Reg. No. : | | | | | | | | | | | | |

Question Paper Code : X20441

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020 AND APRIL/MAY 2021

Third Semester

Electronics and Communication Engineering

EC 6303 – SIGNALS AND SYSTEMS

(Common to Biomedical Engineering/Medical Electronics Engineering)

(Regulations 2013)

(Also Common to PTEC 6303 – Signals and System for B.E. (Part-Time) Second Semester – Electronics and Communication Engineering – (Regulations – 2014))

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. If $\delta(t) = \frac{d}{dt}u(t)$, what is $\delta(t - t_0)$. Also justify your answer.
2. Sketch the real part of $e^{j4\pi t}$ and determine whether it is a periodic signal.
3. Find the Fourier series coefficients of the signal $x(t) = \sin^2\omega_0 t$.
4. What is the Laplace transform of the unit step function u(t) ?
5. A causal LTI system satisfies the linear differential equation $5\frac{d}{dt}y(t) + 6y(t) = 2x(t)$. Find the frequency response $H(j\omega)$ of the system.
6. What is $e^{-at}\, u(t) * \delta(t - t_0)$? Where $*$ represents the convolution operation.
7. Find the Nyquist rate of the signal $x(t) = 1 + \sin\frac{2\pi}{5}t$ in Hz.
8. If x(z) is the z-transform of x[n], what is the z-transform of 2x(n – 4) in terms of x(z) ?
9. Given x(n) = {1, 2, – 2} and h[n] = {1, 2, 2} convolve x(n) and h(n).
10. Given the difference equation representation of a discrete time system. y[n] = 2y[n – 1] + 3y [n – 2] + 3x [n] – 2x[n – 1]. Determine whether it is recursive or non-recursive system and justify your answer.

PART – B **(5×13=65 Marks)**

11. a) Plot the following signals

i) $2u(t) - u(t-1)$. **(3)**

ii) $\sum_{k=-\infty}^{\infty} \delta(t-2K)$. **(3)**

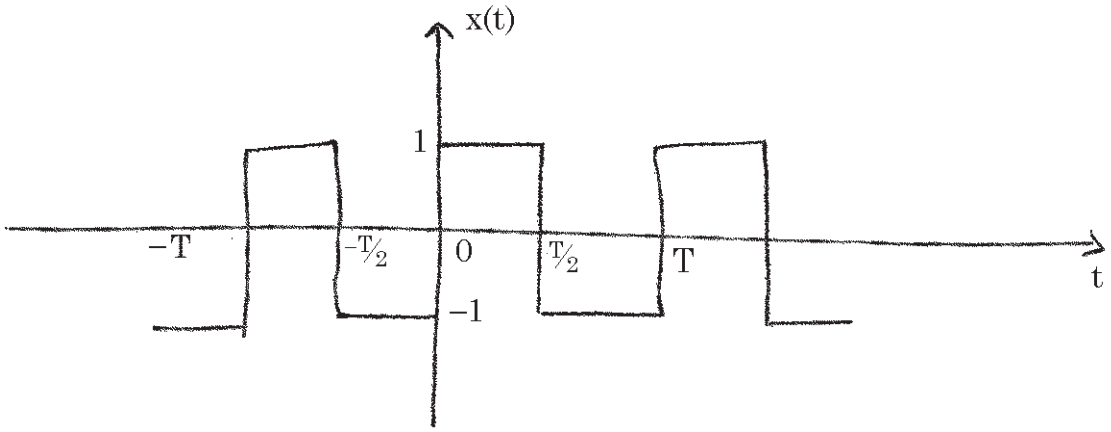
iii) $u[n] - 2u[n+4]$. **(3)**

iv) $n^2[\delta(n+2) - \delta(n-2)]$. **(4)**

(OR)

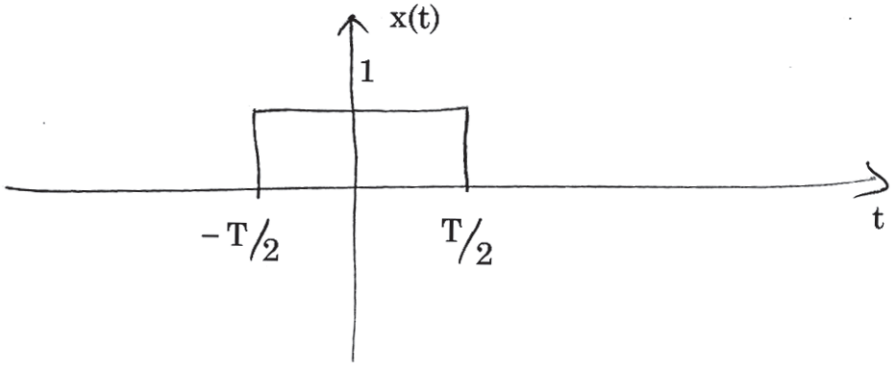
b) The input-output relationship of a discrete time system is given by $y[n] = x[n-1]\, x[n+1]$. Determine whether the system is Linear, Time Invariant, stable, causal and memoryless.

12. a) Find the Fourier series coefficients of the periodic square wave shown below :



(OR)

b) Find and plot the Fourier transform of the following square pulse.



13. a) Find and sketch $y(t) = x(t) * h(t)$ where $*$ represents convolution operation and $x(t) = h(t) = e^{-at}u(t)$.

(OR)

b) The output of an unknown LTI system is observed to be $y(t) = [e^{-2t} - e^{-3t}]\, u(t)$ when the input is $x(t) = [e^{-t} - e^{-2t}]\, u(t)$. Determine $H(j\omega)$ using Fourier transform. Also find $h(t)$.

14. a) State and prove the following properties of Discrete Time Fourier Transform (DTFT).

i) Frequency shifting property. **(3)**

ii) Convolution property. **(5)**

iii) Parseval's relation. **(5)**

(OR)

b) Determine the inverse z-transform of the following X(z) by the partial fraction expansion method $X(z) = \dfrac{z+2}{2z^2 - 7z + 3}$ with ROC. **(13)**

i) $|z| > 3$

ii) $|z| < \frac{1}{2}$

iii) $\frac{1}{2} < |z| < 3$.

15. a) The input x(n) and the impulse response h[n] of a discrete time LTI system are given by $x[n] = \alpha^n\, u[n]$ $h[n] = u[n]$ for $0 < \alpha < 1$. Compute the output y[n].

(OR)

b) The impulse response of a discrete time LTI system is given by

$h[n] = [2(\frac{1}{2})^n - (\frac{1}{4})^n]\, u[n]$.

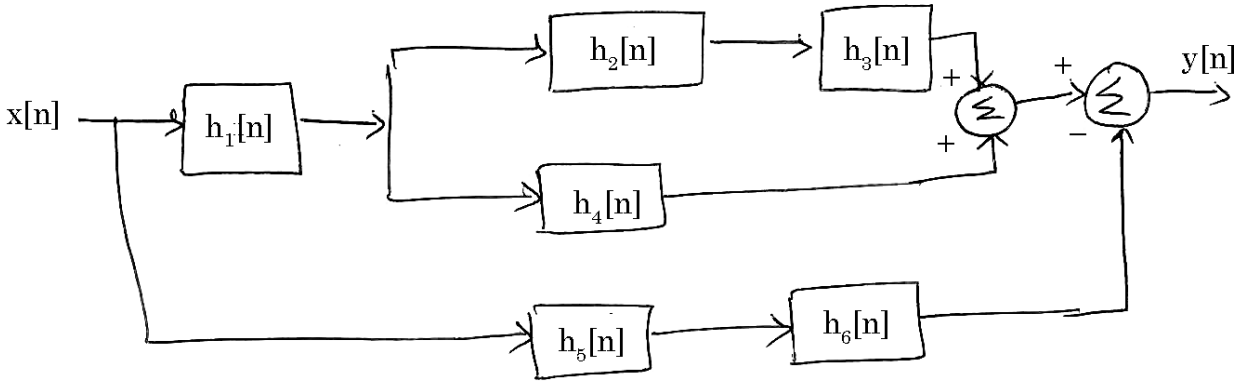
i) Determine the frequency response $H(e^{j\omega})$ of the system. **(4)**

ii) Give the difference equation representation of the system. **(4)**

iii) Is the system stable and causal ? Justify your answer. **(5)**

PART – C **(1×15=15 Marks)**

16. a) Consider the interconnection of the discrete time LTI systems shown below :



Using the properties of LTI system, find the overall impulse response h[n], given

$h_1[n] = u[n] - u[n-1]$

$h_2[n] = \delta[n-2]$

$h_3[n] = u[n-1]$

$h_4[n] = u[n+1]$

$h_5[n] = r[n]$

$h_6[n] = u[n]$

(OR)

b) Given a system with system function $H(z) = \frac{z}{z^2+1}$ for ROC $|z| > 1$.

i) Is this a causal system ? Justify. **(3)**

ii) Is the system BIBO stable ? Justify. **(3)**

iii) Find the difference equation representation of the system. **(3)**

iv) Is the system linear or non-linear ? **(3)**

v) Is the system shift invariant ? Why or why not ? **(3)**

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