Fourth Semester B.E. Degree Examination, Aug./Sept.2020
Signals and Systems

Time: 3 hrs.   Max. Marks:100

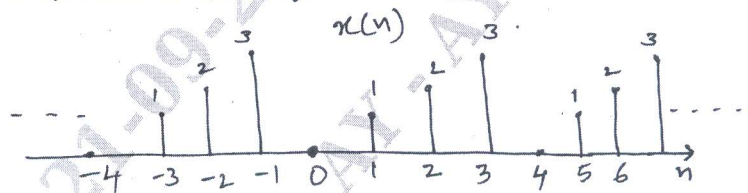**Note:** *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART - A

1 a. Sketch $y(t) = r(t+1) - r(t) + r(t-2)$. **(05 Marks)**

b. Determine whether $x(n) = \cos(\frac{1}{5} \pi n) \sin(\frac{1}{3} \pi n)$ is periodic or not. If periodic, determine the period. **(05 Marks)**

c. Check for casual memory , time – invariance , stable and linear properties of the system $y(n) = \log_{10}(|x(n)|)$. **(05 Marks)**

d. Given

$$x(t) = \begin{cases} 5-t & ; & 4 \leq t \leq 5 \\ 1 & ; & -4 \leq t \leq 4 \\ t+5 & ; & -5 \leq t \leq -4 \\ 0 & ; & \text{otherwise} \end{cases}$$ Sketch $y(t) = x(10t-5)$. **(05 Marks)**

2 a. Determine the convolution integral of $x(t) = u(t-1) - u(t-3)$ and $h(t) = u(t) - u(t-2)$. **(10 Marks)**

b. Determine the convolution sum of $y(n) = \beta^n u(n) * \alpha^n u(n)$; $|\alpha| < 1$ and $|\beta| < 1$. **(10 Marks)**

3 a. Determine the natural response of $y(n) - \frac{1}{2} y(n-1) = 2x(n)$; $y(-1) = 3$. **(05 Marks)**

b. Determine the Forced Response of

$$\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 8y(t) = 2x(t) \; ; \; x(t) = e^{-t} u(t).$$ **(10 Marks)**

c. Implement DF – I and DF – II for the system.

$y(n) + \frac{1}{2} y(n-1) - \frac{1}{8} y(n-2) = x(n) + 2x(n-1)$. **(05 Marks)**

4 a. Evaluate the DTFS representation for the signal $x(n)$ shown in fig.Q4(a) and sketch spectra. Also verify Parseval's identity.

Fig.Q4(a)

(10 Marks)

b. Find the Fourier series coefficient of the signal $x(t)$ shown in fig.Q4(b) and draw the spectra.

Fig.Q4(b)

(10 Marks)

PART - B

5 a. State and prove Parseval's theorem. Frequency shift and Time shift properties of DTFT.
(12 Marks)

   b. Obtain the Fourier Transform of the signal $x(t) = e^{-a|t|}$; $a > 0$. Draw its spectrum. (08 Marks)

6 a. Specify the Nyquist rate for each of the following signals.
   i) $x_1(t) = \sin(200t)$ ii) $x(t) = \cos(5\pi t) + 0.5\cos(10\pi t)$.   (06 Marks)

   b. The impulse response of a continuous time LTI system is given by
   $h(t) = \dfrac{1}{RC} e^{-t/RC}$ u(t). Find the frequency response and plot the magnitude and phase response.
(08 Marks)

   c. State and explain Sampling Theorem.   (06 Marks)

7 a. Determine the Z – transform of $x(n) = \left(\dfrac{1}{4}\right)^n u(-n)$.   (05 Marks)

   b. Determine the Inverse of X(Z) for i) ROC : $|Z| < \frac{1}{2}$ ii) ROC : $\frac{1}{2} < |Z| < 3$
   iii) ROC : $|Z| > 3$.
   $$X(Z) = \frac{Z^{-1}}{(1 - \frac{1}{2}Z^{-1})(1 + 3Z^{-1})}.$$
(10 Marks)

   c. State and prove differentiation in Z – domain property of Z – transform.   (05 Marks)

8 a. Determine the Impulse response of the following system with
   $x(n) = \delta(n) + \dfrac{1}{4}\delta(n-1) - \dfrac{1}{8}\delta(n-2)$ and $y(n) = \delta(n) - \dfrac{3}{4}\delta(n-1)$.   (10 Marks)

   b. Find the natural response of the system described by the difference equation through unilateral Z - transform.
   $y(n) - \dfrac{1}{4}y(n-1) - \dfrac{1}{8}y(n-2) = x(n) + x(n-1)$ with $y(-1) = 0$ and $y(-2) = 1$.   (10 Marks)

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