Register No.: …… Name: ……

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION (S), SEPT 2022
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. Sketch the following signals.

   $i)\ 2u(t+2) - 2u(t-3)$ $ii)\ r(0.25t+1)$

2. Check whether the following signals are periodic or not. If periodic, find the fundamental period.

   $i)\ \sin(10t+1) - 2\cos(5t-2)$ $ii) sin10\pi t + cos20\pi t$

3. State and prove time convolution theorem.

4. Find the convolution of $x_1(t)=e^{-2t}u(t)$ & $x_2(t)= e^{-4t}u(t)$.

5. Find the Fourier transform of signum function.

6. State sampling theorem for a low pass filter.

7. State and prove initial value theorem of Laplace Transform.

8. Find the Laplace transform of a ramp function.

9. Derive the relation between Z transform and DTFT.

10. Find the Z transform of $x(n) = -a^n u(-n-1)$.

PART B

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

MODULE I

11. a) Check whether the following signals are static or dynamic, linear or nonlinear, casual or non-casual, time variant or time invariant. (8)

    $i)\ \frac{d^2y(t)}{dt^2} + 2y(t)\frac{dy(t)}{dt} + 3ty(t) = x(t)$ $ii)\ y(n) = x(n) * x(n-2)$

    b) Find the even and odd components of the signal. (6)

    $i)\ x(n) = \{-3,1,2,-4,2\}$ $ii)\ x(t) = sin2t + cos2t$

OR

12. a) Determine whether the following signals are energy or power and calculate their energy or power. (8)

$i)\ x(t) = tu(t)$ $ii)\ x(t) = Ae^{-at}u(t), a > 0$ $iii)\ x(t) = e^{-3t}u(t)$

b) Check whether the following signals are periodic or not. (6)

$i)\ x(t) = 2\cos(10t + 1) - \sin(4t - 1)$

$ii)\ x(t) = 3cos4t + 2sin\pi t$

$iii)\ x(n) = e^{\frac{j2\pi n}{3}} + e^{\frac{j3\pi n}{4}}$

MODULE II

13. a) From the given impulse response, find whether the systems are causal and stable. (8)

$i)\ h(n) = e^{2n}u(n-1)$ $ii)\ h(n) = 5^n u(3-n)$

b) Determine the response y(n), if $x(n) = \{1, 2, 3, 2\}$ $h(n) = \{1, 2, 2\}$. (6)

OR

14. a) Find the convolution of the following signals. (8)

$i)\ x_1(t) = e^{-3t}u(t)\ \&\ x_2(t) = u(t+3)$

$ii)\ x_1(t) = r(t)\ \&\ x_2(t) = e^{-2t}u(t)$

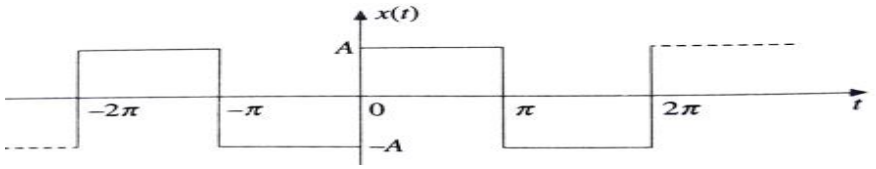
b) Determine whether the following impulse responses are causal and/or stable. (6)

$i)\ h(t) = e^{-2t}u(t+100)$ $ii) h(t) = te^{-t}u(t)$

MODULE III

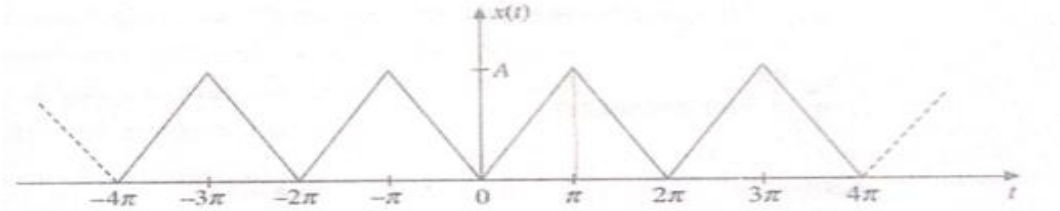
15. a) Consider a causal LTI system with impulse response $h(t) = e^{-4t}u(t)$. Find (8)
i) the output of the system for an input $x(t) = 3e^{-t}u(t)$.
ii) Frequency response of the system.

b) Find the trigonometric Fourier series for the given waveform. (6)



OR

16. a) Find the trigonometric Fourier series of the following waveform. (8)



(6)

b) Using properties of Fourier transform,

i)find the fourier transform of x(t) $= e^{-3t}u(t-2)$.

ii)find the convolution of

$$x_1(t) = te^{-t}u(t) \quad x_2(t) = te^{-2t}u(t).$$

MODULE IV

17. a) Show that the spectrum of the sampled signal is the infinite sum of shifted replicas of spectrum of original signal. (6)

b) Obtain the Laplace transform and ROC of the following signals. (8)

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

ii) $x(t) = e^{-t}u(t) + e^{-4t}u(t)$

OR

18. a) For the transfer function $H(S) = \frac{S+5}{S^2+3S+2}$. Find the response due to input $x(t) = cos2tu(t)$. (6)

b) Find the Nyquist sampling rate and sampling interval for (8)

i) $x(t) = \frac{1}{2}sinc(100\pi t) + \frac{1}{3}sinc(50\pi t)$

ii)$x(t) = -10\sin(40\pi t)\cos(300\pi t)$.

MODULE V

19. a) A system has impulse response $h(n) = \left(\frac{1}{3}\right)^n u(n)$. Determine the transfer function and frequency response of the system. Also determine the input of the system if the output is given by $y(n) = \frac{1}{2}u(n) + \frac{1}{4}\left(\frac{-1}{3}\right)^n u(n)$. (8)

b) Find the DTFT of the following signals. (6)

i) $x(n) = (0.5)^n u(n) + 2^n u(-n-1)$

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

OR

20. a) Find the Z transform and ROC of the following signals. (8)

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

ii) $x(n) = (\frac{1}{2})^n u(n) * (\frac{1}{4})^n u(n)$.

b) A causal system has the property that $(\frac{4}{5})^n u(n) \longrightarrow n(\frac{4}{5})^n u(n)$. (6)

i) Determine the frequency response $H(\omega)$ for the system.

ii) Determine a difference equation relating an input $x(n)$ and the corresponding output y(n).

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