Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R,S) (FT/WP/PT) Examination November 2025 (2019 Scheme)

Course Code: EET305

Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 Hours

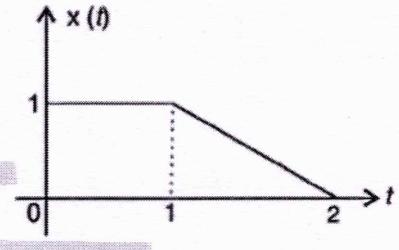
PART A

(Answer all questions; each question carries 3 marks) Marks

1 Evaluate the following integral (3)

$$x(t) = \int_1^2 (3t^2 + 1)\ \delta(t)dt$$

2 The signal $x(t)$ is shown below. (3)



Sketch the following signals. (a) $x(t+1)$ (b) $x\left(\frac{3}{2}t\right)$ (c) $x\left(\frac{3}{2}t+1\right)$

3 List the properties to be satisfied by a periodic function for which Fourier series exists (3)

4 State and prove the time-differentiation property of Fourier Transform. (3)

5 List down any three properties of positive real functions. (3)

6 What is aliasing? What are its effects? What are the methods available to avoid aliasing? (3)

7 List any 3 properties of ROC for the z-transform. (3)

8 Derive the transfer function of a Zero-Order Hold (ZOH) circuit. (3)

9 State and prove time reversal property of discrete time Fourier series (3)

10 Using Jury's stability test, determine the stability of the discrete-time system described by the characteristic equation $z^2 + z + 0.25 = 0$ (3)

PART B

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

Module -1

11 a) Differentiate between energy and power signals. Determine whether the signal $x(t) = e^{-2t}u(t)$ is an energy signal or power signal. (9)

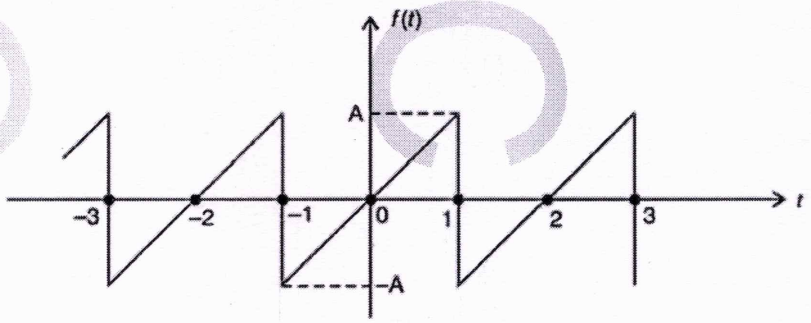
b) Determine the response of the system with impulse response $h(t) = u(t)$ for the input $x(t) = e^{-2t}u(t)$. (5)

12 a) Determine whether the signal $x(t) = \cos 3.5t + \cos 2t + 2\cos\frac{7t}{6}$ is periodic or not? If periodic, then find its fundamental time period. (8)

b) Check whether the system $y(t) = 3x(t) + 5$ is linear or not? (6)

Module -2

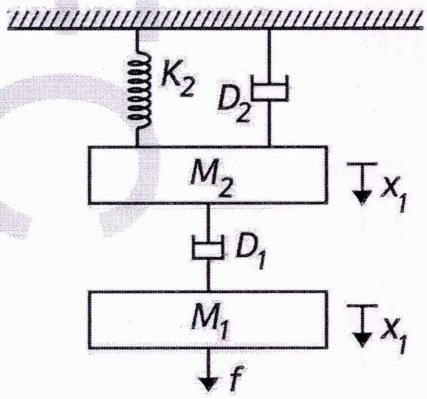
13 a) Obtain the trigonometric Fourier Series for the periodic signal shown below. (10)



b) Obtain the Fourier Transform of a rectangular pulse that is defined to be (4)

$$x(t) = \begin{cases} 1, & -1 < t < 1 \\ 0, & otherwise \end{cases}.$$

14 a) Determine the differential equations for the system shown below. Obtain the electrical analogous circuits based on (i) f-v analogy (ii) f-i analogy (10)



b) The KVL equation of a series RL circuit with $R = 4\ ohms$ and $L = 5H$ is given by (4)

$$0.5\frac{di(t)}{dt} + 4i(t) = v(t)$$

where $v(t)$ is defined to be the circuit input and $i(t)$ is defined to be the circuit output.

Determine the transfer function. Also find $i(t)$ when $v(t) = 12\,u(t)$

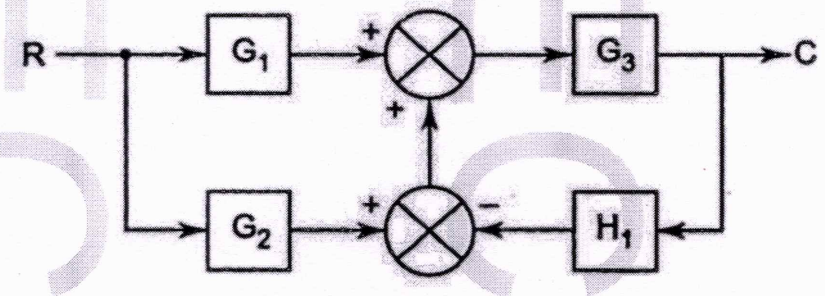
Module -3

15 a) The open-loop transfer function of a unity feedback system is given by (9)

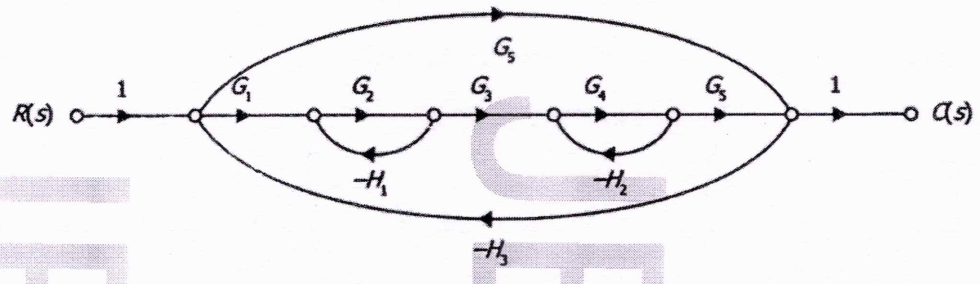
$$G(s) = \frac{16}{s(s^5 + 2s^4 + 8s^3 + 12s^2 + 20s + 16)}$$

Using Routh-Hurwitz stability criterion, ascertain its stability.

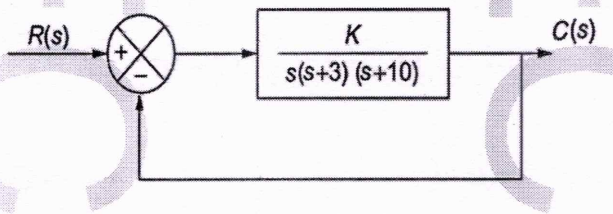
b) Determine the overall transfer function of the block diagram shown below. (5)



16 a) Obtain the transfer function of the system shown in the SFG below (10)



b) The block diagram representation of a unity feedback system is shown below. (4)



Using Routh Array, determine the range of values of gain K for which the system is stable,

Module -4

17 a) Determine the z-transform and ROC of the following signal (5)

$$x(n) = [3(2^n) - 4(3^n)]u(n)$$

b) For each of the following continuous-time signals, find the Nyquist rate and the Nyquist interval. (9)

i. $x(t) = Sin(200t)$

ii. $x(t) = Sin^2(200t)$

iii. $x(t) = Sin(200t) + Sin^2(200t)$

18 a) Find the inverse Z-transform of (9)

$$X(z) = \frac{1 + z^{-1}}{(1 - z^{-1})(1 - 0.5z^{-1})}$$

for the following ROC.

i. $|z| > 1$

ii. $|z| < 0.5$

iii. $0.5 < |z| < 1$

b) Obtain the linear convolution of (5)

$$x(n) = \{1,2,3,4,5\}, \qquad x(n) = \{1,2,3,3,2,1\}$$

Module -5

19 a) Determine the frequency response and impulse response of the causal discrete-time LTI system that is characterized by the difference equation (9)

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = 2x(n)$$

b) Determine the solution of the difference equation (5)

$$y(n) - 3y(n-1) - 4y(n-2) = 0, \qquad n > 0$$

Given $y(-1) = 5, y(-2) = 0$.

20 a) Obtain the Direct form -1 realization and Direct form-2 realization of a discrete-time system described by the difference equation

$$y(n) - y(n-1) + \frac{9}{16}y(n-2) - \frac{1}{16}y(n-3) + \frac{1}{32}y(n-4) \quad (10)$$
$$= x(n) - 2x(n-1) - x(n-2) + 2x(n-3)$$

b) Determine the DTFT of the sequence (4)

$$x(n) = -a^n u(-n-1)$$

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