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SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION(R,S), MAY 2024

Electronics and Communication Engineering

(2020 SCHEME)

Course Code	:	**20ECT204**
Course Name	:	**Signals and Systems**
Max. Marks	:	**100**

Duration:3 Hours

PART A

(Answer all questions. Each question carries 3 marks)

1. A discrete time signal x(n) is described by, x(n) = 1; n=1,2,3
   -1;n=-1,-2,-3
   0; n=0 |n|>3
   Find y(n) = x(2n+2).
2. Describe elementary discrete time signals.
3. State the condition for BIBO stability of the system.
4. Prove that $R_{12}(\tau) = R_{21}(-\tau)$.
5. State Parseval's theorem in Fourier transform.
6. Determine the Fourier series coefficients of the signal x(n) = 2+ cos((π/3)n + (π/4).
7. Find the inverse Laplace transform of 1/(s+a).
8. Explain the concept of causality and stability in S domain.
9. Find DTFT of the signal $x[n] = \frac{1}{2}[\frac{1}{2}^n + \frac{1}{4}^n]u(n)$.
10. State and prove differentiation property in Z transform.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Determine whether the following system is static, time invariant, linear and causal. Give the explanation for each. (8)
    $y(t) = t^2x(t) + x(t-2)$
    b) Determine whether the following system is time invariant, linear and causal. $y(n) = x(n) + 1/x(n-1)$. (6)

OR

12. a) Check the periodicity of given signals. Find the fundamental period if periodic (8)
    (i) $x(n) = cos(\pi n/2) - sin(\pi n/8) + 3cos(\pi n/4 + \pi/3)$
    (ii) $x(n) = e^{j(2\pi/3)n} + e^{j(3\pi/4)n}$
    b) Find the even and odd components of the signal given by (6)
    (i) $x(t) = cos(\omega_0 t + \pi/3)$ ii) $x(t) = [sin\pi t + cos\pi t]^2$

MODULE II

13. a)Convolute the following sequences x(n)={1, 2, 3} h(n)={1, 2, 3, 4} using analytical method. 7

b)Determine the response of the system characterized by the impulse response. $h(n)= (1/3)^n u(n)$ to the input signal $x(n) = 2^n u(n)$. 7

OR

14. a)Given two signals x(t)=u(t+0.5)- u(t-0.5) and $h(t)=e^{j\omega_o t}$, determine the value of ω_o which ensures that y(0)=0, where y(t)=x(t)*h(t). 7

b) Find the convolution of the two discrete sequences given below 7

$x_1(n) = 2^n u(-n-1)$ $x_2(n) = 4^n u(-n-1)$.

MODULE III

15. a) Find the Fourier transform of Rectangular pulse.Plot the spectrum. 7

b) Find the convolution of the signal $x_1(t) = e^{-at}u(t)$; $x_2(t) = e^{-bt}u(t)$ using Fourier transform. 7

OR

16. a) State and prove Convolution property and Parseval's relation of Fourier series. 8

b) A periodic signal has the Fourier series representation given, If Fourier series of x(t) is $X(k) = -k2^{-|k|}$. Find Y(k) using proper properties of Fourier series. 6

(i) $y(t) = \frac{dx(t)}{dt}$ (ii) y(t) = x(t-1)

MODULE IV

17. a) Explain the effects of under sampling. 7

b)The spectral range of a signal extends from 5.6 MHz to 6.8 MHz. Find the minimum sampling rate and maximum sampling time. 7

OR

18. a) Prove that the signals $x(t) = e^{-at} u(t)$ and $x(t) = -e^{-at} u(-t)$ have the same X(s) and differ only in ROC. Also plot their ROCs. 7

b) Find the Laplace Transform and ROC of the signal. 7

$x(t) = (e^{-2t} + 3e^{-3t}) u(t)$

MODULE V

19. a) Consider an LTI system that is characterized by the difference equation. 7

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

Find the frequency response $H(e^{j\omega})$ and the impulse response h(n) of the system.

b) For the LTI system with system function H(z) find the impulse response so that the system is stable. Can this system be both stable and causal. 7

$$H(z) = \frac{5-10z^{-1}}{1-3.5z^{-1}+1.5z^{-2}}$$

OR

20. a) Write the impulse response of the system functions whose algebraic expression is given below. Also check and justify the causality and stability. 7

$$H(z) = \frac{1}{1-\frac{1}{2}z^{-1}} + \frac{1}{1-2z^{-1}}, \frac{1}{2} < |z| < 2$$

b) Evaluate the inverse Z-transform by partial fraction method for the given X(z). 7

$$X(z) = \frac{3-\frac{5}{6}z^{-1}}{\left(1-\frac{1}{4}z^{-1}\right)\left(1-\frac{1}{3}z^{-1}\right)}, |z| < \frac{1}{3}$$

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