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Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Signals and Systems

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Explain the signals and systems with the help of suitable examples. (05 Marks)
b. Obtain the even and odd part of the given signal $x(t)$ shown in Fig.Q1(b).

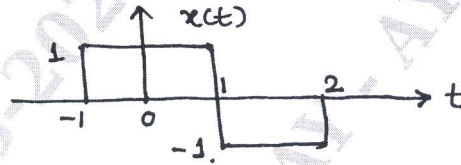


Fig.Q1(b)

- c. For the following system, determine whether the system is (i) Linear (ii) Time invariant (iii) Memoryless (iv) Causal (v) Stable. (05 Marks)
(A) $y(n) = n x(n)$ (B) $y(t) = x(t/2)$ (10 Marks)

OR

- 2 a. Whether the signal shown in Fig.Q2(a) is energy or power signal? Determine energy or power.

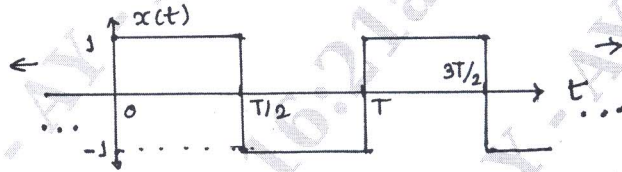


Fig.Q2(a)

- b. Check whether the following signals are periodic or not. If periodic, find the fundamental period (05 Marks)
(i) $x(n) = \cos 2\pi n$ (ii) $x(t) = \cos 2t + \sin 3t$
c. For the continuous time signal $x(t)$ shown in Fig.Q2(c). Sketch the following: (05 Marks)
(i) $x(2t)$ (ii) $x(t+2)$ (iii) $x(-2t+1)$
(iv) $2x(t-3)$ (v) $x(t+2) + x(t-2)$

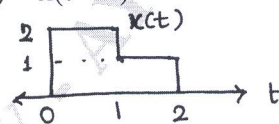


Fig.Q2(c)

Module-2

- 3 a. Consider a LTI system with unit impulse response, $h(t) = e^{-t} \cdot u(t)$. If the input applied to this system is $x(t) = e^{-3t}[u(t) - u(t-2)]$, find the output $y(t)$ of the system. (10 Marks)
b. Find the total response of the system given by $\frac{d^2 y(t)}{dt^2} + 3 \frac{dy(t)}{dt} + 2y(t) = 2x(t)$ with $y(0) = -1$; $\left. \frac{dy(t)}{dt} \right|_{t=0} = 1$ and $x(t) = \cos t \cdot u(t)$ (10 Marks)

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.

OR

- 4 a. 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 $y(-2) = 1$

(08 Marks)

- b. Draw the direct form I and direct form II of the given system function

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = \frac{d^2x(t)}{dt^2} + 3\frac{dx(t)}{dt} + 2x(t)$$

(06 Marks)

- c. Check whether the LTI system which has impulse response given by,

i) $h(t) = \cos(\pi t) \cdot u(t)$ ii) $h(n) = \sin(\frac{1}{2}\pi n)$

is memoryless, causal or stable.

(06 Marks)

Module-3

- 5 a. State and prove the following continuous time fourier transform :

(i) Convolution property (ii) Time shift property

(10 Marks)

- b. Find the fourier transform of the following :

(i) $x(t) = e^{-a|t|}$; $a > 0$ (ii) $x(t) = \delta(t)$

Draw the spectrum.

(10 Marks)

OR

- 6 a. Using partial expansion, determine the inverse fourier transform of

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

(05 Marks)

- b. Find the frequency response and the impulse response of the system having the output $y(t)$ for the input $x(t)$ as given below:

$$x(t) = e^{-t}u(t) \quad \text{and} \quad y(t) = e^{-3t}u(t) + e^{-2t}u(t)$$

(07 Marks)

- c. Find the frequency response and the impulse response of the system described by the differential equation.

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

(08 Marks)

Module-4

- 7 a. Using the appropriate, find the DTFT of the following signal

(i) $x(n) = \left(\frac{1}{2}\right)^n \cdot u(n-2)$ (ii) $x(n) = \sin\left(\frac{\pi}{4}n\right) \left(\frac{1}{4}\right)^n \cdot u(n-1)$

(10 Marks)

- b. Find the inverse DTFT of

(i) $X(e^{j\Omega}) = \frac{6}{e^{-j2\Omega} - 5e^{-j\Omega} + 6}$

(ii) $X(e^{j\Omega}) = 1 + 2\cos\Omega + 3\cos 2\Omega$

(10 Marks)

OR

- 8 a. State and prove the following properties of DTFT :

(i) Linearity property (ii) Frequency shift (iii) Parseval's theorem. (10 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,

$$x(n) = (1/2)^n \cdot u(n) \quad , \quad y(n) = 1/4(1/2)^n \cdot u(n) + (1/4)^n \cdot u(n)$$

(10 Marks)

Module-5

- 9 a. State and prove the following property of z-transform:
 (i) Initial Value theorem (ii) Differentiation in the z-domain. (08 Marks)
 b. For the signal $x(n) = 7(1/3)^n u(n) - 6(1/2)^n \cdot u(n)$, find the z-transform and ROC. (06 Marks)
 c. List the ROC (Region Of Convergence) of z-transform. (06 Marks)

OR

- 10 a. Using partial fraction expansion method, obtain the time domain signal corresponding to the z-transform given below.

$$X(z) = \frac{1 - \frac{1}{2}z^{-1}}{1 + \frac{3}{4}z^{-1} + \frac{1}{8}z^{-2}} \quad \therefore |z| > \frac{1}{2} \quad (06 \text{ Marks})$$

- b. Determine the impulse response $h(n)$ and the system function $H(z)$ of the system, if the input

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

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

- c. A causal LTI system is described by difference equation

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

find the system function $H(z)$. Also determine the impulse response of the system. (08 Marks)

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