Reg. No. : | | | | | | | | | | | |

**Question Paper Code : 30140**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Third Semester

Computer and Communication Engineering

EC 3354 — SIGNALS AND SYSTEMS

(Common to Electronics and Communication Engineering/Electronics and Telecommunication Engineering/Medical Electronics)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Determine whether the signal $x[n]$ is periodic. If yes, find its fundamental period. $X[t] = je^{j10t}$.

2. Define even and odd signal.

3. State the Dirichlet's conditions for the Fourier transform to exist.

4. Draw the ROC of the Laplace transform of a signal $x(t) = e^{at}\ u(-t)$.

5. Find the step response of a LTI system with impulse response $h(t) = \delta(t) - \delta(t-1)$.

6. When the Linear time invariant continuous time system is said to be stable?

7. Determine the system function of the discrete time system described by the difference equation. $y[n] - \frac{1}{2}y[n-1] + \frac{1}{4}y[n-2] = x[n] - x[n-1]$

8. Mention the effects of aliasing.

9. Convolve the two sequences $x(n) = \{ 1, 2, 3 \}$ and $h(n) = \{ 5, 4, 6, 2 \}$

10. List the difference between recursive and non-recursive system.

PART B — (5 × 13 = 65 marks)

11. (a) Explain all classification of systems with Examples for Each Category. (13)

Or

(b) For the given $x(n) = \{1, 4, 3, -1, 2\}$ Plot the following signals.

(i) $x(-n-1)$ (5)

(ii) $x(-n/2)$ (4)

(iii) $x(-n/2)+2$ (4)

12. (a) Consider a casual discrete time LTI system whose input $x[n]$ and output $y[n]$ are related by the following difference equation : $y[n]-\frac{1}{4}y[n-1]=x[n]$. Find the Fourier series representation of the output $y[n]$ for each of the following inputs :

(i) $x[n]=\sin\left[\frac{3\pi}{4}n\right]$ (7)

(ii) $x[n]=\cos\left[\frac{\pi}{4}n\right]+2\cos\left[\frac{\pi}{2}n\right]$ (6)

Or

(b) (i) Determine the Fourier transform of double-sided exponential signal. (5)

(ii) Solve the given differential equation using Laplace transform

$$\frac{d^2y(t)}{dt^2}+3\frac{dy(t)}{dt}+2y(t)=10u(t), \quad t \geq 0$$

with the initial conditions $y(0)=1$ and $y'(0)=-2$. (8)

13. (a) (i) The input and output of a casual LTI system are related, by the differential equation

$$\frac{d^2y(t)}{dt^2}+6\frac{dy(t)}{dt}+8y(t)=2x(t)$$

Find the impulse response $h(t)$ and the output response $y(t)$ of the system when $x(t)=u(t)$. (7)

(ii) Explain the properties of convolution integral. (6)

Or

(b) Realize the system with transfer function in cascade form

$$H(s)=\frac{4(s^2+4s+3)}{s^3+6.5s^2+11s+4}$$ (13)

14. (a) Consider an LTI system with input $x[n]$ and $y[n]$ for which $y[n-1] - \frac{5}{2} y[n] + y[n+1] = x[n]$. This system may or may not be stable or casual.

By considering pole zero pattern of the difference equation, determine the three possible choices for the unit sample response of the system and prove that each choices satisfies the difference equation. (13)

Or

(b) State and prove sampling theorem for a band limited signal. (13)

15. (a) Consider a discrete time LTI System

$y[n] - \frac{3}{2} y[n-1] + \frac{1}{2} y[n-2] = 2x[n] + \frac{3}{2} x[n-1]$ where

$y[-1] = 0$, $y[-2] = 1$ and $x[n] = \left(\frac{1}{4}\right)^n u(n)$

Find output response using Z-transform

Draw its ROC of the transfer function and comment its causality of the system. (13)

Or

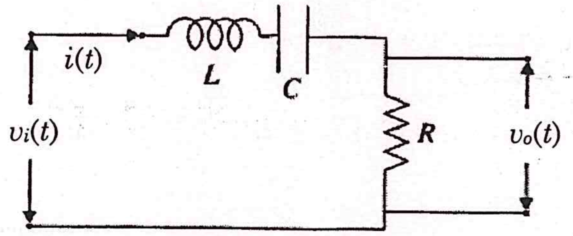
(b) Find the linear convolution of $x(n) = \{1, 2, 3, 4, 5\}$, $h(n) = \{1, 2, 3, 3, 2, 1\}$ Use graphical methods. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Consider the R.LC. series circuit shown with $L = 1H$, $C = 1F$ and R = 2.5 ohms. Derive an expression for the output voltage $V_0(t)$ if the input is an

(i) Impulse

(ii) Unit step. Assume zero initial conditions. (15)




Or

(b) Consider the following system function:

$$H(s) = \frac{z}{\left(z - \frac{1}{4}\right)\left(z + \frac{1}{4}\right)\left(z - \frac{1}{2}\right)}$$

For different possible ROCs, determine the causality, stability and the impulse response of the system. (15)