CBCS SCHEME

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18EE54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Signals and Systems

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Determine whether the following signals are energy or power signals or neither. Justify your answer.

i) $x(t) = e^{j(t+\pi/2)}$ ii) $x(t) = 8\cos(4t) \cdot \cos(6t)$. **(10 Marks)**

b. Sketch the following signals :

i) $x_1(t) = -u(t+3) + 2u(t+1) - 2u(t-1) + u(t-3)$.

ii) $x_2(t) = r(t) - r(t-1) - r(t-3) + r(t-4)$. **(10 Marks)**

OR

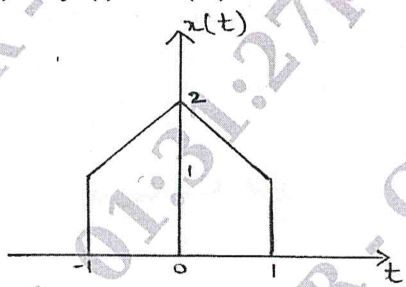
2 a. Determine whether the system $y(t) = e^{x(t)}$ is i) Causal ii) Time Invariant iii) Linear iv) Stability v) Memoryless. Justify your answer. **(10 Marks)**

b. For the signal shown in Fig. Q2(b), sketch and label each of the following signals :

i) $y_1(t) = x(t-2)$ ii) $y_2(t) = x(2t-2)$ iii) $y_3(t) = x(\frac{1}{2}t + 2)$

iv) $y_4(t) = x(-2t-1)$ v) $y_5(t) = 3x(2t)$. **(10 Marks)**

Fig. Q2(b)



Module-2

3 a. Evaluate the convolution integral for a system with input x(t) and impulse response h(t). Given $x(t) = u(t-1) - u(t-3)$; $h(t) = u(t) - u(t-2)$. Also sketch y(t). **(10 Marks)**

b. Represent the direct form I and form II realization for the system described by

i) $y[n] + \frac{1}{4}y[n-1] + \frac{1}{8}y[n-2] = x[n] + x[n-1]$.

ii) $\frac{d^2}{dt^2}y(t) + 5\frac{d}{dt}y(t) + 4y(t) = x(t) + 3\frac{d}{dt}x(t)$. **(10 Marks)**

OR

4 a. Determine the complete response of the system describe by the differential equation.

$\frac{d^2}{dt^2}y(t) + 5\frac{d}{dt}y(t) + 4y(t) = \frac{d}{dt}x(t)$ with $y(0) = 0$; $\frac{d}{dt}y(t)\big|_{t=0} = 1$;

For input $x(t) = e^{-2t}u(t)$. **(10 Marks)**

b. Investigate the causality, stability and memory of the LTI system described by the impulse response i) $h(t) = e^{-2|t|}$ ii) $h[n] = 2^n u[n-1]$. **(10 Marks)**

Module-3

5 a. Prove the following properties related to continuous – time Fourier transform :
i) Convolution ii) Parseval's theorem. **(10 Marks)**

b. Determine the Fourier Transform of the following signals :
i) $x(t) = e^{at} u(-t)$ ii) $x(t) = e^{-a|t|}$ iii) $x(t) = e^{-a|t|} sgn(t)$. **(10 Marks)**

OR

6 a. Determine the Inverse Fourier Transform of the following :
i) $X(jw) = \frac{2jw+1}{(jw+2)^2}$ ii) $X(jw) = \frac{1}{(a+jw)^2}$. **(10 Marks)**

b. Determine the Fourier transform of the signal $x(t) = e^{-3|t|} \sin(2t)$ using appropriate properties. **(10 Marks)**

Module-4

7 a. Determine the Inverse DTFT of the following :
i) $X(e^{j\Omega}) = 1 + 2\cos\Omega + 3\cos 2\Omega$ ii) $Y(e^{j\Omega}) = j(3 + 4\cos\Omega + 2\cos 2\Omega)\sin\Omega$. **(10 Marks)**

b. Using appropriate properties, determine the DTFT of
i) $x[n] = \left(\frac{1}{2}\right)^n u[n-2]$ ii) $x[n] = \sin\left(\frac{\pi}{4}n\right)\left(\frac{1}{4}\right)^n u[n-1]$. **(10 Marks)**

OR

8 a. Prove the following properties related to DTFT :
i) Frequency differentiation ii) Modulation. **(10 Marks)**

b. Compute the DTFT of the following signals :
i) $x[n] = 2^n u[-n]$ ii) $x[n] = a^{|n|}$; $|a| < 1$. **(10 Marks)**

Module-5

9 a. Determine the Inverse Z – transform if

$$X(z) = \frac{(z^3 - 4z^2 + 5z)}{(z-1)(z-2)(z-3)},$$

with ROCs i) $2 < |z| < 3$ ii) $|z| > 3$ iii) $|z| < 1$. **(10 Marks)**

b. Use Unilateral Z – transform to determine the forced response, natural response and complete response of system described by $y[n] - \frac{1}{2}y[n-1] = 2x[n]$ with input $x[n] = 2\left(\frac{-1}{2}\right)^n u[n]$. The initial conditions are $y[-1] = 3$. **(10 Marks)**

OR

10 a. Explain the properties of ROC. **(08 Marks)**

b. A LTI discrete – time system is given by system function

$$H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}.$$ Specify ROC of H(z).

Determine h[n] for the following conditions : i) Stable ii) Causal. **(12 Marks)**

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