Reg. No. :

Question Paper Code : 50960

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Third Semester

Computer and Communication Engineering

EC 3354 – SIGNALS AND SYSTEMS

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

(Regulations 2021)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define continuous and discrete time signals.

2. Distinguish between deterministic and random signals.

3. Write the pair equations of the Fourier series of a periodic continuous time signals.

4. Recall the initial and final value theorems of Laplace transform.

5. Define impulse response.

6. State the condition for an LTI system to be stable.

7. What is aliasing?

8. State any two properties of DTFT.

9. Differentiate between recursive and non-recursive systems.

10. List the condition for an LTI system to be causal.

PART B — (5 × 13 = 65 marks)

11. (a) Describe the following signals with their graphical and mathematical representations.

(i) Step (2)

(ii) Ramp (2)

(iii) Impulse (2)

(iv) Pulse (2)

(v) Real exponentials (3)

(vi) Sinusoids (2)

Or

(b) How do you classify the discrete time systems based on their properties? Describe the property of each category. (13)

12. (a) (i) Determine the Fourier series representation of $x(t) = 2\sin(2\pi t - 3) + \sin(6\pi t)$. (7)

(ii) Find the Fourier transform of the signal $x(t) = e^{2t}u(-t)$. (6)

Or

(b) (i) Determine the Laplace transform of $x(t) = e^{at}u(t)$, and depict the ROC and the locations of poles and zeros in the s-plane. Assume that a is real. (7)

(ii) Determine the function of time $x(t)$ for the following Laplace transform and its associated region of convergence. (6)

$$\frac{s+1}{s^2+5s+6}, \; -3 < \mathrm{Re}\{s\} < -2 .$$

13. (a) Derive the equation of convolutional integral and summarize the evaluation procedure of convolution integral. (13)

Or

(b) (i) The input and output of a stable and causal LTI system are related by the differential equation $\frac{d^2y(t)}{dt^2} + \frac{6dy(t)}{dt} + 8y(t) = 2x(t)$. Find the impulse response of this system. (7)

(ii) A system has the transfer function $H(s) = \frac{2s-1}{s^2+2s+1}$

Determine the impulse response assuming

(1) that the system is causal. (3)

(2) that the system is stable. (3)

14. (a) (i) State and prove sampling theorem. (8)

(ii) Compute the DTFT of the signal $x(n)=a^{|n|}, |a|<1$. (5)

Or

(b) (i) Determine the z-transform and ROC of the signal $x(n)=3^n u(-n-1)$. (7)

(ii) Obtain the time domain signal corresponding to the z-transform (6)

$$X(z)=\frac{1+\frac{7}{6}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1+\frac{1}{3}z^{-1}\right)}, \quad |z|>\frac{1}{2}.$$

15. (a) Evaluate the discrete time convolution sum of the following.

$$y(n)=\left(\frac{1}{4}\right)^n u(n) * u(n+2).$$ (13)

Or

(b) Determine the transfer function and the impulse response for the causal LTI system described by the difference equation. (13)

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

PART C — (1 × 15 = 15 marks)

16. (a) (i) Determine whether the continuous time signal $x(t)=3\cos\left(4t+\frac{\pi}{3}\right)$ is periodic? If the signal is periodic, determine its fundamental period. (8)

(ii) Categorize the following signal as an energy signal or a power signal, find the energy or time-averaged power of the signal

$$x(t)=\begin{cases} t, & 0\le t\le 1 \\ 2-t, & 1\le t\le 2 \\ 0, & otherwise \end{cases}$$ (7)

Or

(b) Determine whether the system $y(n)=nx(n)$ is

(i) Memoryless (3)

(ii) Time invariant (3)

(iii) Linear (3)

(iv) Causal (3)

(v) Stable (3)

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Reg. No. : [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Question Paper Code : 20927

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Third Semester

Computer and Communication Engineering

EC 3354 – SIGNALS AND SYSTEMS

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

(Regulations 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give the conditions for a system to be linear and time invariant.

2. Determine whether the signal $x(t) = \cos^2(2\pi t)$ is periodic or not.

3. State Dirichlet conditions for the existence of Fourier series.

4. Obtain the continuous time Fourier transform of the impulse function.

5. Write the convolution property and final value theorem of laplace transform.

6. What is the relationship between Fourier transform and Laplace transform?

7. State the sampling theorem for baseband signals.

8. Prove Parseval's theorem using discrete time fourier transform.

9. List the properties of linear convolution.

10. What are recursive and non-recursive systems?

PART B — (5 × 13 = 65 marks)

11. (a) Determine whether the system $y(t)=10x(t)+5$ is static, linear, time invariant, casual and stable or not.

Or

(b) Give the detailed classification of signals with examples for each of the category.

12. (a) Find the continuous time Fourier transform of the signal $x(t)=A\cos(2\pi f_c t)u(t)$ and plot its amplitude spectrum.

Or

(b) Find the inverse Laplace transform of the function $X(S)=\dfrac{1}{S^2+3S+2}$ with ROC as : $2<\mathrm{Re}(S)<-1$.

13. (a) The differential equation of the system is given as, $\dfrac{d^2y(t)}{dt^2}+5\dfrac{dy(t)}{dt}+6y(t)=-\dfrac{dx(t)}{dt}$. Using Fourier transform determine the impulse response of the system.

Or

(b) The system transfer function is given as, $H(S)=\dfrac{S}{S^2+5S+6}$. The input to the system is $x(t)=e^{-t}u(t)$. Determine the output assuming zero initial conditions.

14. (a) Identify and explain the following properties of discrete time fourier transform.

(i) Differentiation in frequency domain (5)

(ii) Time reversal (4)

(iii) Convolution (4)

Or

(b) (i) Explain the relationship between Fourier transform and Z transform. (6)

(ii) Explain the time shifting and differentiation in Z domain property of Z transform. (7)

15. (a) A difference equation of the system is given as $y(n)=0.5\,y(n-1)+x(n)$. Determine

(i) System function (4)

(ii) Pole zero plot of the system function (5)

(iii) Unit sample response of the system. (4)

Or

(b) Obtain direct form-I and direct form-II realization of the following system $y(n)=0.75\,y(n-1)-0.125\,y(n-2)+6x(n)+7x(n-1)+x(n-2)$.

PART C — (1 × 15 = 15 marks)

16. (a) Realize the system function $H(S)=\dfrac{1}{(S+1)(S+2)}$ in series and parallel forms.

Or

(b) The transfer function of the discrete time causal system is given as

$$H(z)=\frac{1-z^{-1}}{1-0.2z^{-1}-0.15z^{-2}}$$

(i) Find the difference equation of the system. (5)

(ii) Draw series and parallel realization of the system. (10)

(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)

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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

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

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

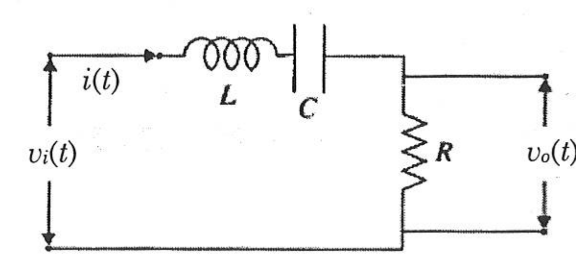
(b) Find the linear convolution of $x(n)=\{1, 2, 3, 4, 5\}$, $h(n)=\{1, 2, 3, 3, 2, 1\}$ Use graphical methods. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Consider the R.L.C. 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

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Question Paper Code : 70087

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Third Semester

Electronics and Communication Engineering

EC 3354 — SIGNALS AND SYSTEMS

(Common to: Computer 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. State whether the following system y (t) = 2t × (t) is time variant or not.

2. Differentiate between causal and non-causal systems.

3. Define Fourier transform.

4. If $X(s)=\frac{2}{(s+3)}$. Find the Laplace transform of $\frac{dx(t)}{dt}$.

5. Determine the impulse response h (t) of the following system $y(t)=x(t-t_o)$. Assume zero initial conditions.

6. Perform Convolution of the causal signal $x_1(t)=2u(t)$, $x_2(t)=u(t)$ using Laplace transform.

7. Compare Fourier transform of discrete and continuous time signals.

8. State the Linearity property of Z transform.

9. What is a recursive system?

10. In an LTI System the impulse response, $h(n)=C^n$ for n ≤ 0. Determine the range of values of C, for which the system is stable.

PART B — (5 × 13 = 65 marks)

11. (a) Determine the periodicity of the following continuous time signals.

(i) x(t) = 2 cos 3t + 3 sin 7t (6)

(ii) x(t) = 5 cos 4 πt + 3 sin 8 πt (7)

Or

(b) Test whether the system $d^2y(t) / dt^2 + 2\, dy(t)/dt + 3\, y(t) = x(t)$ is linear or not.

12. (a) Derive the fourier transform expression from the exponential form of fourier series.

Or

(b) State and prove initial value theorem and final value theorem using Laplace Transform.

13. (a) Explain the cascade structure and parallel structure of continuous time systems with neat diagram.

Or

(b) Perform convolution of $x_1(t) = e^{-2t} \cos 3t\, u(t)$ and $x_2(t) = 4 \sin 3t\, u(t)$ using Laplace transform.

14. (a) Explain the Correlation property and Parseval's relation in DTFT.

Or

(b) Find the one sided z transform of the discrete time signals generated by mathematically sampling the following continuous time signal $x(t) = e^{-at} \cos \Omega_0 t$.

15. (a) Find the transfer function and unit sample response of the second order difference equation with zero initial conditions y(n) = x(n) – 0.25y (n–2)

Or

(b) Find the linear convolution of the sequence, $x(n) = \{-1, 1, \underset{\uparrow}{2}, -2\}$ and

$h(n) = \{0.5, 1, -\underset{\uparrow}{1}, 2, 0.75\}$

PART C — (1 × 15 = 15 marks)

16. (a) Using z transform, perform deconvolution of the response, $y(n) = \{1, 4, 8, 8, 3, -2, -1\}$ and impulse response h(n) = {1, 2, 1, -1} to extract the input x(n).

Or

(b) Evaluate the step response of an LTI system whose impulse response, is given by $h(n) = a^{-n} u(-n);\ 0 < a < 1$.

Reg. No. :

Question Paper Code : X10353

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
Third Semester
Electronics and Communication Engineering
EC8352 – SIGNALS AND SYSTEMS
(Common to Electronics and Telecommunication Engineering / Computer and Communication Engineering / Biomedical Engineering / Medical Electronics)
(Regulations 2017)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Determine average power P_∞ for the signal x(t) = 2cos(t).

2. Express discrete time unit impulse signal in terms of discrete time unit step signal and express discrete time unit step signal in terms of discrete time unit impulse signal.

3. Determine Fourier transform for unit step signal.

4. Determine the Laplace transform for the signal $x(t) = e^{-4t}u(t)$.

5. Define an invertible continuous time system.

6. State Parsevals Theorem.

7. Determine the Nyquist rate for the signal x(t) = 1 + cos (4000πt).

8. Find the Fourier transform for the discrete time signal $x[n] = \delta[n] + \delta[n-1] + \delta[n+1]$ and draw its spectrum.

9. State the characteristic of Region Of Convergence of a Causal LTI system described by its transfer function H(z).

10. Determine Z-transform of unit impulse signal δ[n] and sketch its ROC.

PART – B (13×5=65 Marks)

11. a) i) Consider the system described by the input output relation, $y(t) = [\cos(3t)]x(t)$. Here x(t) stands for input and y(t) for output. State with justification whether the system is linear and/or time invariant. **(4)**

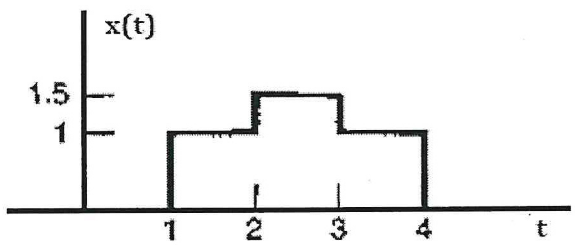
ii) Derive the condition necessary for the impulse response h[n] of an LTI system to be stable and Causal. **(5)**

iii) State whether the LTI system described by impulse response $h[n]=\left(\frac{1}{4}\right)^n u[-n]$ is causal and stable with justification. **(4)**

(OR)

b) i) For the signal x(t) shown in Figure, sketch $x\left(2-\frac{t}{2}\right)$. **(5)**

ii) Sketch the even and odd part of the signal x(t) shown in Figure. **(4)**



Figure

iii) Let $x[n] = u[n+4]$; $h[n]= \delta[n] - \delta[n-2]$. Sketch the convolution of x[n] and h[n]. **(4)**

12. a) i) Consider the periodic signal $x(t) = \sum_{k=-\infty}^{+\infty} a_k e^{jk\omega_0 t}$. Derive the expression for the Fourier series coefficient a_m of the complex exponential $e^{jm\omega_0 t}$. **(7)**

ii) Let $x(t)= \delta(t) - \frac{2}{3}e^{-2t}u(t) + \frac{1}{3}e^{-4t}u(t)$. Determine Laplace transform for the signal x(t). Plot pole zero and mark region of convergence. **(6)**

(OR)

b) i) Derive the Fourier Transform for the rectangular pulse x(t) given in the below expression and plot the magnitude spectrum $X(j\omega)$. **(7)**

$$x(t) = \begin{cases} 1, & |t| < T_1 \\ 0, & T_1 < |t| < T/2 \end{cases}$$

ii) Determine Laplace transform for the signal $x(t) = e^{-a|t|}$ and mark the region of convergence in s plane. **(6)**

13. a) Let $x(t) = u(t-2) - u(t-5)$ and $h(t) = e^{-5t}$. Compute the convolution $y(t) = x(t)*h(t)$ and sketch the signal y(t). **(13)**

(OR)

b) Consider an LTI system described by differential equation

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = \frac{dx(t)}{dt} + 2x(t).$$ Here x(t) and y(t) are the input and output of the system respectively.

i) Determine the transfer function H(s) of the system, if the system is causal and stable. **(6)**

ii) Considering the system to be causal and stable, if the input is defined as $x(t) = e^{-3t}u(t)$, determine the response y(t). **(7)**

14. a) i) Determine DTFT for the signal x[n]

$$x[n] = \begin{cases} 1, & |n| < N_1 \\ 0, & |n| > N_1 \end{cases}$$. Sketch its spectrum for $N_1 = 4$. **(8)**

ii) Consider a signal $x[n] = 5\left(\frac{1}{3}\right)^n u[n] - 3\left(\frac{1}{4}\right)^n u[n]$, determine its Z-transform X[z] and mark its ROC. **(5)**

(OR)

b) i) Determine the Z-transform for the signal $x[n] = \left(\frac{1}{2}\right)^n \sin\left(\frac{\pi}{8}n\right) u[n]$ and mark its ROC. **(8)**

ii) Determine the Fourier transform for the signal $x[n] = u[n-3] - u[n-7]$. **(5)**

15. a) i) A Discrete time LTI system provides response $y[n] = 0.4^n u[n]$ for input $x[n] = 0.2^n u[n]$. Determine frequency response $H(e^{j\omega})$ of the system. **(7)**

ii) Consider second order LTI system described by $H(z) = \dfrac{1}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{3}z^{-1}\right)}$.

Determine the impulse response if the system is causal. **(6)**

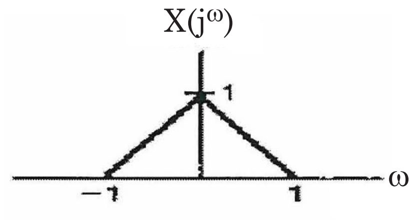
(OR)

b) Determine and plot the convolution of x[n] and h[n] defined by

$x[n] = \left(\frac{1}{3}\right)^{n-1} u[n-1]$ and $h[n] = u[n+3]$. **(13)**

PART – C **(1×15=15 Marks)**

16. a) Consider a signal x(t) with $X(j^{\omega})$ shown in Figure Let p(t) = sin(t).sin(2t). Determine the Fourier transform for the signal y(t) generated by the product of x(t) and p(t) given by y(t) = x(t).p(t). Sketch the spectrum $Y(j^{\omega})$. **(15)**



(OR)

b) Given x[n] has Fourier transform $x(e^{j\omega n})$. Express Fourier transform for the following signals

i) $x_1[n] = x[2 - n] + x[-2 - n]$ **(5)**

ii) $x_2[n] = (n - 1)^2 x[n]$. **(10)**

Reg. No. :

Question Paper Code : 90175

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019
Third Semester
Electronics and Communication Engineering
EC 8352 – SIGNALS AND SYSTEMS
(Common to Medical Electronics/Biomedical Engineering/Computer and Communication Engineering/Electronics and Telecommunication Engineering)
(Regulations – 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. Determine whether the signal $x(t) = \sin\sqrt{2}t$ is periodic or not.

2. Give an example for deterministic and random signals.

3. State Gibbs Phenomenon.

4. Find the Fourier series coefficients of the signal $x(t) = 1 + \sin\frac{\pi}{2}t$.

5. Two systems with impulse responses $h_1(t) = e^{-at}\, u(t)$ and $h_2(t) = u(t-1)$ are connected in parallel. What is the overall impulse response h(t) of the system ?

6. The input – output relationship of a system is given by
$$\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = \frac{dx}{dt}.$$
Find the system function H(s) of the system.

7. Find the Nyquist rate of the signal $x(t) = \cos 200\pi t + \sin 400\pi t$.

8. Find the z-transform and its associated ROC for the signal
$x[n] = \delta[n+1] + 2\,\delta[n] - 3\,\delta[n-2]$.

9. Convolve the following signals
$x[n] = \{\underset{\uparrow}{1}, 2, 3\}$ $h[n] = \{1, 2\}$

10. Determine whether the following system is a recursive system and justify your answer $y[n] = 2x[n] + 3x[n-1] - 2x[n-2]$.

PART – B (5×13=65 Marks)

11. a) Plot the following signals, given x[n] :

i) $x[n] = \{1, 2, 1, \underset{\uparrow}{2}, 1, 2, 1\}$ (2)

ii) $x[n-1]$ (2)

iii) $x[2n]$ (2)

iv) $x[n/2]$ (2)

v) $x\left[\frac{n}{2}-1\right]$ (2)

vi) $x\left[-\frac{n}{2}-1\right]$ (3)

(OR)

b) Determine whether the following system is Linear, Time Invariant, Causal, Memoryless and Stable.

$y[n] = nx[n]$

12. a) Find the Fourier transform of the signal $x(t) = e^{-\alpha|t|}$, $\alpha > 0$ and plot its spectrum.

(OR)

b) Specify all possible ROC's for the function X(s) given below. Also find x(t) in each case.

$$X(s) = \frac{4s}{(s+2)(s+4)}$$

13. a) Convolve the following signals $x(t) = u(t)$ $h(t) = u(t) - u(t-2)$.

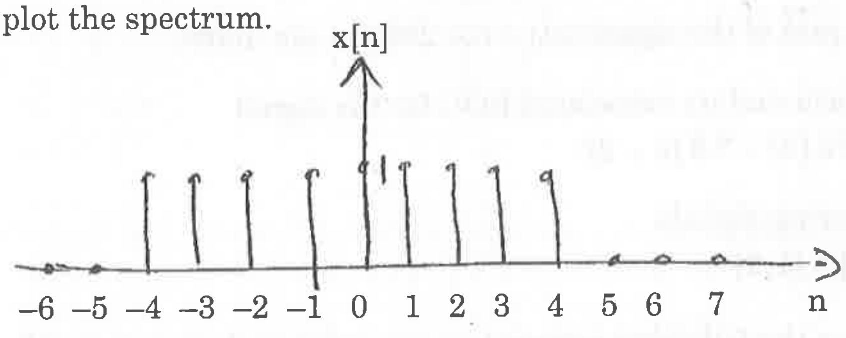
(OR)

b) An LTI system which is initially at rest is described by the differential equation

$$\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = \frac{dx}{dt} + 3x\,.$$

Find the system function H(s) and the impulse response h(t).

14. a) Find the DTFT of the rectangular pulse sequence shown below and also plot the spectrum.



(OR)

b) Given the z – transform of a sequence x[n] as $X(z) = \frac{z}{z-1}$

Find the z – transform of the following signals in terms of X(z) using properties of z – transform.

i) $x[n-1]$ **(3)**

ii) $x[-n]$ **(3)**

iii) $\alpha^n x[n]$ **(3)**

iv) $nx[n]$ **(4)**

15. a) Convolve the following signals $x[n] = \alpha^n u[n]$ $h[n] = u[n-1]$.

(OR)

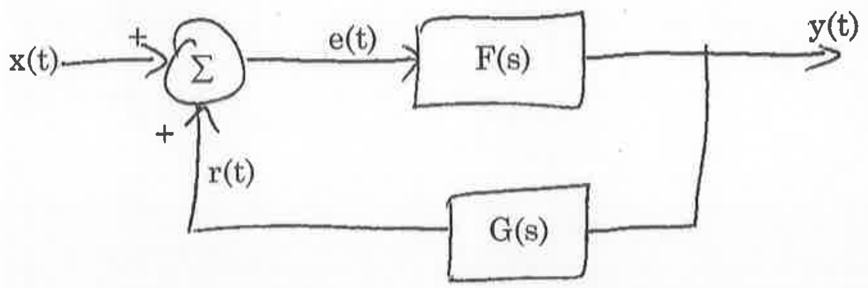
b) Consider a DT LTI system whose system function H(z) is given by

$H(z) = \frac{z}{z-0.5}$ $|z| > 0.5$.

Find the step response of the system.

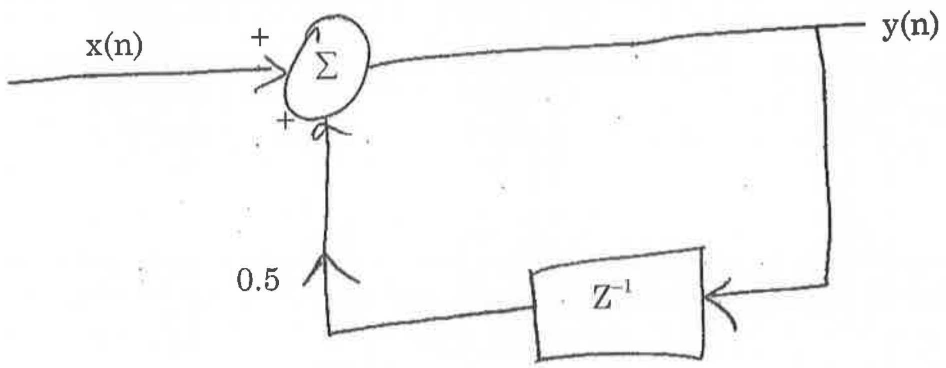
PART – C **(1×15=15 Marks)**

16. a) The feedback interconnection of two causal subsystems with system functions F(s) and G(s) is shown below. Find the overall system function H(s) for this feedback system.



(OR)

b) Consider the discrete time LTI system shown below.



Find the frequency response $H(e^{j\omega})$ and the impulse response h(n) of the system. Sketch the magnitude response $|H(e^{j\omega})|$ for the system.

Reg. No. :

Question Paper Code : 80112

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Third Semester

Electronics and Communication Engineering

EC 8352 — SIGNALS AND SYSTEMS

(Common to Medical Electronics/B.E. Biomedical Engineering/Computer and Communication Engineering/Electronics and Telecommunication Engineering)

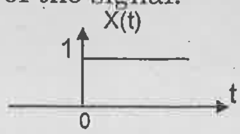
(Regulation 2017)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

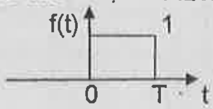
1. Find the even and odd part of the signal.



2. Determine whether the given discrete time sequence is periodic or not. If the sequence is periodic, find the fundamental period. $x[n] = \cos\left(\frac{n}{8}\right)\cos\left(\frac{\pi n}{8}\right)$.

3. Find the Fourier series coefficients for the given signal.
$x(t) = [1+\cos(2\pi t)]\left[\sin\left(10\pi t + \frac{\pi}{6}\right)\right]$.

4. Find the Laplace transform of the given signal.



5. Check whether the given system is causal and stable. $h(t) = (e)^{-4t}\ u(t+10)$.
6. State Dirichlet's condition for Region of convergence.
7. Define Sampling theorem.
8. Write the relationship between DTFT and Z-transform.
9. Determine the Z-transforms of the following two signals. Note that the Z–transforms for both have the same algebraic expression and differ only in the ROC. $x_1[n] = \left(\frac{1}{2}\right)^n u[n]$ and $x_2[n] = -\left(\frac{1}{2}\right)^n u[-n-1]$.
10. Find the initial and final values of the function, $X(z) = \frac{1+z^{-1}}{1-0.25z^{-2}}$.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Draw the waveforms represented by the following step functions,
$\rightarrow f_1(t) = 2u(t-1)$ $\rightarrow f_2(t) = -2u(t-2)$
$\rightarrow f(t) = f_1(t) + f_2(t)$ $\rightarrow f(t) = f_1(t) - f_2(t)$. (5)

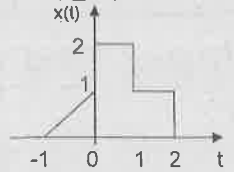
(ii) Determine the energy and power of the given signal $x(t) = t\,u(t)$. (4)

(iii) Check whether the given system is linear or not $y(t) = x^2(t)$. (4)

Or

(b) (i) A continuous time signal $x(t)$ is shown in figure below, Sketch and label each of the following signals.

$x(t-2)$, $x(2t+3)$, $x\left(\frac{3}{2}t\right)$, and $x(-t+1)$. (4)



(ii) Determine the energy and power of the given signal (4)

$x[n] = \cos\left[\frac{\pi}{4}n\right]$.

(iii) Check whether the given system is Linear/nonlinear, Time Variant /Time Invariant, Causal/Non-causal $y[n] = x[n] - x[n-1]$. (5)

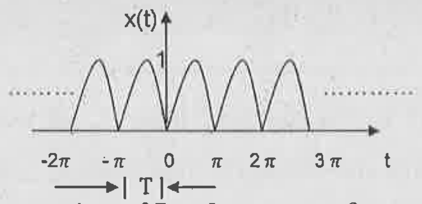
12. (a) Find the Fourier transform of each of the following signals and sketch the magnitude and phase as a function of frequency, including both positive and negative frequencies (13)

(i) $\delta(t-5)$

(ii) $e^{-at}u(t)$ a real, positive.

Or

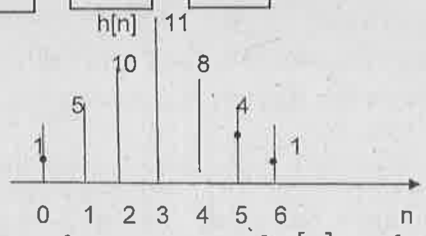
(b) (i) Determine the Fourier Series representation of the given full wave rectifier. (8)



(ii) List the properties of Laplace transform and write its ROC. (5)

13. (a) (i) Consider the cascade interconnection of three stage causal LTI system with impulse response $h_1[n]$, $h_2[n]$ and $h_3[n]$ as shown in figure below. The impulse response $h_2[n] = u[n] - u[n-2]$. The overall impulse response $h[n]$ is given in the figure below.

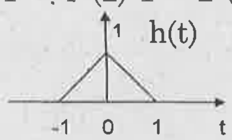
$x[n] \rightarrow \boxed{h_1[n]} \rightarrow \boxed{h_2[n]} \rightarrow \boxed{h_2[n]} \rightarrow y[n]$

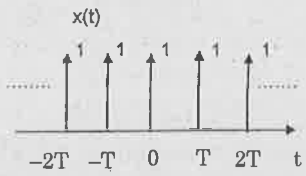


Find the impulse response $h_1[n]$ and the response $y[n]$ of the overall system to the input $x[n] = \delta[n] - \delta[n-1]$. (9)

(ii) Let $h(t)$ be a triangular pulse and let $x(t)$ be the impulse train. Determine and sketch $y(t)$ for the following values of T. (4)

(1) $T = 4$ (2) $T = 2$ (3) $T = 1$ (4) $T = 3/2$.





Or

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(b) (i) Find the convolution between $x[n]$ and $h[n]$, where $x[n] = (\alpha)^n u[n]$; $0 < \alpha < 1$ and $h[n] = u[n]$. (6)

(ii) Find the convolution of $x(t)$ and $h(t)$ (7)

$$x(t) = \begin{cases} 2 & for\ -2 \le t \le 2 \\ 0; & \text{otherwise} \end{cases} \text{ and } h(t) = \begin{cases} 4 & for\ 0 \le t \le 2 \\ 0; & \text{otherwise} \end{cases}$$

14. (a) (i) Find the inverse Laplace transform of $\left[\frac{s+4}{2s^2+5s+3}\right]$; Roc : $Re\{s\} > -1$. (4)

(ii) Consider the LTI system with impulse response $h[n] = (\alpha)^n u[n]$; $|\alpha| < 1$ and $x[n] = (\beta)^n u[n]$; $|\beta| < 1$. Find the response of the LTI system. (9)

Or

(b) (i) Consider a discrete-time LTI system with impulse response $h[n] = \left[\frac{1}{2}\right]^n u[n]$. Use Fourier transform to determine the response of the system to the input $x[n] = \left[\frac{3}{4}\right]^n u[n]$. (6)

(ii) A difference equation of the system is given as, $y(n) - y(n-1) + \frac{1}{4} y(n-2) = x(n) + \frac{1}{4} x(n-1) - \frac{1}{8} x(n-2)$. Determine the transfer function of the inverse system. Check whether the inverse system is causal and stable. (7)

15. (a) (i) Find the inverse Z-transform of

$$X(z) = \frac{1-(1/2)z^{-1}}{1+(3/4)z^{-1}+(1/8)z^{-2}}; \ |Z| > \frac{1}{2}.$$ (8)

(ii) Compute discrete-time Fourier Transform of $x(n) = a^n$ for $0 \le n \le N-1$. (5)

Or

(b) (i) Determine the Z-transform and ROC of the given sequence. (5)

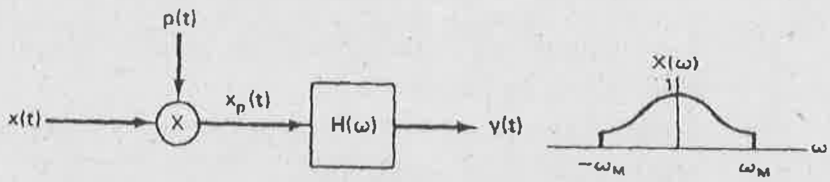
$$x[n] = \left(\frac{-1}{3}\right)^n u[n] - \left(\frac{1}{2}\right)^n u(-n-1).$$

(ii) Obtain the direct form I and direct form II realizations of the LTI system. (8)

$$y(n) = -\frac{3}{8} y(n-1) + \frac{3}{32} y(n-2) + \frac{1}{64} y(n-3) + x(n) + 3x(n-1) + 2x(n-2).$$

PART C — (1 × 15 = 15 marks)

16. (a) (i) A system in which the sampling signal $p(t)$ is an impulse train with alternating sign is given in the figure 16(a). The Fourier transform $x(w)$ of the input signal are $x(t)$ and the Fourier transform $H(w)$ as indicated in the figure 16. (11)



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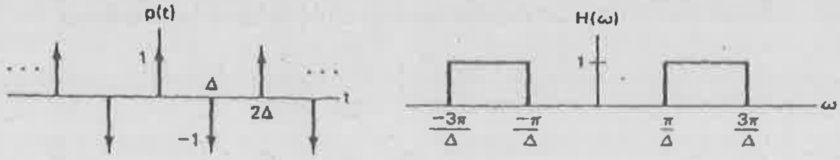


Fig. Q. 16(a)

(1) For $\Delta < \pi/2\omega_M$, sketch the Fourier transform of $x_p(t)$ and $y(t)$

(2) For $\Delta < \pi/2\omega_M$, determine a system that will recover $x(t)$ from $x_p(t)$.

(3) For $\Delta < \pi/2\omega_M$, determine a system that will recover $x(t)$ from $y(t)$.

(4) What is the maximum value of Δ in relation to ω_M for which $x(t)$ can be recovered from either $x_p(t)$ or $y(t)$.

(ii) Using figure 16(a)(i) determine $y(t)$ and sketch $Y(\omega)$ if $X(\omega)$ is given by figure 16 (a) (ii). Assume $\omega_c < \omega_0$. (4)

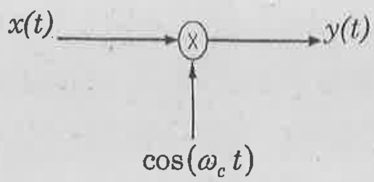


Figure 16(a) (i)

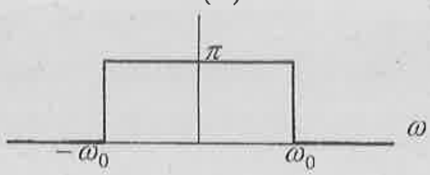


Figure 16(a) (ii)

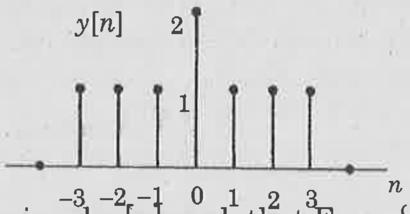
Or

(b) (i) (1) Suppose that the signal $e^{j\omega t}$ is applied as the excitation to a linear, time-invariant system that has an impulse response h(t). By using the convolution integral, show that the resulting output is $H(\omega)\,e^{j\omega t}$, where $H(\omega) = \int_{-\infty}^{\infty} h(\tau)\,e^{j\omega\tau}\,d\tau$.

(2) Assume that the system is characterized by a first-order differential equation $\frac{dy(t)}{dt} + ay(t) = x(t)$.

If $x(t) = e^{j\omega t}$ for all t, then $y(t) = H(\omega)\,e^{j\omega t}$ for all t. By substituting into the differential equation, determine $H(\omega)$. (8)

(ii) Consider the signal $y[n]$. (7)



(1) Find a signal $x[n]$ such that Even $\{x[n]\} = y[n]$ for $n \geq 0$, and Odd $(x[n]\} = y[n]$ for $n < 0$.

(2) Suppose the Even $\{w[n]\} = y[n]$ for all n. Also assume that $w[n] = 0$ for $n < 0$. Find $w[n]$.

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

Question Paper Code : 25073

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Third Semester

Electronics and Communication Engineering

EC 8352 — SIGNALS AND SYSTEMS

(Common to : Electronics and Telecommunication Engineering/ Medical Electronics/ Biomedical Engineering/ Computer and Communication Engineering)

(Regulations 2017)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give the mathematical and graphical representations of a discrete time ramp sequence.

2. Evaluate the following integral

$$\int_{-1}^{1} (2t^2 + 3)\, \delta(t)\, dt .$$

3. State Dirichlet's conditions.

4. If $X(j\Omega)$ is the Fourier transform of the signal $x(t)$, what is the Fourier transform of the signal $x(3t)$ in terms of $X(j\Omega)$?

5. If the system function $H(s) = 4 - \frac{3}{s+2}$; $\mathrm{Re}(s) > -2$, find the impulse response $h(t)$.

6. Two systems with impulse response $h_1(t) = e^{-2t}u(t)$ and $h_2(t) = \delta(t-1)$ are connected in series. What is the overall impulse response $h(t)$ of the system?

7. A continuous time signal $x(t)$ has the following real Fourier transform :

$$X(j\Omega) = \begin{cases} 1, & |\Omega| \le 10\pi \\ 0, & \text{otherwise} \end{cases}$$

Is $x(t)$ band limited? If so, find the Nyquist rate.

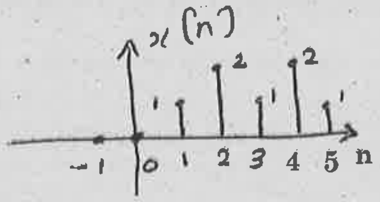
8. The DTFT of a discrete time signal $x(n)$ is given as $X(e^{jw}) = 2e^{2jw} + 3 + 4e^{-jw} - 2e^{-2jw}$. Find the time domain signal $x(n)$.

9. The input $x(n)$ and output $y(n)$ of a discrete time LTI system is given as $x(n) = \{1, 2, 3, 4\}$ and $y(n) = \{0, 1, 2, 3, 4\}$. Find the impulse response $h(n)$.

10. Given the system function $H(z) = \dfrac{z^{-1}}{z^{-2} + 2z^{-1} + 4}$. Find the difference equation representation of the system.

PART B — (5 × 13 = 65 marks)

11. (a) A discrete time signal $x(n)$ is shown below :



Plot the following signals :

(i) $x[n-2]$ (2)

(ii) $x[n+1]$ (2)

(iii) $x[-n]$ (2)

(iv) $x[-n+1]$ (2)

(v) $x[2n]$ (2)

(vi) $x[-2n+1]$. (3)

Or

(b) A continuous time system has the input-output relation given by $y(t) = tx(t-1)$

Determine whether the system is

(i) Linear (3)

(ii) Time-invariant (3)

(iii) Stable (3)

(iv) Memoryless (2)

(v) Causal. (2)

12. (a) Find the Fourier transform of $x(t)=e^{-a|t|}$, $a>0$ and sketch its corresponding magnitude spectrum.

Or

(b) Find the Laplace transform of $x(t)=e^{-a|t|}$, $a>0$ and its associated ROC and indicate whether the Fourier transform $X(j\Omega)$ exists.

13. (a) Find the output $y(t)$ of the system

$$H(s)=\frac{1}{s+2} \text{ Re }\{s\}> -2$$

for the input $x(t) = e^{-3t} u(t)$.

Or

(b) A causal LTI system satisfies the linear differential equation

$$\frac{d^2}{dt^2} y(t) + 7\frac{d}{dt} y(t) + 12 y(t) = \frac{d}{dt} x(t) + 2x(t)$$

(i) Find the frequency response $H(j\Omega)$ of the system. (6)

(ii) Find the output $y(t)$ of the system for the input $x(t)=e^{-2t} u(t)$. (7)

14. (a) Let $X(e^{jw})$ be the Fourier transform of the sequence $x[n]$. Determine in terms of $x[n]$ the sequence corresponding to the following transforms using the properties of DTFT. Also prove the properties used.

(i) $X(e^{j(w-w_0)})$ (3)

(ii) $X^*(e^{-jw})$ (3)

(iii) $j\frac{d}{dw} X(e^{jw})$ (3)

(iv) $\frac{1}{2\pi} X_1(e^{jw}) \circledast X_1(e^{jw})$ (4)

Or

(b) Derive the z – transform of the following sequence

$x[n] = \sin(w_0 n)\, u[n]$

Also specify its ROC.

15. (a) Let $y[n]=x[n]*h[n]$

where $x[n]=\left(\frac{1}{3}\right)^n u[n]$ and

$h[n]=\left(\frac{1}{5}\right)^n u[n]$

Find $y(z)$ by using the convolution property of $z-$transform and find $y[n]$ by taking the inverse transform of $y(z)$ using the partial fraction expansion method.

Or

(b) A causal DT LTI system is described by the difference equation

$$y[n-2]-\frac{7}{10}y[n-1]+\frac{1}{10}y[n]=x[n]$$

Determine the system function $H(z)$. Also plot the pole-zero plot and determine whether the system is stable.

PART C — (1 × 15 = 15 marks)

16. (a) Given the impulse response of a discrete time LTI system

$$h[n]=\left[-2\left(\frac{1}{3}\right)^n+3\left(\frac{1}{2}\right)^n\right]u[n]$$

(i) Find the system function $H(z)$ of the system

(ii) Find the difference equation representation of the system

(iii) Find the step response of the system.

Or

(b) The input output relationship of a discrete time system is given by $y[n]-\frac{1}{4}y[n-1]=x[n]$. Find the response $y[n]$ if the Fourier transform of the input $x[n]$ is given as $X(e^{jw})=\dfrac{1}{1-\frac{1}{2}e^{-jw}}$.
