USN

Fifth Semester B.E. Degree Examination, July/August 2021
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Explain the following i) Continuous time and discrete time signals ii) Even and odd signals Give examples. **(05 Marks)**

b. Sketch the signal $x(t) = -u(t+3) + 2u(t+1) - 2u(t-1) + u(t-3)$. **(05 Marks)**

c. x(n) is a signal with real part $x_e(n)$ and odd part as $x_0(n)$, prove that :

$$\sum_{n=-\infty}^{\infty} x^2(n) = \sum_{n=-\infty}^{\infty} x_e^2(n) + \sum_{n=-\infty}^{\infty} x_0^2(n).$$ **(05 Marks)**

d. If $y(n) = \log_{10}(|x(n)|$, check for linearity, time invariance, memory, causality and stable properties. **(05 Marks)**

2 a. Given that $x(n) = \left(\underset{\uparrow}{1}, 2, 3, 4\right)$ and $h(n) = \left(\underset{\uparrow}{1}, 2, 1, 2\right)$. Determine the output y(n) using graphical method and linearity-time shifting method. **(10 Marks)**

b. Determine the discrete convolution sum if $x(n) = \left(\frac{1}{2}\right)^n .u(n-2)$ and h(n) = u(n). Explain the calculation of K for different values of n from the graphs of x(n) and h(n). **(10 Marks)**

3 a. For a continuous time system, the impulse response is given by, $h(t) = e^{-3t}.u(t-1)$ check for stable and causal properties. **(05 Marks)**

b. Solve the following difference equation using time domain approach.

$y(n) - \frac{1}{4}y(n-1)\frac{1}{8}y(n-2) = x(n) + x(n-1)$ where $x(n) = \left(\frac{1}{8}\right)^n \cdot u(n)$ with $y(-1) = 0$ and $y(-2) = 0$. **(10 Marks)**

c. A continuous time system is given by $\frac{d^2y(t)}{dt^2} + \frac{5dy(t)}{dt} + 4y(t) = \frac{dx(t)}{dt}$. Draw direct form – I and direct form II structures. **(05 Marks)**

4 a. Determine the DTFS representation for the signal x(n) shown in Fig.4(a) and sketch the spectrum of magnitude and phase of X(K). Verify Parseval's identity.

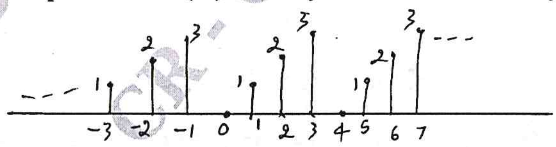

Fig.Q4(a) **(10 Marks)**

b. Determine the Fourier series for the signal $x(t) = \sin(2\pi t) + \cos(3\pi t)$. Draw the magnitude and phase spectrum. **(05 Marks)**

c. Calculate the Fourier series representation of impulse train as in Fig.Q4(c). Draw the spectrum.

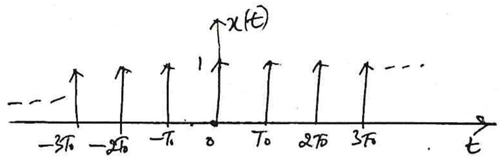

Fig.Q4(c) **(05 Marks)**

5 a. With respect to Fourier transform, state and prove the following properties :
i) Time differentiation
ii) Frequency differentiation. **(10 Marks)**

b. Find the Fourier transform for $x(t) = e^{-3t} \cdot u(t-1)$. Write expressions for magnitude and phase. **(05 Marks)**

c. Find the time domain signal for the spectrum shown in Fig.Q5(c).

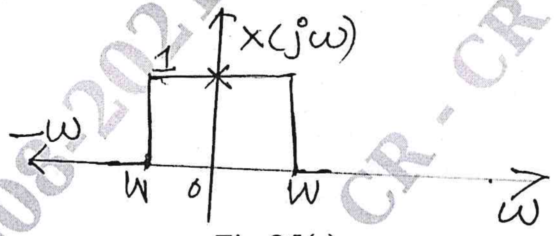

Fig.Q5(c) **(05 Marks)**

6 a. Calculate DTFT of the signal :
i) $x(n) = 2^n \cdot u(-n)$
ii) $x(n) = \left(\frac{1}{4}\right)^n \cdot u(n+4)$. **(10 Marks)**

b. Find the differential equation for the system having $h(t) \Rightarrow$ i.e $h(t) = \frac{1}{a} e^{-t/a} \cdot u(t)$. **(05 Marks)**

c. Find the Fourier transform representation for the signal $x(t) = \cos\omega_0 t$ and draw the spectrum. **(05 Marks)**

7 a. Find the Z-transform and state ROC for :
i) $x(n) = \alpha^{|n|}$, where $|\alpha| < 1$
ii) $x(n) = (-1)^n \cdot 2^{-n}, u(n)$. **(10 Marks)**

b. Determine inverse z-transform using partial fraction expansion method if $x(z) = \dfrac{4 - 3z^{-1} + 3z^{-2}}{(1+2z^{-1})(1-3z^{-1})^2}$. Show the calculation of constants in detail. **(07 Marks)**

c. Determine IZT if $X(Z) = \cos(2Z)$ where $|Z| < \infty$. Use power series expansion method. **(03 Marks)**

8 a. Using Z-transform method solve the difference equations :
$Y(n) - \frac{5}{6} y(n-1) + \frac{1}{6} y(n-2) = x(n)$ where $x(n) = 2^n \cdot u(n)$. **(10 Marks)**

b. A system has impulse response $h(n)$ given by $h(n) = \left(\frac{1}{2}\right)^n u(n)$. Find the input to the system if the output is given by, $y(n) = \frac{1}{3} \cdot u(n) + \frac{2}{3}\left(-\frac{1}{2}\right)^n \cdot u(n)$. **(10 Marks)**

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