

# **INSTITUTE OF AERONAUTICAL ENGINEERING**

(Autonomous) (Dundigal-500043, Hyderabad)

B.Tech III SEMESTER END EXAMINATIONS (REGULAR / SUPPLEMENTARY) - FEBRUARY 2023

Regulation:UG20

SIGNAL AND SYSTEMS

Time: 3 Hours (ELECTRONICS AND COMMUNICATION ENGINEERING) Max Marks: 70

Answer ALL questions in Module I and II Answer ONE out of two questions in Modules III, IV and V All Questions Carry Equal Marks All parts of the question must be answered in one place only

# MODULE - I

- 1. (a) How to approximate the given signal using complete set of orthogonal functions? Explain with one example. [BL: Understand] CO: 1|Marks: 7]
  - (b) Figure 1 shows a square wave. Represent the signal f(t) by sint. Plot an error in this representation

[BL: Apply| CO: 1|Marks: 7]



Figure 1

# $\mathbf{MODULE}-\mathbf{II}$

- 2. (a) With regard to Fourier series representation, justify the following statements
  - i) Odd functions have only sine term
  - ii) Even functions have no sine term
  - iii) Functions with half wave symmetry have only odd harmonics.

[BL: Apply| CO: 2|Marks: 7]

(b) Solve the Fourier transform of

## i) Rectangular pulse.

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ii)  $x(t)=e^{-at}u(t)$  ; a>0

[BL: Apply] CO: 2|Marks: 7]

#### $\mathbf{MODULE}-\mathbf{III}$

3. (a) What is an LTI system? Explain the associative, distributive and commutative property of it. [BL: Understand] CO: 3|Marks: 7]

(b) A causal and stable LTI system has the frequency response  $H(i\omega) = \frac{j\omega + 4}{6 - \omega^2 + 5j\omega}$ . Determine

- i) Differential equation relating the input  $\mathbf{x}(t)$  and output  $\mathbf{y}(t)$
- ii) Impulse response h(t) of the system [BL: Apply| CO: 3|Marks: 7]
- 4. (a) Check the following properties of system y(t) = ax(t) i) Linearity ii) Time invariance iii)Stability iv) Causality v) Memoryless [BL: Understand CO: 4|Marks: 7]
  - (b) With the help of plots, determine the convolution of the following two signals in time domain  $x_1(t) = e^{-4t}u(t)$   $x_2(t) = u(t)$  [BL: Apply] CO: 4|Marks: 7]

#### MODULE - IV

- 5. (a) Mention the advantages of Laplace transform over Fourier transform. Explain the relationship between them. [BL: Understand| CO: 5|Marks: 7]
  - (b) Obtain the Laplace transform and ROC of following signal  $e^{-at} \sin(bt)u(t)$

[BL: Apply] CO: 5|Marks: 7]

- 6. (a) Prove that the following sequences have the same X(z) and differ only ROC. Also plot their ROCs. i)  $x(n) = a^n u(n)$ 
  - ii)  $x(n) = -a^n u(-n-1)$  [BL: Understand CO: 5|Marks: 7]
  - (b) Determine the Z-transform of the following sequence  $x(n) = n^2 u(n)$  [BL: Apply] CO: 5|Marks: 7]

### $\mathbf{MODULE}-\mathbf{V}$

- 7. (a) Explain the correlation of a finite energy signal. Find the relationship between autocorrelation function and power spectral density function. [BL: Understand] CO: 6|Marks: 7]
  - (b) Find the Nyquist sampling rate and Nyquist sampling interval for the following signal:  $x(t) = \sin^2(200t)$  [BL: Apply] CO: 6|Marks: 7]
- 8. (a) State and prove sampling theorem for low pass signals. Describe the process of reconstruction.

[BL: Understand CO: 6 Marks: 7]

(b) The signal  $x(t) = 2\cos 200\pi t + 6\cos 180\pi t$  is ideally sampled at a frequency of 150 samples / sec. i) Determine the Nyquist rate

ii) Check whether aliasing will occur or not

[BL: Apply] CO: 6|Marks: 7]

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