CBCS SCHEME

USN [| | | | | | | | |]

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.***

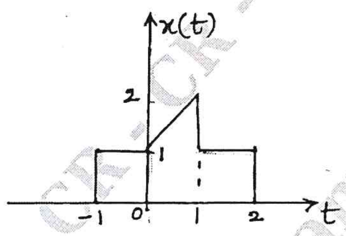
Module-1

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) $x[n] = \{-2, 5, \underset{\uparrow}{1}, -3\}$. **(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.

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = \frac{d^2x(t)}{dt^2} + \frac{dx(t)}{dt}.$$ **(10 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 $X(jw) = \dfrac{jw}{(2+jw)^2}$. (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 is 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 $x(j\Omega) = \dfrac{3 - \left(\frac{1}{4}\right)e^{-j\Omega}}{\left(\frac{-1}{16}\right)e^{-j2\Omega} + 1}$. (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)

$$X(z) = \frac{1 - z^{-1} + z^{-2}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - 2z^{-1}\right)\left(1 - z^{-1}\right)}$$, 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)