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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S, FE) / S5 (PT) (S) Examination June 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 A rectangular signal $x(t)$ is shown in Fig. 1. Sketch the following signals: i) $x(t-2)$ ii) $3x(t)$ iii) $x(t-3)+3x(t)$ 3

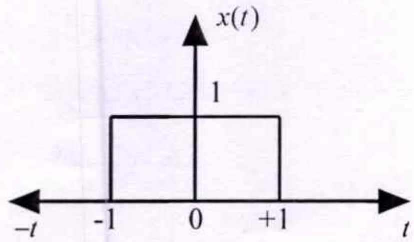

Fig. 1

2 A system is described by the input- output equation, $y(t)=x(t+1)+x(t^2)$. Determine whether the system is static, causal, time invariant, linear and stable. 3

3 State and prove the time- shifting property of Fourier series 3

4 Find the Fourier transform of $x(t)=\delta(t-2)$ 3

5 The signal flow graph of a system is shown in Fig. 2. Obtain the transfer function, $\frac{C(s)}{R(s)}$ 3

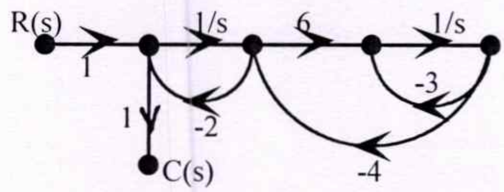

Fig. 2

6 By means of Routh's criteria, determine the stability of the system represented by the characteristic equation, $s^4+2s^3+8s^2+4s+3=0$ 3

7 Find the Nyquist rate and Nyquist width of the signal, $x(t)=(\sin 200\pi t)^2$ 3

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8		Derive the transfer function of a ZOH circuit.	3
9		State and prove the time shifting property of discrete Fourier transform.	3
10		Find the discrete time Fourier series of $x[n] = \sin 0.2\pi n$.	3

PART B

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

Module -1

11	a)	Explain random variables and random processes	7
	b)	Find the output of a system with impulse response $h(t) = \left(2 - e^{-2t}\right)u(t)$ and the input signal, $x(t) = e^{-3t}u(t)$	7
12	a)	Find the odd and even components of the signal, $x(t) = \cos t + \sin t + \cos t \sin t$	7
	b)	Differentiate energy and power signals. Determine the energy and power of the signal, $x(t) = 5\cos(10t + \phi) + 10\sin(5t + \phi)$	7

Module -2

13 a) Find the exponential Fourier series coefficients for the signal shown in Fig. 3 — 9

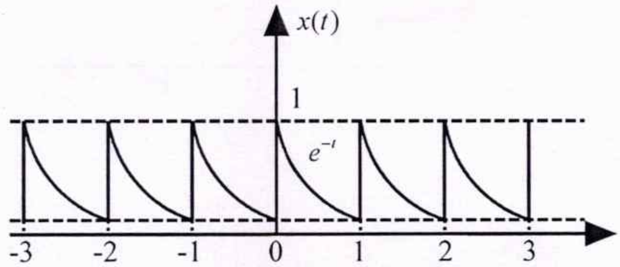

Fig. 3

b) State and prove the time integration property of Fourier transforms — 5

14 a) Find the unit step response of the circuit shown in Fig.4 — 7

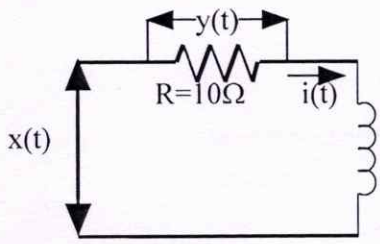

Fig. 4

b) Determine the output response of the system whose impulse response $h(t) = e^{-2t}u(t)$, for a unit step input. — 7

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Module -3

15 a) Reduce the block diagram shown in Fig.5 and obtain the transfer function $\frac{C(s)}{R(s)}$ 10

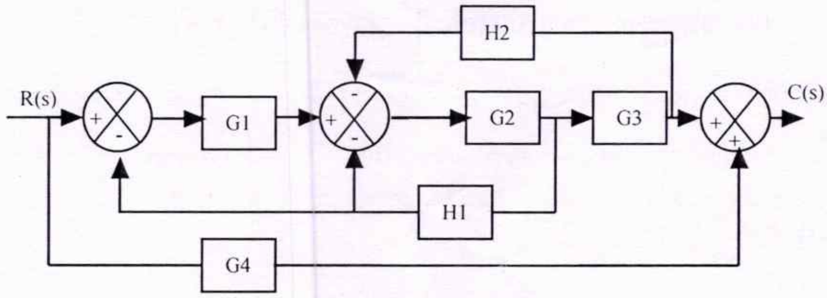

Fig. 5

b) State Mason's gain formula and explain the terms involved 4

16 a) State and explain the Hurwitz criterion for analysing the stability of LTI systems 4

b) Determine the range of values of K that stabilises the closed loop system shown in Fig. 6. 10

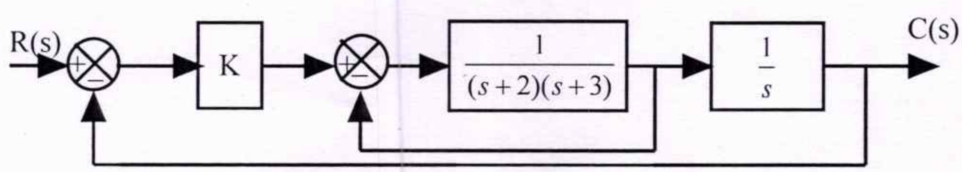

Fig. 6

Module -4

17 a) Find the z- transform of $x[n] = a^n \cos\omega_o n u[n]$ 5

b) A linear, time- invariant system has the impulse response, $h(n) = [u(n) - u(n-6)]$. The system is excited by $x(n) = [u(n-1) - u(n-5)]$. Determine the output of the system. 9

18 a) The input to a causal LTI system is $x[n] = u[-n-1] + \left(\frac{1}{2}\right)^n u[n]$. The z- transform of the output of the system is $Y[z] = \dfrac{-\frac{1}{2}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1+z^{-1}\right)}$. Determine $H[z]$, the z-transform of the impulse response and also determine the output $y[n]$ 10

b) Explain aliasing effect in sampled data systems. 4

Module -5

19 a) Solve the difference equation, $y[n]+6y[n-1]+8y[n-2]=5x[n-1]+x[n-2]$. The initial conditions are $y[-1]=1$; and $y[-2]=2$. The input $x[n]=u[n]$. 8

b) Find the discrete Fourier series coefficients and Fourier series for the function, $x[n]=\sin^2\left(\frac{\pi}{6}n\right)$ 6

20 a) Obtain the parallel form realization of the system function, $H[z]=\frac{z^2+4z+10}{(z+2)(z+4)}$ 7

b) Check the stability of the system whose characteristic equation is given by , $z^4-1.7z^3+1.04z^2-0.268z+0.024=0$, using Jury's stability criterion. 7

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