Reg. No. :

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B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Third Semester

Electronics and Communication Engineering

EC 8352 – SIGNALS AND SYSTEMS

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

(Regulations 2017)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Evaluate the following integral

$$\int_{-3}^{5} e^{-t}\,\delta(2t-2)\,dt$$

2. Consider a discrete time signal $x(n) = Sin\left(\frac{\pi}{4}n\right)Sin\left(\frac{\pi}{8}n\right)$. If signal is periodic, calculate the fundamental time period.

3. If $x(j\omega)$ is the fourier transform of a signal *x(t)*. What is the fourier transform of the signal $x(5t-3)$ in terms of $x(j\omega)$?

4. Find the initial and final value of the function $F(S) = \frac{2(s+1)}{s^2+4s+7}$.

5. Consider two continuous time signals $x(t) = e^{-t}$ and $y(t) = e^{-2t}$ which exist for $t > 0$, Find the convolution of $z(t) = x(t) * y(t)$.

6. The impulse response of a system is $h(t) = tu(t)$. If input of the system is $u(t-1)$, Find the output of system.

7. Determine the fourier transform of $x[n] = u[n] - u[n-N]$.

8. State the sampling theorem.

9. The system function of LTI system is $H(z)=\frac{z}{(z-2)^2}$. Find the difference equation representation of system.

10. Two discrete time systems with impulse responses $h_1[n]=\delta[n-1]$ and $h_2[n]=\delta[n-3]$ are connected in cascade. Find overall impulse response of the cascaded system.

PART B — (5 × 13 = 65 marks)

11. (a) (i) For the signal *x(t)* shown in Fig 11 (a), sketch and label each of the following signals: (9)

(1) $x(3t-1)$

(2) $x(t)\{u(t)-u(t-1.5)\}$

(3) $x(t)\delta\left(t-\frac{8}{5}\right)$

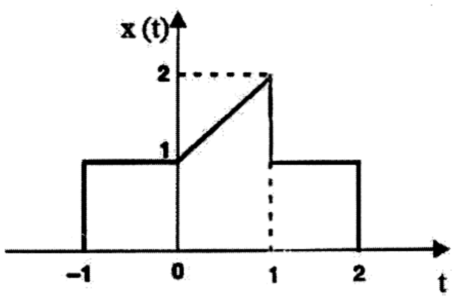

Fig 11 (a)

(ii) Determine the energy and power signals of the signals $x[n]=(-0.4)^n u[n]$. (2)

(iii) Check whether the given system is linear or not $y[n]=x[n]+7$. (2)

Or

(b) (i) A discrete-time signal x[n] is shown in Fig. 11 (b). Sketch and label each of the following signals (6)

(1) $x[n]u[1-n]$

(2) $x[n]\{u[n+2]-u[n]\}$

(3) $x[n]\delta[n+1]$

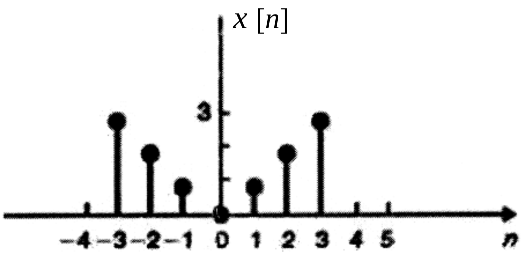

Fig. 11 (b)

(ii) Consider the continuous time signal $x(t) = \delta(t+5) - \delta(t-5)$. Calculate the Energy for the signal $y(t) = \int_{-\infty}^{t} x(\tau)d\tau$. (4)

(iii) Check whether the given system is time invariant or not $y(t) = [6 + 2\,sin\,t]x(t)$. (3)

12. (a) Consider a continuous time signal $f(t)$ shown in Figure 12 (a). Determine the fourier transform of signal. Also plot the magnitude and phase spectrum. (13)

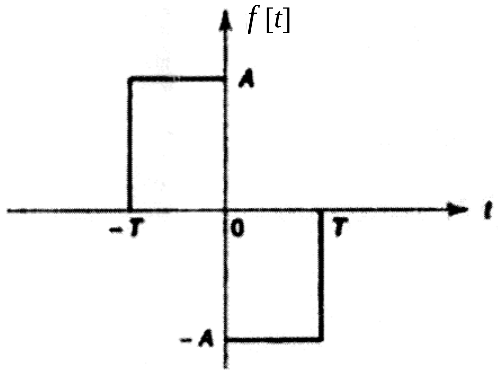

Figure 12 (a)

Or

(b) (i) Determine the laplace transform of the continuous time signals $x(t) = e^{-4|t|}$ and sketch its ROC. (6)

(ii) Determine the fourier series of the square wave shown in Fig 12 (b). (7)

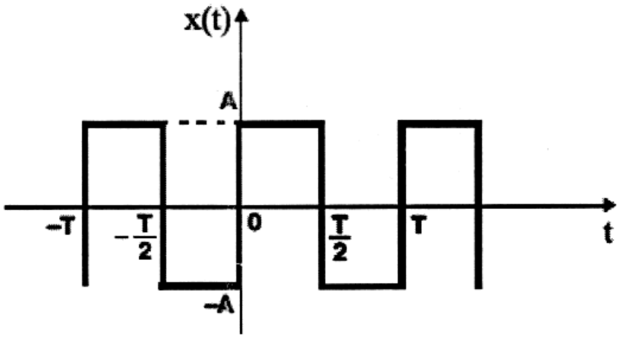

Fig 12 (b)

13. (a) Consider a continuous-time LTI system for which input x(t) and output y(t) is related by differential equation:

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

Find the impulse response h (t) for each of the following cases:

(i) The system is causal

(ii) The system is stable

(iii) The system is neither stable nor causal (13)

Or

(b) Determine the convolution integral for the given signal.

$$x(t)=\begin{cases}0; & t<0\\ \frac{t}{4}; & 0\le t\le 4\\ 0; & t>4\end{cases} \quad \text{and} \quad h(t)=\begin{cases}0; & t<-1\\ 1; & -1\le t\le 1\\ 0; & t>1\end{cases}$$ (13)

14. (a) (i) Determine the Z transform and ROC of the given sequence x[n]. (6)

$x[n]=(0.5)^n u[n]-(0.8)^n u[-n-1]$.

(ii) Use parseval's property to calculate the energy of given signal

$$x[n]=\sum_{n=-\infty}^{\infty}\frac{sin^2(4n)}{\pi^2 n^2}$$ (7)

Or

(b) (i) Let $X\left(e^{j\omega}\right)$ denotes the fourier transform of given signal $x[n]$.

$x[n]=(-1,0,1,\underset{\uparrow}{2},1,0,1,2,1,0,-1)$

(1) Evaluate $X\left(e^{jo}\right)$ (2)

(2) Evaluate $\int_{-\pi}^{\pi}\left|X\left(e^{j\omega}\right)\right|^2 d\omega$ (3)

(ii) Consider a discrete time signal

$$x[n]=\begin{cases}a^n, & 0\le n\le N-1 \quad a>0\\ 0, & otherwise\end{cases}$$

Find the X(z) and plot the pole zero constellation diagram. (8)

15. (a) (i) Consider a LTI system with impulse response, $h_1[n]=\left(\frac{1}{3}\right)^n u[n]$ is connected in parallel with another causal LTI system with impulse response h_2[n]. The resulting parallel interconnections has the frequency response,

$$H\left[e^{j\omega}\right]=\frac{-12+5e^{-jw}}{12-7e^{-j\omega}+e^{-j2w}}$$

Determine h_2[n]. (8)

(ii) Consider a causal LTI system that is characterized by the difference equation:

$$y[n]-3/4\ y[n-1]+1/8\ y[n-2]=2x[n]$$

Determine the impulse response of the system. (5)

Or

(b) (i) For the system described by the difference equation:

$$3y[n]-4y[n-1]+y[n-2]=x[n]$$

Find the frequency response of the system. (3)

(ii) An LTI system has the impulse response $h[n]=a^n u[n]$ with $|a|<1$. The input to the system is $x[n]=\beta^n(u[n]-u[n-7])$ with no restriction on the value of β. Find the general closed form equation for the system output $y[n]$. (10)

PART C — (1 × 15 = 15 marks)

16. (a) The following facts are given facts about an LTI system with impulse response $h[n]$ and frequency response $H\left(e^{j\omega}\right)$:

(i) For the input $\left(\frac{1}{2}\right)^n u[n]$ the corresponding output is $g[n]$, where

$g[n]$ = 0 for n < 0 and n ≥ 2.

(ii) $H\left(e^{j\frac{\pi}{2}}\right)=1$

(iii) $H\left(e^{j\omega}\right)=H\left(e^{j(\omega-\pi)}\right)$

Determine $h[n]$ (15)

Or

(b) (i) Consider a signal $x(t)$ with fourier transform $X(j\omega)$. Following facts are given,

(1) $x(t)$ is real and non-negative.

(2) $IFT\{(1+j\omega)X(j\omega)\} = Ae^{-2t}u(t)$ where A in independent of t, and IFT denotes inverse fourier transform

(3) $\int_{-\infty}^{\infty} |X(j\omega)|^2 \, d\omega = 2\pi$

Determine the closed-form expression of $x(t)$ (9)

(ii) Consider a system with impulse response

$$h[n] = \left[(1/2)^n \cos \pi n / 2\right] u[n]$$

If $x[n] = \cos\left(\frac{\pi n}{2}\right)$. Determine that system output $y[n]$. (6)