

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

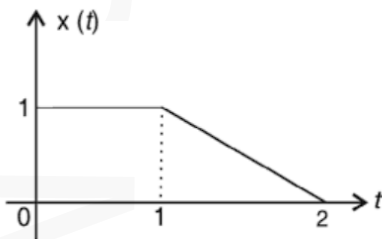
PART A*(Answer all questions; each question carries 3 marks)*

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) $x\left(\frac{3}{2}t + 1\right)$

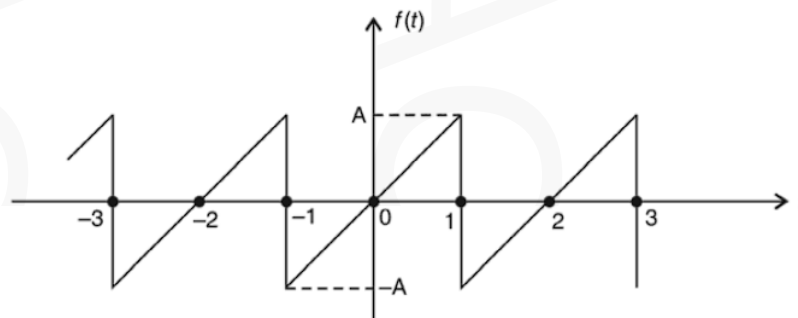
- 3 List the properties to be satisfied by a periodic function for which Fourier series exists (3)
- 4 State and prove the time-differentiation property of Fourier Transform. (3)
- 5 List down any three properties of positive real functions. (3)
- 6 What is aliasing? What are its effects? What are the 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

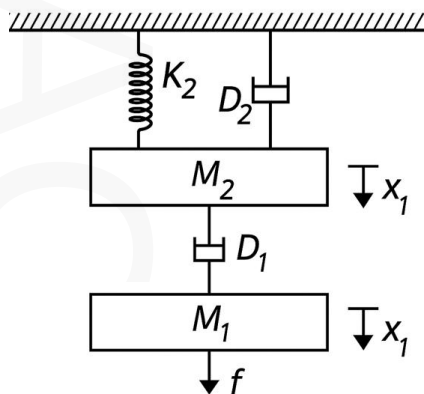
- 13 a) Obtain the trigonometric Fourier Series for the periodic signal shown below. (10)



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

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

- 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 $R = 4 \text{ ohms}$ 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 $v(t) = 12 u(t)$

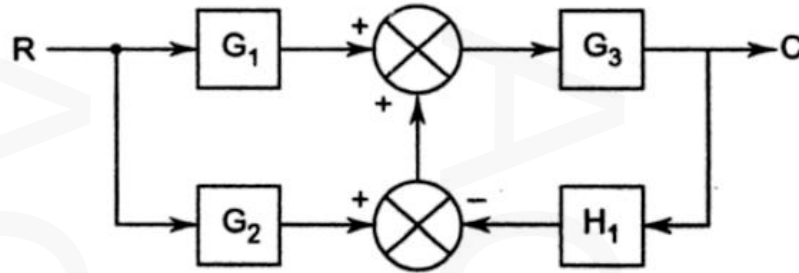
Module -3

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

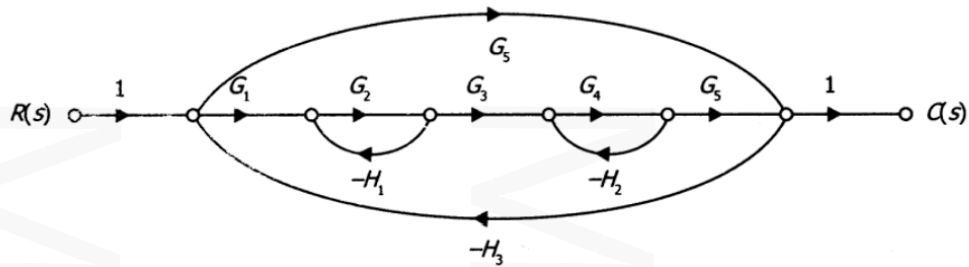
$$G(s) = \frac{16}{s(s^5 + 2s^4 + 8s^3 + 12s^2 + 20s + 16)}$$

Using Routh-Hurwitz stability criterion, ascertain its stability.

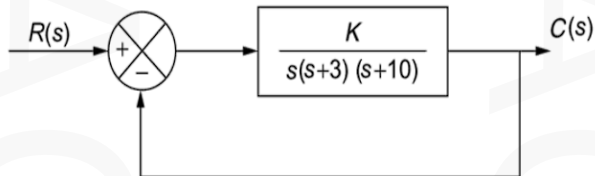
- b) Determine the overall transfer function of the block diagram shown below. (5)



- 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)

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

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)

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

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

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

- b) Determine the DTFT of the sequence (4)

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