Reg. No. :

Question Paper Code : 41012

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

Seventh Semester

Electrical and Electronics Engineering

OEC 753 – SIGNALS AND SYSTEMS

(Common to : Computer Science and Engineering/Electronics and Instrumentation Engineering/Instrumentation and Control Engineering/Information Technology)

(Regulations 2017)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Determine whether each of the following signals is periodic
   (a) $x_1(n) = u(n) + u(-n)$
   (b) $x_2(t) = 2e^{j(t+\pi/4)}u(t)$

2. Determine the values of E_∞, and P_∞, for the signal $x_1(t) = e^{5t}u(t)$.
3. Distinguish between deterministic and random signals.
4. State Parseval's power theorem.
5. What is the relation between convolution and correlation?
6. State sampling theorem.
7. List the difference between Fourier transform of discrete-time signal and analog signal.
8. Write the difference equation for non-recursive system.
9. What is the condition for Z-transform to exist?
10. What are the conditions for a discrete-time LTI system to be causal and stable?

PART B — (5 × 13 = 65 marks)

11. (a) Check whether the system $y(n) = \sum_{k=-\infty}^{n+i} x(k)$ is
    (i) State (2)
    (ii) Linear (3)
    (iii) Causal (2)

(iv) Time-invariant (3)

(v) Stable (3)

Or

(b) A continuous-time signal $x(t)$ is shown in Figure 1. Sketch and label carefully each of the following signals

(i) $x(t-2)$ (3)

(ii) $x(t+2)$ (3)

(iii) $x(2t+1)$ (3)

(iv) $[x(t)+x(-t)]u(t)$ (4)

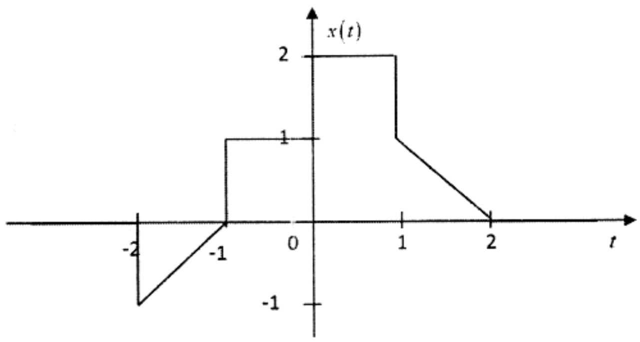

Figure 1

12. (a) A causal and stable LTI system has the property that

$$\left(\frac{4}{5}\right)^n u(n) \rightarrow n\left(\frac{4}{5}\right)^n u(n)$$

(i) Determine the frequency response $H(e^{jw})$ for the system. (7)

(ii) Determine a difference equation relating any input $x(n)$ and the corresponding output $y(n)$. (6)

Or

(b) Consider two systems are connected in parallel with impulse responses

$h_1(t)=e^{-t}u(t)$ and $h_2(t)=e^{2t}u(-t)$.

(i) Find the overall transfer function using Laplace transform. (8)

(ii) Find the output of the system for the unit step input. (5)

13. (a) Find the exponential Fourier series coefficients for the signal shown in Figure 2. (13)

Hint : $\int te^{at}dt = e^{at\left(\frac{t}{a}-\frac{1}{a^2}\right)}$

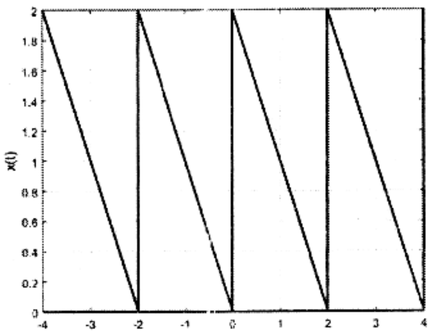

Figure 2.

Or

(b) Consider the periodic signal $x(t) = \cos(3\pi t) + \sin\left(5\pi t + \frac{\pi}{4}\right) + 2$.

(i) Find the fundamental period and fundamental frequency of the signal. (4)

(ii) Find the Trigonometric Fourier series coefficients of the signal. (5)

(iii) Find the exponential Fourier series coefficients of the signal using the result in part (ii) without directly computing it. (4)

14. (a) Use the z-transform to perform the convolution of the following two sequences, $h(n) = \begin{cases} \left(\frac{1}{2}\right)^2, & 0 \le n \le 2 \\ 0, & \text{elsewhere} \end{cases}$ and $x(n) = \delta n + \delta(n-1) + 4\delta(n-2)$.(13)

Or

(b) (i) Find inverse discrete time Fourier transform to the following signal (7)

$$X(e^{jw}) = \begin{cases} 0, & 0 \le |\omega| \le \omega_0 \\ 1, & \omega_0 \le |\omega| \le \pi \end{cases}.$$

(ii) Find discrete time Fourier transform to the following signal, where $|a| < 1$ $x(n) = n\ a^n u(n)$. (6)

15. (a) An LTI system is given by the difference equation $y(n)+2y(n-1)+y(n-2)=x(n)$.

(i) Determine the unit impulse response (8)

(ii) Determine the response of the system to the input (3, –1, 3). (5)

Or

(b) Compute the time domain convolution of the signals

$$h(n)=\begin{cases}\left(\frac{1}{2}\right)^n, & 0 \le n \le 2 \\ 0, & \text{else}\end{cases}$$

$$x(n)=\delta(n)+\delta(n-1)+4\delta(n-2).$$

PART C — (1 × 15 = 15 marks)

(Q.No. 16 is Compulsory)

16. (a) A linear system S has the relationship

$$y[n]=\sum_{k=-\infty}^{x} x[k]g[n-2k]$$

between its input $x[n]$ and its output $y[n]$, where $g[n] = u[n] - u[n-4]$.

(i) Determine $y[n]$ when $x(n)=\delta[n-1]$ (4)

(ii) Determine $y[n]$ when $x(n)=\delta[n-2]$ (4)

(iii) Is S is LTI? (3)

(iv) Determine $y[n]$ when $x(n)=u[n]$ (4)

Or

(b) Let

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

be a periodic signal with fundamental period T = 2 and Fourier coefficients a_k.

(i) Determine the value of a_0 (3)

(ii) Determine the Fourier series representation of $dx(t)/dt$. (6)

(iii) Use the result of part (ii) and the differentiation property time Fourier series to help determine the Fourier series coefficients of $x(t)$. (6)

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