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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIFTH SEMESTER B.TECH DEGREE EXAMINATION (S), FEBRUARY 2023
ELECTRICAL AND ELECTRONICS ENGINEERING
(2020 SCHEME)

Course Code : **20EET305**

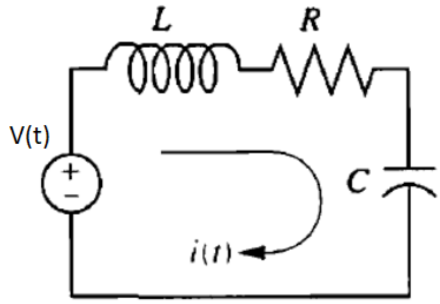
Course Name: **Signals and Systems**

Max. Marks : **100** **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Check whether the system described by $\frac{d^3y(t)}{dt^3}+4\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt}+2y^2(t)=x(t)$ is linear and time variant.
2. Describe random signals with examples.
3. Explain energy spectral density and power spectral density.
4. Define transfer function. Find out the transfer function of a series RLC circuit which is energized by a DC voltage source shown below.



5. Explain Mason's gain formula with an example.
6. Define Hurwitz polynomial and positive real function.
7. Find the output signal if the input sequence is $x(n)=\{1,4,3,2\}$ and $h(n)=\{1,3,2,1\}$.
8. An analog signal is expressed by the equation $x(t)=15\cos 50\pi t+15\sin 300\pi t+10\sin 100\pi t$.
   Calculate the Nyquist rate in Hz for this signal.
9. State and prove time shifting property of DTFT.
10. Define Z transfer function. A difference equation of the system is given by $y(n)=0.5y(n-1)+x(n)$, determine Z-transfer function and draw its pole-zero plot.

PART B

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

MODULE I

11. a) Check whether the given signal is periodic or not, if periodic find the fundamental period. (7)

(i) $x(t) = \cos^2(2t - \frac{\pi}{3})$

(ii) $x(n) = \sin(\frac{6\pi}{7}n + 1)$

b) A continuous signal is defined as $x(t) = \frac{1}{6}(t+2) \quad ; -2 \le t \le 4$ (7)

$= 0 \quad ; otherwise$

sketch the waveforms (i) $x(t)$ (ii) $x(t+1)$

(iii) $x(2t)$ (iv) $x(\frac{t}{2})$

OR

12. a) Find the even and odd parts of the signal (4)

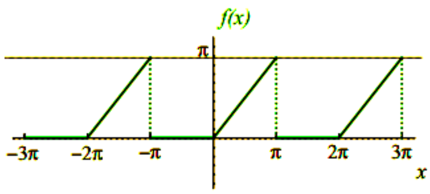
$x(t) = \sin 2t + \cos t + \sin t \cos 2t$.

b) Find the output of the system, if input $x(t) = e^{-3t}u(t)$ and impulse response $h(t) = u(t+3)$. (5)

c) Explain different types of non-linearities with example. (5)

MODULE II

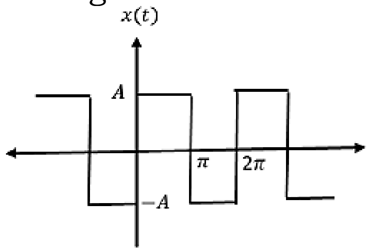
13. a) Determine the trigonometric Fourier series coefficients of the following signal defined by $f(x) = \begin{Bmatrix} 0 & -\pi < x < 0 \\ x & 0 < x < \pi \end{Bmatrix}$. (10)



b) Define Fourier Transform of a continuous time signal and explain the Dirichlet's conditions for existence of Fourier Transform. (4)

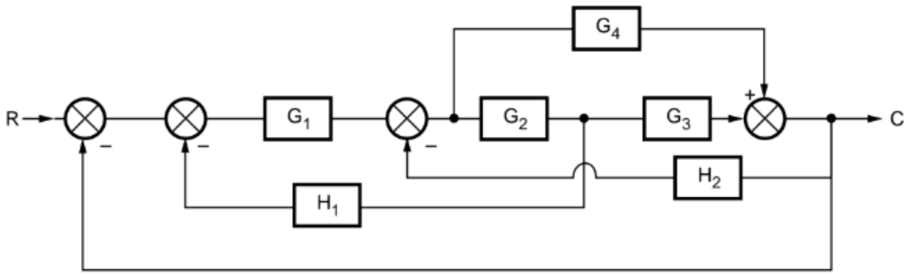
OR

14. a) Find the exponential Fourier series and plot the magnitude and phase spectrum of the following waveform. (10)



b) State and prove time scaling property of Continuous Time Fourier Transform. (4)

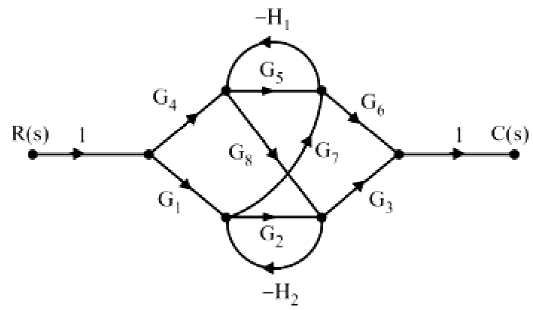
15. a) Determine the transfer function of the system shown below using block diagram reduction technique. (10)



b) Determine the stability of the system described by the characteristic equation $3s^4 + 10s^2 + 5s^2 + 5s + 2 = 0$. (4)

OR

16. a) Using Mason's gain formula, find the gain of the following system. (10)



b) Plot the pole-zero plot of the function given below (4)

$X(s) = \dfrac{4s}{(s+2)(s^2+2s+2)}$ and find x(t).

MODULE IV

17. a) Explain zero order and first order hold circuits and derive the transfer function of ZOH. (7)

b) Determine the Z transform and ROC of the discrete time signal $x(n) = 0.3^n u(n) - 0.8^n u(-n-1)$. (7)

OR

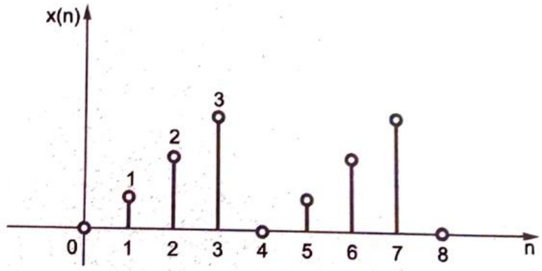
18. a) State and prove sampling theorem. Also, explain the effect of aliasing. (8)

b) Determine the inverse z-transform of the function (6)

$$X(z) = \frac{2}{(1+z^{-1})(1-z^{-1})^2}$$

MODULE V

19. a) Find the Discrete Time Fourier Series Coefficients of the signal given below. (7)



b) Check the stability of the system described by the equation (7)
$F(z) = z^5 + 2.6z^4 - 0.56z^3 - 2.05z^2 + 0.0775z + 0.35.$

OR

20. a) Find the Fourier transform of $x(n) = -a^n u(-n-1)$, where 'a' is real. (7)

b) Find the direct form-I and direct form-II realization of a discrete time system governed by the equation (7)

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

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