ECE (old)

G 1605 (Pages : 3) Reg. No.....

Name.....

SAINTGITS COLLEGE OF ENGINEERING LIBRARY KOTTAYAM

B.TECH. DEGREE EXAMINATION, MAY 2015

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]

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 4 *marks.*

1. Check whether the system $y(n)=\dfrac{x(n-5)+x(n-7)}{x(n-2)\,x(n-3)}$ is linear or not ? Prove.
2. Explain causality and time invariance with respect to discrete time systems.
3. Find the Fourier transform of the rect function which is unity over the interval – 0.5 to + 0.5, and zero elsewhere.
4. Specify the Nyquist rate for the following signals :
   (a) $g(t)$ = sinc (400 t).
   (b) $g(t)$ = sinc (400t) + sinc^2 (400t).
5. Find the Discrete Fourier series for the periodic sequence $x(n)=2\cos(1.6\pi n)+\sin(2.4\pi n)$.
6. Find the Discrete Fourier series representation of a periodic sequence $x(n)=\{1,1,0,0\}$ with period N = 4.
7. Write any *four* properties of ROC.
8. From the definition of z-transform find the z-transform of $x(n)=\sinh(w_0 n)$, for $n\geq 0$.
9. Define and distinguish between random variable and random process.
10. Derive the relationship between CDF and PDF.

(10 × 4 = 40 marks)

Turn over

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Part B

Answer **all** *questions.*
Each full question carries 12 *marks.*

11. (a) Prove that the response of an LTI system is governed by convolution sum. (5 marks)

(b) Solve the differential equation :

$$\frac{d^2y}{dt^2}(t)+5\frac{dy(t)}{dt}+4y(t)=\frac{dx(t)}{dt} \text{ given, } y(0)=0, \frac{dy}{dt}/_{t=0}=1, x(t)=e^{-2t}u(t).$$ (7 marks)

Or

12. (a) For the system $T[x(n)]=\sum_{k=n_0}^{n} x(k)$ determine whether the system is stable, causal, linear, time-invariant and memoryless ?

(5 marks)

(b) Solve the differential equation $y(n)=\frac{1}{4}y(n-1)-\frac{1}{8}y(n-2)=x(n)+x(n-1)$, given :

$$y(-1)=2,\ y(-2)=-1, x(n)=2^n u(n).$$ (7 marks)

13. (a) Determine appropriate Fourier representation for the following time domain signal :

$$x(t)=e^{-3t}\cos \pi t\, u(t).$$ (7 marks)

(b) For the analog signal $x_a(t)=3\cos 2000\pi t+5\sin 6000\,\pi t+10\cos 12000\,\pi t$, find the Nyquist rate. Also find the discrete time signal obtained from this if the signal is sampled at a rate f_s = 5000 Hz.

(5 marks)

Or

14. (a) A continuous system is described by $\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt}+6y(t)+\frac{dx(t)}{dt}=0$. Determine its frequency response.

(8 marks)

(b) Explain sampling and reconstruction of continuous time signals. (4 marks)

15. (a) The signal $x(n)=\{1,0,5\}$ is applied to a system with frequency response $H(\Omega)$ and the resulting output is $y[n]-\delta[n]-2\delta[n-1]-\delta[n-2]$. Find $H(\Omega)$.

(6 marks)

(b) Find the DTFS coefficients of the sequence $x(n)=\cos\left(\frac{6\pi}{13}n+\frac{\pi}{6}\right)$. (6 marks)

Or

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16. (a) A LTI system has frequency response $H(e^{j\Omega}) = \frac{e^{j\Omega}}{1+\cos\Omega}$. Find the difference equation that connects the input and output.

(8 marks)

(b) State and prove linearity property of DTFS. (4 marks)

17. (a) State and prove any four properties of z-transform. (4 marks)

(b) Determine the inverse z-transform of $X(z) = \frac{z^2 - 3z}{\left(z^2 - \frac{3}{2}z - 1\right)}$, $\frac{1}{2} < |z| < 2$. (8 marks)

Or

18. (a) Determine the step response of a continuous time LTI system described by the differential equation $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = x(t)$ using Laplace transform.

(6 marks)

(b) Find the inverse Laplace transform of $X(s) = \frac{-5s-7}{(s+1)(s-1)(s+2)}$, with ROC $-1 < R_e(s) < 1$.

(6 marks)

19. The marginal probability density functions of two random variables X and Y are given below :

$$f_x(x) = \begin{cases} 3(1-x^2), & \text{for } 0 \le x \le 1 \\ 0 & \text{, for } x < 0, x > 1 \end{cases} \quad \text{and} \quad f_y(y) = \begin{cases} 3(1-y^2), & \text{for } 0 \le y \le 1 \\ 0 & \text{, for } y < 0, y > 1 \end{cases}$$

Determine :

(a) Mean of random variables X and Y and

(b) Variance of random variables X and Y.

Or

20. The PDF is given by $f_x(x) = ae^{-b|x|}$, where x is a random variable whose values lie in the range $x = -\infty$ to $x = +\infty$. Determine the following :

(a) The relationship between a and b.

(b) The cumulative distribution function.

(c) The probability that the outcome lies between 1 and 2.

(5 × 12 = 60 marks)