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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

December 2023 Supplementary Examinations

Programme: B.E. **Semester: III**

Branch: Electronics & Telecommunication Engineering **Duration: 3 hrs.**

Course Code: 22ET3PCSSA **Max Marks: 100**

Course: Signals and Systems: Analog

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1. a) Obtain the Energy and Power of the following signal and classify as Energy or power signal **05**

$$x(t) = \begin{cases} 5t & 0 \le t \le 10 \\ 0 & otherwise \end{cases}$$

b) Consider the signal x(t) given below: **10**

$$x(t) = u(t+2) + u(t) - 2u(t-2)$$

Sketch the following:

(i) $x(t)$
(ii) $3x(t)$
(iii) $x(t/4)$
(iv) $x(t-4)$
(v) $x(2t-4)$
(vi) $x(t)-x(t-2)$
(vii) $\frac{d}{dt}x(t)$
(viii) $\int_{-\infty}^{t} x(t)dt$

c) Test the following systems for linearity, and classify as Linear/non-linear **05**

(i) $y(t) = x(t) + 10$

(ii) $y(t) = 2x(t) + 5\frac{d}{dt}x(t)$

UNIT - II

2 a) Consider two Linear Time Invariant systems, A and B, with impulse response as given below: **08**

$$h_A(t) = e^{-3t}u(t) \qquad h_B(t) = e^{-5t}u(t)$$

(i) Obtain the equivalent impulse response of the two systems connected in parallel
(ii) Obtain the equivalent impulse response of the two systems connected in series

b) The impulse response of a system is given below: **08**

$$h(t) = 4e^{-4t}u(t)$$

(i) Sketch the impulse response and comment on the stability of the system

(ii) Obtain and sketch the step response of the system

(iii) Give the circuit to obtain the given impulse response

(iv) Give the impulse response of the inverse of the system

c) State and prove properties of LTI system. **04**

OR

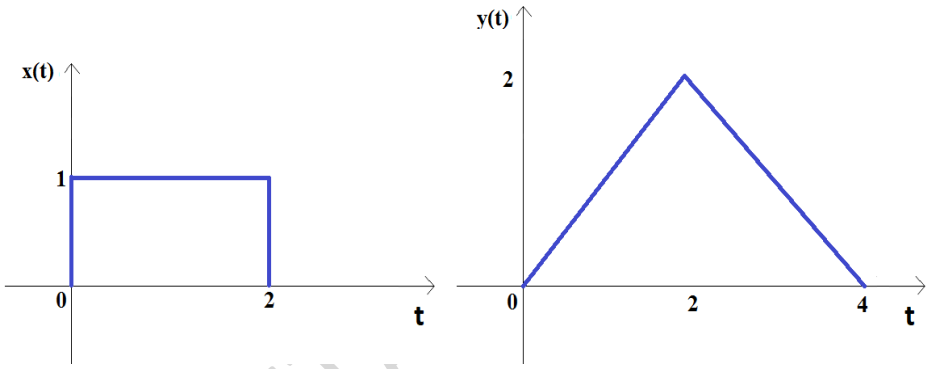
3 a) Consider the signal x(t) given below: **08**

$$x(t) = 2\{u(t) - u(t-5)\}$$

(i) Obtain and sketch the convolution of x(t) with itself

(ii) Obtain and sketch the auto-correlation of x(t)

b) The input-output pair of an LTI system is given below: **08**



Obtain and sketch the output for the following inputs:

(i) $x_2(t) = \begin{cases} 1 & 0 < t < 2 \\ -1 & 2 < t < 4 \end{cases}$

(ii) $x_3(t) = \delta(t) - \delta(t-2)$

c) Test the signals given below for orthogonality **04**

$$x(t) = \begin{cases} 1 & 0 \le t \le 2 \\ 0 & otherwise \end{cases} \qquad y(t) = \begin{cases} 1 & 0 \le t \le 1 \\ -1 & 1 < t \le 2 \end{cases}$$

UNIT - III

4 a) Obtain and sketch the Fourier Transform of the following signals: **10**

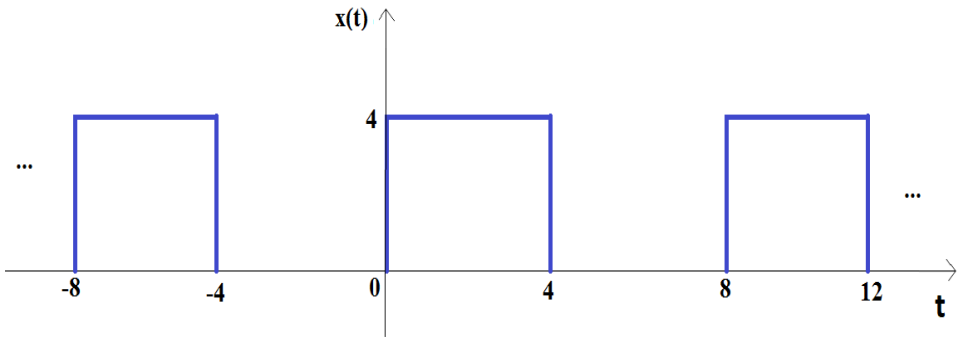
(i) $x(t) = e^{-2t}u(t)$

(ii) $y(t) = \begin{cases} 4 & -2 \le t \le 2 \\ 0 & otherwise \end{cases}$

b) Determine the complex exponential Fourier series representation of the signal $x(t) = \cos\left(2t + \frac{\pi}{4}\right)$ **10**

OR

5 a) Obtain and sketch the Fourier Transform of the signal given below: **10**



b) Derive the Fourier series representation of the following periodic signals: **10**

$$x(t) = \cos(\pi t/2) + \sin(2\pi t/3)$$

Also obtain the Fourier transform representation. Sketch the spectrum.

UNIT - IV

6 a) Consider the differential equation of a system given below: **08**

$$y(t) = 3x(t) + 5\frac{d}{dt}x(t) + 7\frac{d^2}{dt^2}x(t) - 9\frac{d}{dt}y(t) - 11\frac{d^3}{dt^3}y(t)$$

(i) Give the Direct Form-I implementation
(ii) Give the Direct Form-II implementation

b) Consider the differential equation of a system given below: **12**

$$6y(t) = x(t) - 5\frac{d}{dt}y(t) - \frac{d^2}{dt^2}y(t)$$

(i) Obtain the system transfer function H(s)
(ii) Obtain the system impulse response h(t), and comment on the stability
(iii) Sketch the pole-zero plot and comment on the stability
(iv) Obtain the Frequency response H(ω) of the system
(v) Sketch the magnitude response and comment on the type of the filter

UNIT - V

7 a) (i) Obtain the transfer function H(s) of the 5th order Butterworth prototype filter. **08**
(ii) Sketch the pole-zero plot of the 5th order Low-Pass filter with cut-off ω_c=1 rad/sec
(iii) Sketch the pole-zero plot of the 5th order High-Pass filter with cut-off ω_c=1 rad/sec

b) (i) Obtain the transfer function of a third order High-Pass Butterworth filter with cut-off 2 kHz and dc gain 6. **12**
(ii) Give the OP-AMP implementation of the filter.
(iii) Obtain the output of the filter, if the input to the filter is 2sin(4000πt).

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