{5}\pi n) \sin(\frac{1}{3}\pi n)$. **(08 Marks)**

OR

2 a. Sketch the following signals and determine their even and odd signals $r(t+2) - r(t+1) - r(t-2) + r(t-3)$. **(08 Marks)**

b. Given signal x(t) as shown in Fig.Q2(b). Sketch the following : i) $x(-2t+3)$ ii) $x(t/2 - 2)$.

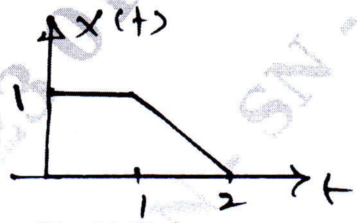

Fig.Q2(b) **(06 Marks)**

c. For each of the system, state whether the system is linear, shift variant, stable, causal and memory. i) $y(n) = \log[x(n)]$ ii) $y(t) = x(t^2)$. **(06 Marks)**

Module-2

3 a. Compute the convolution of two sequences $x_1(n)$ and $x_2(n)$ given below :

$$x_1(n) = \{\underset{\uparrow}{1}, 2, 3\} \quad x_2(n) = \{1, 2, \underset{\uparrow}{3}, 4\}.$$ **(06 Marks)**

b. Convolute the following two signals

$x(t) = 1 \;;\; 0 < t < T$ $\quad h(t) = t \;;\; 0 < t < 2T$
$\quad\;\; 0 \;;$ otherwise $\quad\quad\quad 0 \;;$ otherwise

Obtain expression for the output y(t). **(08 Marks)**

c. An LTI system represented by the impulse response :

i) $h(t) = e^{t2^t} u(t-1)$ ii) $h(n) = a^n u(n+2)$

Determine whether its stable, causal and memory. **(06 Marks)**

OR

4 a. Find the forced response for the system described by

$$\frac{d^2y(t)}{dt^2}+\frac{5dy(t)}{dt}+6y(t)=2x(t)+\frac{dx(t)}{dt}$$

with input $x(t) = 2e^{-t}u(t)$. **(08 Marks)**

b. Find the natural response of the system described by difference equation :

$y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + x(n-1)$ with $y(-1) = 0$ and $y(-2) = 1$. **(06 Marks)**

c. Draw the direct form I and II realization for the following system :

$$2\frac{d^3y(t)}{dt^3}+\frac{dy(t)}{dt}+3y(t)=x(t).$$ **(06 Marks)**

Module-3

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

b. Obtain the Fourier transform of the signal :

i) $x(t) = e^{-at}\,u(t)$

ii) $x(t) = e^{-a|t|}$. **(06 Marks)**

c. Using convolution theorem, find the inverse Fourier transform of

$$X(\omega)=\frac{1}{(a+j\omega)^2}.$$ **(06 Marks)**

OR

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

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

b. Find the Fourier transform of the following signal using appropriate properties.

$x(t) = \sin(\pi t)e^{-2t}\,u(t)$. **(06 Marks)**

c. Consider the continuous time LTI system described by

$$\frac{dy(t)}{dt}+2y(t)=x(t).$$

Using Fourier transform, find the output y(t) with input signal $x(t) = e^{-t}u(t)$. **(08 Marks)**

Module-4

7 a. Describe the following properties of DTFT

i) Frequency differentiation

ii) Scaling

iii) Modulation. **(06 Marks)**

b. Find the DTFT of the following signals :

i) $x(n) = (0.5)^{n+2}u(n)$

ii) $x(n) = n(0.5)^{2n}u(n)$. **(06 Marks)**

c. Find the inverse DTFT

$$X(\Omega)=\frac{3-\frac{5}{4}e^{-j\Omega}}{\frac{1}{8}e^{-j2\Omega}-\frac{3}{4}e^{-j\Omega}+1}.$$ **(08 Marks)**

OR

8 a. Find the frequency response and the impulse response of discrete time system described by difference equation :

$$y(n-2) + 5y(n-1) + 6y(n) = 8x(n-1) + 18x(n)$$ **(10 Marks)**

b. Determine the difference equation for the system with following impulse response

$$h(n) = \delta(n) + 2(\tfrac{1}{2})^n u(n) + [-\tfrac{1}{2}]^n u(n).$$ **(10 Marks)**

Module-5

9 a. Explain the properties of ROC. **(06 Marks)**

b. For the signal $x(n) = 7(\frac{1}{3})^n - 6(\frac{1}{2})^n u(n)$, find the Z – transform and ROC. **(06 Marks)**

c. By using suitable properties of Z – transform find the Z – transform and ROC of the following :

i) $x(n) = (\frac{1}{2})^n u(n) - 3^n u(-n-1)$

ii) $x(n) = n\, a^n u(n-3)$. **(08 Marks)**

OR

10 a. Find the inverse Z – transform of the sequence $x(z) = \dfrac{z}{3z^2 - 4z + 1}$, for the following :

i) $|z| > 1$ ii) $|z| < \frac{1}{3}$ iii) $\frac{1}{3} < |z| < 1$. **(06 Marks)**

b. Solve the following linear constant co-efficient difference equation using unilateral Z – transform method.

$y(n) = \frac{3}{2}y(n-1) + \frac{1}{2}y(n-2) = (\frac{1}{4})^n u(n)$, with I.C. $y(-1) = 4$, $y(-2) = 10$. **(08 Marks)**

c. A system has impulse response $h(n) = (\frac{1}{2})^n u(n)$. Determine the input to the system if the output is given by $y(n) = \frac{1}{3}u(n) + \frac{2}{3}(-\frac{1}{2})^n u(n)$. **(06 Marks)**

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