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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R, S) / S5 (PT) (R,S) / S5 (WP) (R) Examination November 2024 (2019 Scheme)

Course Code: EET 305
Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

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

1	Define unit step signal. Sketch the signal $x(t) = -2u(t+2)$	(3)
2	Explain any two peculiar characteristics of non-linear systems.	(3)
3	What are the conditions under which a periodic signal can be represented by a Fourier series?	(3)
4	Find the Fourier transform of the rectangular pulse shown below in Fig.1	(3)

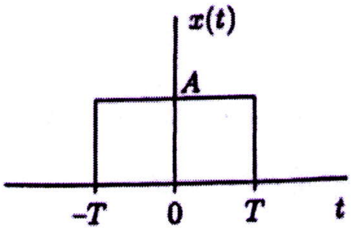

Fig.1

5	Determine the unit impulse response for the system with transfer function $H(s) = \frac{10}{s+100}$	(3)
6	List down the conditions under which a polynomial function is said to be positive real.	(3)
7	Determine the transfer function of the Zero Order Hold circuit used for signal reconstruction.	(3)
8	List down any 3 properties of discrete convolution.	(3)
9	State and prove the time reversal property of discrete time Fourier series.	(3)
10	Explain how bilinear transformation can be used to determine the stability of discrete-time systems.	(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 following signal, $x(t) = e^{-4t}u(t)$ is an energy signal or power signal.	(7)

b) Evaluate the convolution $y(t) = x_1(t) * x_2(t)$ where $x_1(t) = \sin 3t\, u(t)$ and $x_2(t) = u(t)$ (7)

12 a) Determine the fundamental period of the signal (5)

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

b) With suitable examples, differentiate between (9)

(a) Causal and non-causal systems

(b) Static and dynamic systems

(c) Stable and unstable systems

Module -2

13 a) Find the trigonometric Fourier Series for the signal shown below in Fig.2 (9)

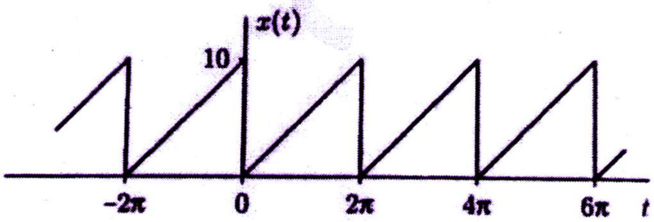

Fig.2

b) State and prove the differentiation property of Fourier Transform. (5)

14 a) Derive the transfer function $\frac{X_2(s)}{F(s)}$ of the mechanical system shown below in Fig.3. (9)

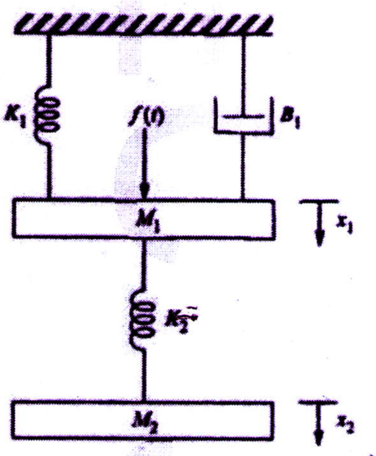

Fig.3

b) Determine the zero-input response of a system represented by the differential equation $\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 6y(t) = 0$ using Laplace transform analysis. Assume that the initial conditions on the system are $y(0) = 1, \frac{dy(0)}{dt} = 2$ (5)

Module -3

15 a) Determine the overall transfer function using block diagram reduction. (5)

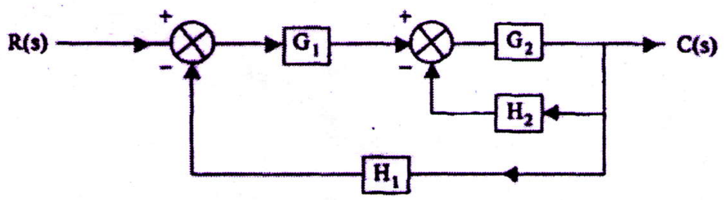

Fig.4

b) Find the range of values of K for the closed loop system in below in Fig.5 to remain stable. (9)

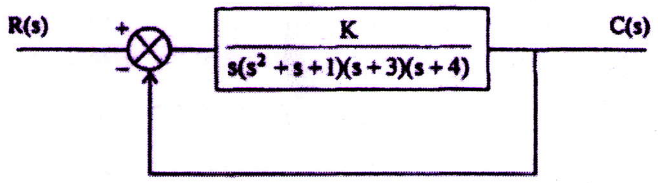

Fig.5

16 a) Determine the transfer function of the system represented by the SFG using Mason's Gain Formula. (9)

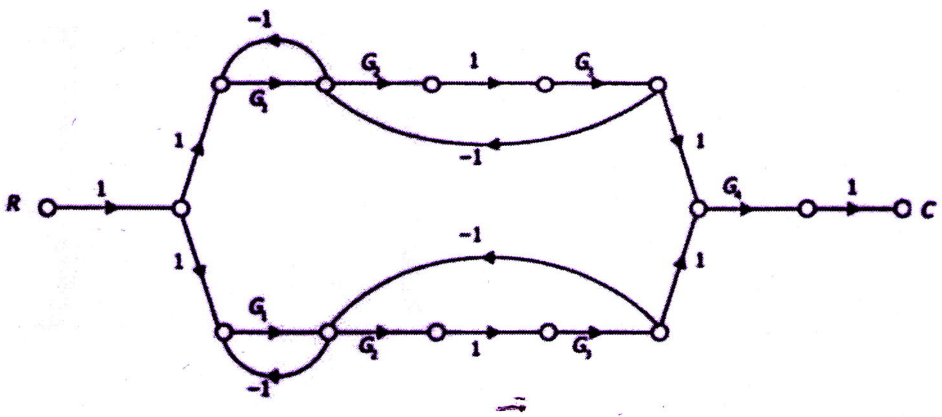

Fig.6

b) Check the stability of the system represented by the following characteristic equation using Routh stability criterion: $s^4 + 2s^3 + 8s^2 + 4s + 3$ (5)

Module -4

17 a) Determine the convolution sum of the two sequences (8)

$x(n) = \{1,2,3,1\}$ and $h(n) = \{1,2,1,-1\}$

b) Determine the Z-transform of $x(n) = e^{j\omega_0 n}\, u(n)$. Also, specify the ROC. (6)

18 a) Explain the aliasing effect in sampled data systems (5)

b) Find the inverse Z-transform of (9)

$$X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$$

for the following three possibilities of ROC given as:

(i) $|z| > 1$

(ii) $|z| < 0.5$

(iii) $0.5 < |z| < 1$

Module -5

19 a) A causal discrete time LTI system is described by (9)

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

where $x(n)$and $y(n)$ are the input and output of the system, respectively.

Determine the transfer function $H(z)$ of the system. Also find the impulse response of the system.

b) Determine the Fourier Transform of the sequence $x(n) = a^n u(n)$, $|a|<1$ (5)

20 a) Obtain the Direct form-II realization for the system described by the difference equation (9)

$$y(n) + \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) - \frac{7}{4}x(n-1) - \frac{1}{2}x(n-2)$$

b) Check stability of the system described by the following characteristic equation, using Jury's test: $2z^4 + 7z^3 + 10z^2 + 4z + 1$ (5)

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