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18EE54

Fifth Semester B.E. Degree Examination, July/August 2022
Signals and Systems

Time: 3 hrs.

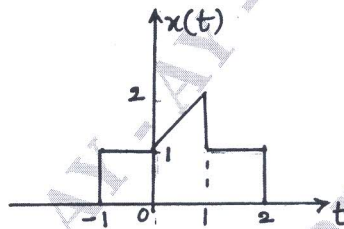
Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Explain the classification of Signals. (04 Marks)
 b. For the signal $x(t)$ shown in Fig. Q1(b), sketch the following :
 i) $x(t-3)$ ii) $x(\frac{1}{2}t-2)$ iii) $2x(t+2)$ iv) $x(\frac{5}{3}t)$. (08 Marks)

Fig. Q1(b)



- c. Find the even and odd components of the following signals :
 i) $x(t) = (1 + t^2 + t^3) \cos^2 10t$ ii) $x[n] = \{-2, 5, 1, -3\}$. (08 Marks)

OR

- 2 a. For each of the following signals, determine whether it is periodic and if it is, find fundamental period i) $x(t) = \cos^2(2\pi t)$ ii) $x[n] = [-1]^n$. (06 Marks)
 b. Categorize the following signals as energy signal or power signal. Find out corresponding value. i) $x(t) = u(t) - u(t-4)$ ii) $x[n] = e^{j(\pi/3)n + \frac{\pi}{2}}$ iii) $x(t) = e^{-5t} u(t)$. (08 Marks)
 c. Check whether the system $y[n] = a^n u[n]$ is i) Static ii) Linear iii) Causal
 iv) Time invariant. Justify the answer. (06 Marks)

Module-2

- 3 a. State and derive the commutative property of Convolution Sum. (06 Marks)
 b. Evaluate the Convolution Integral for a system with input $x(t) = u(t-1) - u(t-3)$ and impulse response $h(t) = u(t) - u(t-2)$. Also sketch the output $y(t)$. (10 Marks)
 c. For the impulse response $h[n] = 2^n u[-n]$, determine whether the corresponding system is
 i) Memoryless ii) Causal iii) Stable. (04 Marks)

OR

- 4 a. Find the output, given the input and initial conditions for the system described by the difference equation $y[n] - \frac{1}{4} y[n-1] - \frac{1}{8} y[n-2] = x[n] + \frac{11}{8} x[n-1]$; $x[n] = 2^n u[n]$;
 $y[-2] = 26$, $y[-1] = -1$. (10 Marks)
 b. Draw the direct form I and direct II implementation of the following differential equation.

$$\frac{d^2 y(t)}{dt^2} + 3 \frac{dy(t)}{dt} + 2y(t) = \frac{d^2 x(t)}{dt^2} + \frac{dx(t)}{dt} \quad (10 \text{ Marks})$$

Module-3

- 5 a. State and derive time shifting property of continuous time Fourier Transform. (06 Marks)
 b. Find the Fourier transform of :
 i) $x(t) = e^{at} u(-t)$ ii) $x(t) = \delta(t+2) + \delta(t+1) + \delta(t-1) + \delta(t-2)$. (06 Marks)
 c. Find and sketch Magnitude Spectrum of Signum function
 $x(t) = \text{Sgn}(t) = 1 ; t > 0$
 $= -1 ; t < 0$. (08 Marks)

OR

- 6 a. Find the Inverse Fourier transform of $X(j\omega) = \frac{j\omega}{(2+j\omega)^2}$. (10 Marks)
 b. The input and output of a causal LTI system are describe by the differential equation
 $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t)$
 i) Find the frequency response of the system.
 ii) Find the impulse response of the system.
 iii) What is the response of the system if $x(t) = t e^{-t} u(t)$? (10 Marks)

Module-4

- 7 a. State and prove Parseval's theorem in discrete time domain. (06 Marks)
 b. Find the DTFT of signal $x[n] = a^n u[n]$. (06 Marks)
 c. Find the Inverse DTFT of $x(j\Omega) = \frac{3 - \left(\frac{1}{4}\right)e^{-j\Omega}}{\left(\frac{-1}{16}\right)e^{-j2\Omega} + 1}$. (08 Marks)

OR

- 8 a. State and derive Time Convolution Property of DTFT. (06 Marks)
 b. Find the frequency response of the causal system
 $y[n] - y[n-1] + \frac{3}{16}y[n-2] = x[n] - \frac{1}{2}x[n-1]$. (06 Marks)
 c. A discrete system is given by $y[n] - 5y[n-1] = x[n] + 4x[n-1]$. Determine its Magnitude and phase response. (08 Marks)

Module-5

- 9 a. List the properties of Region of Convergence RoC. (05 Marks)
 b. Using appropriate properties of Z – transform, find the Z – transform of the following :
 i) $x[n] = u[-n]$ ii) $x[n] = a^{n-2} u[n-2]$. (06 Marks)
 c. Find the Inverse Z – transform of $X(z)$
 $X(z) = \frac{1 - z^{-1} + z^{-2}}{\left(1 - \frac{1}{2}z^{-1}\right)(1 - 2z^{-1})(1 - z^{-1})}$, with RoC i) $1 < |z| < 2$ ii) $\frac{1}{2} < |z| < 1$. (09 Marks)

OR

- 10 a. State and prove Final Value Theorem. (06 Marks)
 b. Find the Impulse response of the system described by difference equation
 $y[n] - 3y[n-1] - 4y[n-2] = x[n] + 2x[n-1]$. (06 Marks)
 c. Determine the response of LTI Discrete Time system governed by difference equation.
 $y[n] - 2y[n-1] - 3y[n-2] = x[n] + 4x[n-1]$ for the input $x[n] = 2^n u[n]$ and with initial conditions $y[-2] = 0$, $y[-1] = 5$. (08 Marks)

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