Question Paper Code:R3B03

B.E./B.Tech. DEGREE EXAMINATION, NOV 2025

Third Semester

R21UBM303–PRINCIPLES OF SIGNALS AND SYSTEMS

Biomedical Engineering

(Regulations R2021)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. Is the signal $x(t) = 10cos(2\pi t) + sin(5\pi t)$ a periodic signal. If it is,   CO2-App
    determine the fundamental period?

2. Differentiate between causal and non-causal systems.   CO1 - U

3. State the trigonometric form of the Fourier series representation of a periodic   CO1 U
    signal?

4. State Convolution property for Laplace transforms.   CO1 U

5. Define impulse response of a system.   CO1 U

6. What are the tools used for analysis of LTI-CT systems?   CO1 U

7. Write the main condition to avoid aliasing?   CO1 U

8. Define Z transform.   CO1 U

9. Write the convolution sum with its equation x1(n) & x2(n) as two input   CO1 U
    sequence.

10. Is the discrete time system described by the difference equation   CO3 App

    $y(n) = x(-n)$causal?

11. (a) (i) Estimate whether the following signals are energy signals or power signals.   CO2-App   (16)
    a. $x(t) = u(t)$ b. $x(t) = e^{5t} u(t)$
    (ii) Estimate the fundamental period T for the following continuous time signals.
    a. $y(t) = 20cos (10\pi t + \pi /6)$
    b. $x(t) = 3cos (17\pi t + \pi / 3) + 2sin (19\pi t - \pi /3)$

Or

(b) For each of the following input-output relationship, check whether the corresponding system is linear, time invariant and causal.   CO2-App   (16)
(a) $y(t) = t^2 x(t - 1)$
(b) $y[n] = x^2[n - 2]$

12. (a) Determine the trigonometric Fourier series for the periodic signal x (t) shown in the figure.   CO2-App   (16)

Or

(b) Calculate the Laplace Transform of the following signals and sketch the ROC   CO2-App   (16)
    i. $x(t) = e^{-2t} u(t)$
    ii. $x(t) = e^{-at} u(t) + e^{-bt} u(-t)$

13. (a) An LTI system is represented by $\frac{d^2 y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = \frac{dx(t)}{dt} + x(t)$ with initial conditions $y(0) = 1, y'(0) = 3$. Conclude the output of the system, when the input is $x(t) = u(t)$.   CO3 -App   (16)

Or

(b) An LTI system is defined by differential equation   CO3 -App   (16)
$\frac{d^2 y(t)}{dt^2} - 4\frac{dy(t)}{dt} - 5y(t) = 5x(t)$.
Find the response of the system y(t) using Laplace transform for an input
$x(t) = u(t)$, if the initial conditions are $y(0) = 1; y'(0) = 2$.

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14. (a) (i) Consider an analog signal $x(t) = 5cos200\pi t$.   CO3 -App   (16)
(a) Examine the minimum sampling rate to avoid aliasing effect.
(b) If sampling rate $Fs = 400Hz$. Determine the Discrete time signal after sampling?
(ii)Explain types of sampling.

<div align="center">Or</div>

(b) Infer the Z-transform and ROC of   CO3-App   (16)
$x[n] = 2^n u(n) + 3^n u(-n-1)$.Experiment the Z-transform of the sequences
$x(n) = \{5,3,2,4,0,1,6\}$.

15. (a) i. Formulate the linear convolution of $x(n) = \{1,4,3,2\}$ and   CO3-App   (16)
$h(n) = \{1,3,2,1\}$
ii. In LTI discrete time system
$y(n) = \frac{3}{2}y(n-1) - \frac{1}{2}y(n-2) + x(n) + x(n-1)$ is given an input
$x(n) = u(n)$.Observe the transfer function of the system.

<div align="center">Or</div>

(b) Evaluate the impulse and step response of the system described   CO3-App   (16)
by the following difference equation $y(n) + \frac{1}{3}y(n-1) = x(n)$.

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