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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 :

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

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

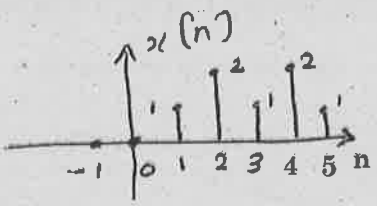
8. The DTFT of a discrete time signal $x(n)$ is given as $X(e^{jw})=2e^{2jw}+3+4e^{-jw}-2e^{-2jw}$. Find the time domain signal $x(n)$.

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) $\frac{1}{2\pi}X_1(e^{jw})\circledN X_1(e^{jw})$ (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 $X(e^{jw})=\frac{1}{1-\frac{1}{2}e^{-jw}}$.