Register No.: .... Name: ....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 2023
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. Evaluate the following integrals
   (i) $\int_{-\infty}^{\infty} t\,\delta(t-3)dt$ (ii) $\int_{-\infty}^{\infty}(t^3+4)\,\delta(1-t)dt$.
2. Sketch the following signals
   (i)u(t)-u(t-2) (ii)r(t)u(2-t).
3. What is the condition for a system to be BIBO stable? Check the stability of the system $h(t)=e^{2t}u(t)$.
4. Find the convolution of the following sequence
   $x_1(n)=\{1,-2,3,1\}$ $x_2(n)=\{2,-3,2\}$.
5. Find the Fourier transform of unit step signal.
6. Find the complex exponential Fourier series representation of the signal x(t)=2+2cos 2t+sin 4t.
7. Derive the relation between Fourier transform and Laplace transform?
8. Determine the Nyquist sampling rate for the following signals
   (i)$\text{sinc}^2(200\pi t)$ (ii)1+cos2000 πt +sin 4000πt.
9. Find the DTFT of $(0.25)^n\, u(n+1)$.
10. Write any four properties of ROC of Z transform.

PART B

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

MODULE I

11. a) Find which of the following signals are energy signals, power signals neither energy or nor power signals (9)
    (i)$e^{-3t}\,u(t)$ (ii)cost (iii) $(1/3)^n\, u(n)$.

    b) Find whether the following signals are periodic or not. If periodic find the period (5)
    (i)x(t)=2cos(10t+1)-sin(4t-1) (ii)u(t)-1/2 (iii)$\frac{3}{5}e^{\,j3\pi(n+1/2)}$.

OR

12. a) Check whether following systems are (9)
(a)Static or dynamic (b)linear or non-linear (c)causal or non-causal (d)time invariant or time variant
(i) $y(t)=odd\{x(t)\}$ (ii)$u(n)=x(n)\ x(n-1)$ (iii)$y(n)=\cos[x(n)]$.

b) Find even and odd components of the following signal $x(n)=\{1,0,-1,2,3\}$. (5)

MODULE II

13. a) Find the autocorrelation function of the signal $x(t)=\sin \omega_o t$. (5)

b) Find the convolution of the signals by graphical method $x(t)=e^{-3t}u(t)$; $h(t)=u(t+3)$. (9)

OR

14. a) State and prove the Time convolution theorem. (7)

b) Find the linear convolution of (7)
$x(n)=\{1,2,3,4,5,6\}$ with $y(n)=\{2,-4,6,-8\}$.

MODULE III

15. a) Find the Trigonometric Fourier series expansion of the half wave rectified sine wave form with maximum amplitude A and the fundamental period 2π. (10)

b) Find the Fourier transform of Signum function. (4)

OR

16. a) The input and the output of a causal LTI system are related by the differential equation $\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt}+6y(t)=x(t)$. Find the impulse response of the system. (8)

b) Find the Fourier transform of the following using properties of Fourier transform (i)$e^{-at}u(t)$ (ii)$te^{-2t}u(t)$. (6)

MODULE IV

17. a) A signal $x(t)=\cos 100\pi t+\cos 250\pi t$ is sample at sampling frequency 150 Hz and the sampled signal is passed through an ideal low pass filter with bandwidth is 75 Hz. Sketch the frequency spectrum of the output y(t) of the low pass filter, find y(t). (10)

b) State and prove the time shifting property of Laplace transform. (4)

OR

18. a) Find the inverse Laplace transform of the following (8)
(i)$\log\frac{(1+s)}{s^2}$ (ii)$\frac{s^2+6s+7}{s^2+3s+2}$ Re(s)> -1.

b) A system is described by the differential equation (6)
$\frac{d^2y(t)}{dt^2}-2\frac{dy(t)}{dt}-3y(t)=x(t)$. Find the impulse response.

MODULE V

19. a) A causal LTI system is described by the difference equation $y(n)-ay(n-1)=bx(n)+x(n-1)$ where **a** is real and less than 1 in magnitude. Find a value of $b(b \neq a)$ such that frequency response of the system satisfies $|H(\omega)|=1$ for all ω. (8)

b) Determine the inverse Z-transform of $X(z)=\frac{1}{2-4z^{-1}+2z^{-2}}$ by long division method when ROC$|z|>1$. (6)

OR

20. a) An LTI system is described by the difference equation $y(n)-\frac{9}{4}y(n-1)+\frac{1}{2}y(n-2)=x(n)-3x(n-1)$.Specify the ROC of H(z) ,and determine h(n) for the following conditions. (10)

(i)The system is stable (ii)The system is causal.

b) Show that $Z[nx(n)] = -z\frac{d}{dz}X(z)$. (4)

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