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

Autonomous Institute Affiliated to VTU

May 2023 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Electronics & Telecommunication Engineering **Duration: 3 hrs.**
Course Code: 22ET3PCSSA **Max Marks: 100**
Course: Signals and Systems: Analog **Date: 15.05.2023**

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) Determine the average power for the signal given in Fig Q-1. **04**

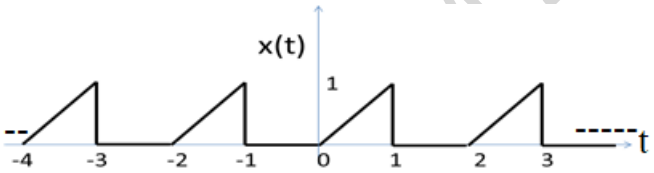

Fig: Q-1

b) Determine whether the following signals are periodic or not. If periodic, find the fundamental period: **04**

(i) $x(t) = 5\ Sin(500\pi t) + 10\ Cos(250\pi t)$

(ii) $y(t) = 10\ sin(500\pi t).\ cos(250\pi t)$

c) For the signal $x(t) = e^{-t}\ [u(t)- u(t-5)]$, sketch the following: **06**

x(t), x(5-2t) and x(t).x(-t).

d) The input- output relation of a continuous time system is **06**

$$y(t) = x(t) + x(t-1) + x(t-2)$$

Determine whether the system is linear, time invariant and stable.

UNIT - II

2 a) The impulse response of a continuous-time LTI system is **06**

$$h(t) = 3\ u(t)$$

Verify whether the system is causal, memory less and stable. Justify your answers with relevant reasons.

b) The impulse response of an RC circuit is defined as $h(t) = 2e^{-2t}\ u(t)$. **10**

(i) Determine and sketch the step response, s(t) for the system.

(ii) Compute response of the system for input: x(t) = u(t) – u(t-3).

c) What is Hilbert Transform? Briefly explain the applications of Hilbert transform. **04**

OR

3 a) Obtain the representation for the signals given in Fig Q-3 in terms of orthogonal functions. Assume T = 0.4 sec. **06**

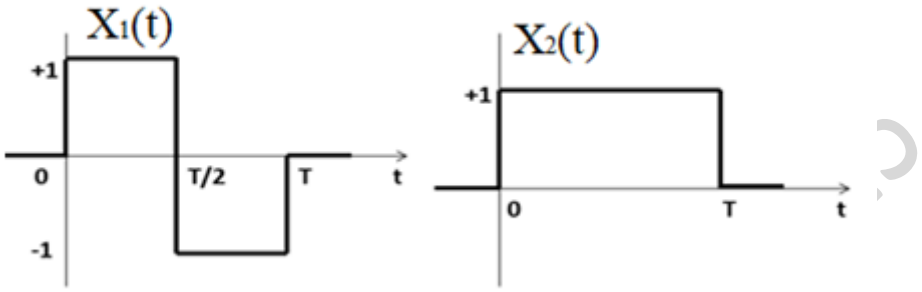

Fig Q-3

b) Briefly explain the following terms: **06**

i) Auto Correlation

ii) Cross correlation

iii) Convolution integral.

c) Two systems are connected in cascade. Let the impulse responses be $h_1(t) = 2e^{-2t}\,u(t)$ and $h_2(t) = 5e^{-t}\,u(t)$. Obtain the overall impulse response of the cascaded system. **08**

UNIT - III

4 a) Determine the Fourier transform of $x(t) = e^{-2t}\,u(t)$. **08**
Compute and sketch the magnitude and phase spectrum.

b) Using inverse Fourier transform, obtain the time domain signal for the following Fourier transform: **06**

$$X(j\omega) = \begin{cases} 1 & for\ \ 0 < |\omega| < B. \\ 0 & for\ \ |\omega| > B. \end{cases}$$

c) Derive the canonical representation for band pass signals. **06**

OR

5 a) Obtain the Fourier transform for the signal g(t) given in Fig Q-5. Determine and Sketch the spectrum. **08**

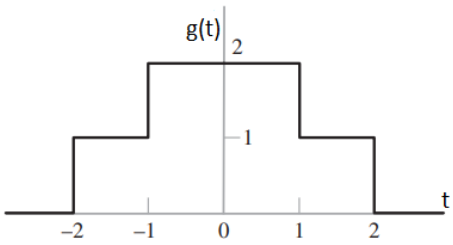

Fig Q-5

b) Derive the Fourier series representation of the following periodic signals: **08**

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

Also obtain the Fourier transform representation. Sketch the spectrum.

c) Differentiate between Energy spectral density and Power spectral density. **04**

UNIT - IV

6 a) A continuous time system is defined by the differential equation: **12**

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

(i) Using Laplace Transform, obtain the system transfer function.
(ii) Sketch pole-zero plot and comment on the stability of the system.
(iii) Obtain the impulse response of the system.
(iv) Draw the block diagram representation for the system.

b) A system has the transfer function **08**

$$H(s) = \frac{2}{s+3} + \frac{1}{s-2}$$

Find the impulse response assuming:

(i) the system is stable and (ii) the system is causal.

Also verify whether the system can be both stable and causal.

UNIT - V

7 a) What are ideal filters? Draw the frequency response for an ideal high pass filter and explain. **04**

b) Derive the transfer function of a Butterworth filter of the low pass type with cut-off frequency ω_c = 1 rad/sec and filter order, N = 3. **08**
Draw the pole-zero plot for the designed filter transfer function.

c) Consider a low pass filter whose transfer function is **08**

$$H(s) = \frac{1}{s+1}$$

Find the transfer function for each of the following filters:
(i) Low-pass filter with cut-off frequency ω_o = 10 rad/sec
(ii) High-pass filter with cut-off frequency ω_o = 10 rad/sec
(iii) Band pass filter with mid-band frequency ω_o = 20 rad/sec and bandwidth, B = 0.2.

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