CBCS SCHEME

USN | | | | | | | | | | 15EE54

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Signals and Systems

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain the following classes of signals
   i) Periodic an Non-periodic signals
   ii) Energy and power signals **(04 Marks)**

b. Find the even and odd parts of the signal x(t) shown in Fig Q1(b).

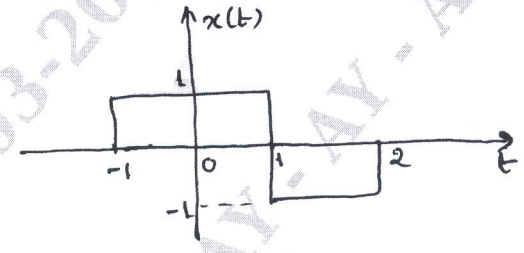

Fig Q1(b) **(04 Marks)**

c. Sketch the waveforms for the following signals :
   i) $x_1(t) = u(t + 2) - 2u(t) + u(t - 2)$
   ii) $x_2(t) = -u(t + 3) + 2u(t + 1) - 2u(t-1) + u(t - 3)$
   iii) $x_3(t) = r(t + 1) - r(t) + r(t - 2)$
   iv) $x_4(t) = r(t + 2) - r(t + 1) - r(t - 1) + r(t - 2)$ **(08 Marks)**

OR

2 a. Determine the average power and the energy of the following sequences:
   i) $x_1(n) = nu(n)$
   ii) $x_2(n) = A_0 e^{J\Omega_0 n}$ **(06 Marks)**

b. Determine whether the system described by, $y(t) = e^{x(t)}$ is :
   i) Linear
   ii) Time – invariant
   iii) Stable. **(06 Marks)**

c. A discrete time system is represented by the following input output relation : $y(n) = 2x(n) + 3x(n - 1) + 4x(n - 2) + 5x(n - 3)$. Draw the block diagram showing the parallel implementation of system operator 'H'. **(04 Marks)**

Module-2

3 a. Find the convolution of the two discrete sequence given below :
   $x_1(n) = 2^n u(-n - 1)$
   $x_2(n) = 4^n u(- n - 1)$ **(08 Marks)**

b. Evaluate the step response for the LTI system represented by the impulse response, $h(t) = e^{-|t|}$. **(04 Marks)**

c. Determine whether the system described by its impulse response $h(n) = e^{2n} u(n - 1)$ is
   i) Causal
   ii) Stable. **(04 Marks)**

OR

4 a. Find the response of the system described by the difference equation $y(n) + 4\,y(n-1) + 4\,y(n-2) = 2^n u(n)$ with $y(-1) = 0$, $y(-2) = 1$. **(08 Marks)**

b. Draw the direct form I and direct form II implementation for the system described by the differential equation $\frac{d^3y(t)}{dt^3} + 2\frac{dy(t)}{dt} + 3y(t) = x(t) + 3\frac{dx(t)}{dt}$. **(08 Marks)**

Module-3

5 a. State and prove duality property of continuous time Fourier transformer. **(04 Marks)**

b. Find the Fourier transform of a rectangular pulse described below :

$x(t) = \begin{cases} 1, & |t| < a \\ 0, & |t| > a \end{cases}$. Also sketch the magnitude and phase spectra. **(08 Marks)**

c. Find the inverse Fourier transform of x(jw) for the spectra shown in Fig Q5(c) i) and Fig Q5(c) ii) below :

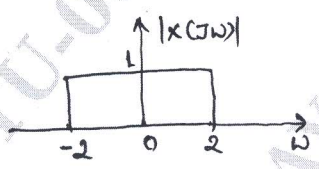

Fig Q5(c) i)

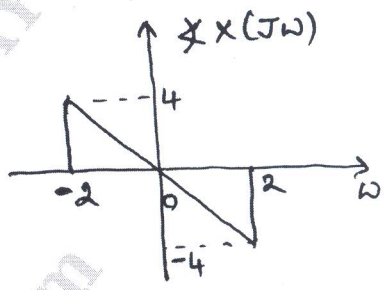

Fig Q5(c) ii) **(04 Marks)**

OR

6 a. Determine the frequency response of the system described by the impulse response, $h(t) = \delta(t) - 2e^{-2t}u(t)$. Also sketch the spectra. **(06 Marks)**

b. Find the frequency response and the impulse response of the system described by the differential equation :

$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t)$. What is the response of the system is $x(t) = t\,e^{-t}u(t)$? **(10 Marks)**

Module-4

7 a. State and prove summation property of discrete time Fourier transforms. **(05 Marks)**

b. Compute the DTFT of the signal, $x(n) = \text{Cos}\left(0.2n\pi + \frac{\pi}{4}\right)$ and sketch the amplitude and phase spectra over $-\pi \le \Omega \le \pi$. **(07 Marks)**

c. Find the inverse DTFT of $x(e^{j\Omega}) = e^{-j4\Omega}$, $\frac{\pi}{2} < |\Omega| < \pi$ **(04 Marks)**

OR

8 a. Determine the frequency response and the impulse response of the system described by the difference equation $y(n) - \frac{1}{2}y(n-1) = x(n) + \frac{1}{2}x(n-1)$. What is the response of the system to an input $x(n) = \text{Cos}\left(\frac{\pi}{2}n\right)$ **(08 Marks)**

b. Obtain the difference equation forth system with the frequency response

$$H(e^{j\Omega}) = \frac{1 - e^{-j\Omega} - 3e^{-j2\Omega}}{1 + \left(\frac{1}{3}\right)e^{-j\Omega} + \left(\frac{1}{6}\right)e^{-j2\Omega}}.$$ **(04 Marks)**

c. Find the difference equation for the system having impulse response

$$h(n) = \delta(n) + 2\left(\frac{1}{2}\right)^n u(n) + \left(-\frac{1}{2}\right)^n u(n)$$ **(04 Marks)**

Module-5

9 a. Determine the z-transform of the signal $x(n) = \frac{1}{n}(-2)^{-n}u(-n-1)$. Sketch the ROC. **(05 Marks)**

b. Find the z-transform of the sequence $x(n) = n \operatorname{Sin}\left(\frac{\pi}{2}n\right)u(-n)$, using appropriate properties. **(05 Marks)**

c. Find the inverse z-transform of $x(z) = \log\left(\frac{1}{1-az^{-1}}\right)$, $|z| > |a|$ **(06 Marks)**

OR

10 a. A system has an impulse response given by $h(n) = 2\delta(n) + \frac{5}{2}\left(\frac{1}{2}\right)^n u(n) - \frac{7}{2}\left(\frac{-1}{4}\right)^n u(n)$. Find the transfer function of the inverse system. **(05 Marks)**

b. Determine whether the system described below is causal and stable

$$H(z) = \frac{1 + 2z^{-1}}{1 + \frac{14}{8}z^{-1} + \frac{49}{64}z^{-2}}.$$ **(05 Marks)**

c. Find the value of x(0) for the left sided sequence, x(n) which is zero for $n > 0$, if

$$x(z) = \frac{3z^{-1} + 2z^{-2}}{3 - z^{-1} + z^{-2}}.$$ **(06 Marks)**

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