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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. Distinguish between :
- i) Continuous and Discrete time signal
 - ii) Even and Odd signal
 - iii) Periodic and Non periodic signal
 - iv) Energy and Power signal. (08 Marks)
- b. Find the Even and Odd component of the signal.
- i) $x(t) = (1 + t^3) \cos^3 10t$
 - ii) $x(t) = 1 + t + 3t^2 + 5t^3 + 9t^4$. (06 Marks)
- c. Determine and sketch the Even and Odd part of the signal shown in Fig. Q1(c). (06 Marks)

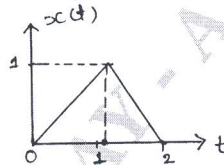


Fig. Q1(c)

OR

- 2 a. Determine whether the following Signals are periodic, if periodic determine fundamental period : i) $x(t) = \cos 2t + \sin 3t$ ii) $x(n) = \cos(\frac{n\pi}{5}) \sin(\frac{n\pi}{5})$. (08 Marks)
- b. What is the Average power of Square wave shown in Fig. Q2(b)? (06 Marks)

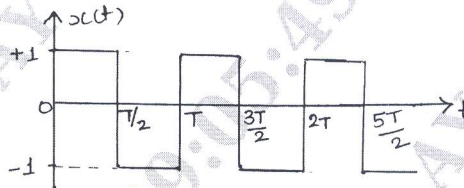


Fig. Q2(b)

- c. Determine whether the system $y(t) = e^{x(t)}$.
- i) Linear
 - ii) Time invariant
 - iii) Memory
 - iv) Causal
 - v) Stable. (06 Marks)

Module-2

- 3 a. Consider the input signal $x(n)$ and the impulse response $h(n)$ given below :
- $$x(n) = \begin{cases} 1 & 0 \leq n \leq 4 \\ 0 & \text{Elsewhere} \end{cases}; \quad h(n) = \begin{cases} \alpha^n & 0 \leq n \leq 6 \\ 0 & \text{Elsewhere} \end{cases}$$
- Compute the output signal $y(n)$. (08 Marks)
- b. Find the forced response for the system described by
- $$d^2 \frac{y(t)}{dt^2} + 5 \frac{dy(t)}{dt} + 6y(t) = 2x(t) + \frac{dx(t)}{dt} \text{ with input } x(t) = 2e^{-t} u(t). \text{ (06 Marks)}$$
- c. Sketch direct form I and direct form II implementation for the difference equation.
- $$y(n) + \frac{1}{2} y(n-1) - y(n-3) = 3x(n-1) + 2x(n-2). \text{ (06 Marks)}$$

OR

- 4 a. Evaluate the Continuous time convolution integral given below :
- $$y(t) = e^{-2t} u(t) \times u(t+2). \text{ (08 Marks)}$$
- b. Find the natural response for the system describe by the following Difference equation.
- $$y(n) - \frac{9}{16} y(n-2) = x(n-1) \text{ with } y(-1) = 1 \text{ and } y(-2) = -1. \text{ (08 Marks)}$$

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.

- c. Explain the following properties of Impulse response representation of LTI system :
 i) Distributive ii) Associative iii) Causal. (04 Marks)

Module-3

- 5 a. Describe the following properties of C T F T :
 i) Frequency shift ii) Time shift iii) Linearity. (06 Marks)
 b. Obtain the Fourier transform of the signal $x(t) = e^{-at} u(t)$ $a > 0$.
 Draw its Magnitude and Phase spectrum. (08 Marks)
 c. Find the Fourier transform of the signal $x(t) = e^{-3|t|} \sin 2t$ using Appropriate properties. (06 Marks)

OR

- 6 a. Find the Inverse Fourier transform

$$X(j\omega) = \frac{-j\omega}{(j\omega)^2 + 3j\omega + 2}$$
 (06 Marks)
 b. Find the Impulse response of continuous time LTI system given by
 $h(t) = \frac{1}{RC} e^{-t/RC} u(t)$. Find the Frequency response and plot magnitude and phase response. (08 Marks)
 c. Find the frequency response and the impulse response of the system describe by Differential equation.

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

Module-4

- 7 a. Discuss the properties of DTFT : i) Linearity ii) Time shift iii) Convolution. (06 Marks)
 b. Find the DTFT of the signal : i) $x(n) = \alpha^n u(n)$ $|\alpha| < 1$. Draw the Magnitude Spectrum. (08 Marks)
 ii) $x(n) = (-1)^n u(n)$. (08 Marks)
 c. Find the DTFT of the signal $x(n) = a^{|n|}$ $|a| < 1$. (06 Marks)

OR

- 8 a. State and prove the following properties of Discrete Time Fourier transform :
 i) Parseval's theorem ii) Scaling. (08 Marks)
 b. Using the Appropriate properties, find the DTFT of the following signal :
 i) $x(n) = (\frac{1}{2})^n u(n-2)$ ii) $x(n) = \sin(\frac{\pi}{4}n) (\frac{1}{2})^n u(n-1)$. (12 Marks)

Module-5

- 9 a. Describe the following properties of Z transform :
 i) Linearity ii) Differentiation in the Z Domain iii) Time shift. (06 Marks)
 b. Find the Z transform of $x(n) = \alpha^n u(n)$. (08 Marks)
 c. Find the Z transform of the signal $x(n) = 3.2^n u(-n)$ using Appropriate properties. (06 Marks)

OR

- 10 a. Explain the properties of Region of Convergence. (06 Marks)
 b. Find the Discrete Time Sequence $x(n)$ which has Z transform :

$$X(z) = \frac{-1 + 5z^{-1}}{(1 - \frac{3}{2}z^{-1} + \frac{1}{2}z^{-2})}$$
 with ROC $|z| > 1$. (08 Marks)
 c. A causal system has input $x(n]$ and output $y[n]$. Find the Impulse Response of the system , if
 $x(n) = \delta(n) + \frac{1}{4} \delta(n-1) - \frac{1}{8} \delta(n-2)$; $y(n) = \delta(n) - \frac{3}{4} \delta(n-1)$. (06 Marks)
