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10EC44

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

$$x(t) = \begin{cases} 5-t & ; \quad 4 \le t \le 5 \\ 1 & ; \quad -4 \le t \le 4 \\ t+5 & ; \quad -5 \le t \le -4 \\ 0 & ; \quad \text{otherwise} \end{cases}$$

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

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

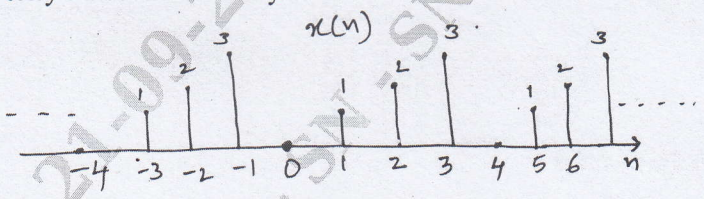

Fig.Q4(a)

(10 Marks)

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

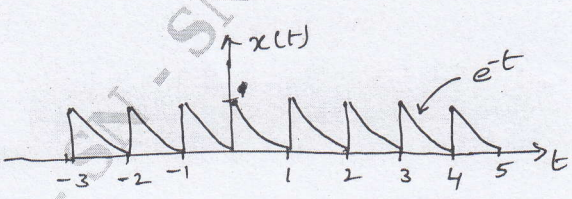

Fig.Q4(b)

(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 $h(t) = \frac{1}{RC}e^{-t/RC}\,u(t)$. 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 $x(n) = \left(\frac{1}{4}\right)^n u(-n)$. **(05 Marks)**

b. Determine the Inverse of X(Z) for i) ROC : $|Z| < ½$ ii) ROC : $½ < |Z| < 3$
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
$x(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2)$ and $y(n) = \delta(n) - \frac{3}{4}\delta(n-1)$. **(10 Marks)**

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

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