

B.TECH. DEGREE EXAMINATION, MAY 2014**Fourth Semester**

Branch : Electronics and Communication/Applied Electronics and Instrumentation/Electronics and Instrumentation/Information Technology

SIGNALS AND SYSTEMS (L, A, S, T)

(Old Scheme—Prior to 2010 Admissions)

[Supplementary/Mercy Chance]

Maximum : 100 Marks

Time : Three Hours

Part A

Answer all questions.
Each question carries 4 marks.

1. Determine the odd and even parts for the following signals :

(a) $x(t) = u(t+1)$.

(b) $x(t) = 2 + 3t + 4t^2 + 5t^3 + 6t^4$.

2. Check whether the following system is linear or not? Prove the same :

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

3. State and prove the frequency shifting property of continuous Time Fourier Transform.

4. Find the Fourier Transform of $P(t) = \sum_{n=-\infty}^{\infty} \delta(t - n\tau)$, τ - fundamental period.

5. Find the DTFT of $x(n) = \left(\frac{1}{3}\right)^n u(n)$.

6. Find the frequency response of the following LTI system : $h(t) = -\delta(t+1) + \delta(t) - \delta(t-1)$.

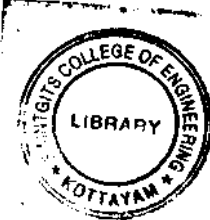
7. Find the z-transform with ROC $x(n) = 3e^{-2n} u(n) + 2[4^n u(-n)] + 5\delta(n)$.

8. What are the conditions to be satisfied by a function to be Laplace Transformable?

9. Determine whether the function given by the expression $f_x(x) = \begin{cases} 0 & , x < 2 \\ \frac{1}{18} (3 + 2x) & , 2 \leq x \leq 4 \\ 0 & , x > 4 \end{cases}$ is a

density function?

Turn over



10. Define random process and explain ensemble and sample function.

(10 × 4 = 40 marks)

Part B

Answer all questions.

Each full question carries 12 marks.

11. (a) Find the convolution of $x(n)$ and $h(n)$ where $x(n) = \left\{ \overset{\downarrow}{1}, \overset{\downarrow}{2}, 3, 4 \right\}$ and

$$h(n) = \left\{ \overset{\downarrow}{2}, 3, 1, 1 \right\}.$$

(5 marks)

- (b) Find the output response of the system described by the differential equation

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

(7 marks)

Or

12. (a) Consider the system $y(t) = x(t) \cos \omega_0 t$. Determine whether the system is memory less, causal, linear, time-in-variant and stable.

(7 marks)

- (b) Evaluate the frequency response for the LTI system represented by

$$h(n) = (-1)^n [u(n+2) - u(n-3)].$$

(5 marks)

13. Derive the Parseval's theorem. Using the same find the energy of the signal $x(t) = e^{-at} u(t)$ and also energy in the frequency band $|w| \leq 0.5$ rad/sec.

(12 marks)

Or

14. (a) Find the frequency response of a continuous system described by

$$\frac{d^2 y(t)}{dt^2} + 5 \frac{dy(t)}{dt} + 6y(t) = - \frac{dx(t)}{dt}.$$

(7 marks)

- (b) The signal $x(t) = 2 \cos(200 \pi t) + 6 \cos(180 \pi t)$ is ideally sampled at a frequency of 150 samples per second. The sampled version $x_s(t)$ is passed through a unit gain ideal low-pass filter with a cut-off frequency of 110 Hz. What frequency components will be present in the output of the filter? Write down an expression for its output signal.

(5 marks)



15. (a) Find the DTFT of $x(n) = \left(\frac{1}{2}\right)^n u(n)$ and plot its magnitude and phase spectrum.

(7 marks)

(b) Find the output of the system whose impulse response $h(n) = \left(\frac{1}{2}\right)^n u(n)$, using Fourier

Transform, the input to the system is $x(n) = \left(\frac{1}{3}\right)^n u(n)$.

(5 marks)

Or

16. Find the DTFT of the following signals :

(a) $x[n] = a^{|n|}$.

(b) $x[n] = a^{-n} u[-n-1]; |a| < 1$.

(c) $x[n] = \sin(\omega_0 n); \omega_0 = \frac{2\pi}{5}$.

17. (a) Consider the signal $x(t) = e^{-4t} u(t-1)$. Evaluate its Laplace Transform $X(s)$ and find its ROC.

(6 marks)

(b) Determine the values of the finite numbers A and t_0 such that the LT of $g(t) = Ae^{-5t} u(t-t_0)$ has the same algebraic form as $X(s)$ in the above part 17 (a). What is the ROC corresponding to $G(s)$?

(6 marks)

Or

18. Determine the Z-transform of the signal $x[n] = \alpha^n u[n]$ and depict the ROC and the locations of poles and zeros in the Z-plane.

(12 marks)

19. Given two random processes $X(t)$ and $Y(t)$ as

$X(t) = Z_1(t) + 3Z_2(t-\tau)$, $Y(t) = Z_2(t+\tau) + 3Z_1(t-\tau)$. Here $Z_1(t)$ and $Z_2(t)$ are independent white noise processes each with a variance = 0.5. Determine (a) autocorrelation functions of $X(t)$ and $Y(t)$ and (b) cross-correlation function of $X(t)$ and $Y(t)$.

(12 marks)

Or



Turn over

20. (a) A random process provides measurements x between the values 0 and 1 with a PDF of

$$f_X(x) = 12x^3 - 21x^2 + 10x, \text{ for } 0 \leq x \leq 1 \\ = 0 \text{ otherwise.}$$

Determine the following :

(i) $P\left[X \leq \frac{1}{2}\right]$ and $P\left[X > \frac{1}{2}\right]$.

(ii) Obtain a number K such that $P[X \leq K] = \frac{1}{2}$.

(8 marks)

(b) Define mean or average or expected value of a random variable. Explain how it is calculated for continuous and discrete random variables.

(4 marks)

[5 × 12 = 60 marks]

