II B. Tech I Semester Regular/Supplementary Examinations, January-2023
SIGNALS AND SYSTEMS
(Com to ECE, EIE, ECT)

Time: 3 hours   Max. Marks: 70

Answer any **FIVE** Questions, each Question from each unit
All Questions carry **Equal** Marks
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UNIT-I

1. a) Determine whether the following signals are energy or power signals. [7M]
   (i) $x(t) = \sin^2 \omega_0 t$ (ii) $x(t) = t\, u(t)$

   b) Distinguish between Causal and Non-casual systems with an example. [7M]

OR

2. a) Explain about time shifting and scaling properties with an example. [7M]

   b) Discuss briefly Orthogonality in complex functions. [7M]

UNIT-II

3. a) What is the Fourier transform of a rectangular pulse from t = -T/2 to t = T/2. [7M]

   b) State and prove the time-convolution property of Fourier transform. [7M]

OR

4. a) Find the Fourier transforms of signal $x(t) = e^{-A(t)} \sin(t)$. [7M]

   b) Show that the unit impulse function is the derivative of unit step function. [7M]

UNIT-III

5. a) Obtain the conditions for distortion less transmission through a system. [7M]

   b) Discuss the concept of convolution in time domain and frequency domain. [7M]

OR

6. a) Write about filter characteristics of linear systems. [7M]

   b) Find the convolution of two signals $x(t) = u(t-1) - u(t+1)$ and $h(t) = e^{-at} u(t)$, a>0. [7M]

UNIT-IV

7. a) Find the Nyquist rate and Nyquist interval for the signals [7M]
   (a) rect (300t)
   (b) 10 sin 40πt cos 300 πt

   b) Explain the difference between Impulse, Natural and Top Sampling. [7M]

OR

8. a) Define power density spectrum and its properties. [7M]

   b) Interpret about the sampling of band pass signals. [7M]

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UNIT-V

9 a) Define Laplace transform of signal x(t) and its region of convergence.   [7M]

   b) Find the Laplace transform of the following signal and its ROC.   [7M]
   $x(t) = e^{-5t} [u(t) - u(t-5)]$

OR

10 a) Distinguish between one-sided and two-sided z-transforms and its ROC.   [7M]

   b) Find the inverse z- transform of $x(z) = z/ (z +2) (z-3)$ when the ROC is   [7M]
   i) ROC: $|z| < 2$ ii) ROC: $2 < |z| < 3$

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UNIT-I

1 a) Define and sketch the following signals: [7M]
   i) Signum Function   ii) Impulse function   iii) Unit step function.
  b) Determine the power and RMS value of the following signals: [7M]
   $y(t) = 5\cos(50t + \pi/3)$, $y(t) = 10(\cos 5t)(\cos 10t)$

OR

2 a) Distinguish between the following: i) Continuous time signal and discrete time [7M]
   signal. ii) Unit step and Unit Ramp functions. iii) Periodic and Aperiodic
   Signals.
  b) Explain the properties of unit impulse function. [7M]

UNIT-II

3 a) State and Prove Convolution property and Parseval's relation of Fourier series. [7M]
  b) What is the difference between Fourier series Analysis and Fourier Transforms? [7M]
   Explain with an example.

OR

4 a) What is the significance of Hilbert Transform? Give the mathematical analysis. [7M]
  b) Prove any two properties of Fourier transforms. [7M]

UNIT-III

5 a) What do you understand by distortedness transmission? Explain. [7M]
  b) Discuss the Causality and Poly-Wiener criterion for physical realization. [7M]

OR

6 a) Derive the relationship between bandwidth and rise time. [7M]
  b) Enlist the differences between LPF & HPF. [7M]

UNIT-IV

7 a) Discuss about the extraction of signal from noise by filtering. [7M]
  b) Explain about the graphical and analytical proof for Band Limited Signals. [7M]

OR

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8 a) Discuss briefly reconstruction of signal from its samples.   [7M]
   b) Obtain the relation between Convolution and correlation of the signals.   [7M]

UNIT-V

9 a) Determine the Laplace transform of the following signal: $x_2(t) = te^{-t} u(t)$.   [7M]
   b) State and prove the initial-value theorem of Laplace transform.   [7M]

OR

10 a) Determine z-transform, ROC and pole-zero locations of $x[n] = e^{jw0n} u[n]$.   [7M]
   b) State and prove time convolution property of Z-transform.   [7M]

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UNIT-I

1 a) Write about elementary Continuous time Signals in Detail. [7M]

   b) Determine whether the following function is periodic or not. If so find the period. x(t)=3sin 200πt + 4cos 100t. [7M]

OR

2 a) Derive the expression for Fourier Transform from Fourier Series. [7M]

   b) Show that the unit impulse function is the derivative of unit step function. [7M]

UNIT-II

3 a) Find the Fourier transform of signum function. [7M]

   b) Explain how the Fourier transform of a periodic signal can be obtained. [7M]

OR

4 a) Find the Hilbert transform of the signal x(t)= cos (2πt). [7M]

   b) State and prove the time-scaling property of Fourier transform. [7M]

UNIT-III

5 a) Explain about Poly-Wiener criterion. [7M]

   b) Obtain the convolution of the following two signals:
   $x(t) = e^{2t} u(t)$ and $h(t) = u (t-3)$. [7M]

OR

6 a) What is Impulse Response? Show that the response of an LTI system is convolution integral of its impulse Response with input signal? [7M]

   b) Define rise time and bandwidth. Derive the relationship between them. [7M]

UNIT-IV

7 a) State and prove sampling theorem for low pass band limited signal and explain the process of reconstruction of the signal from its samples. [7M]

   b) Discuss about Energy density spectrum with an example. [7M]

OR

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8　a)　Explain about Auto-correlation and list its properties.　　　　　　　　[7M]

　　b)　Determine the cross correlation between the two sequences x(n) = {1,0,01} and　　[7M]
　　　　h(n) = { 4,3,2,1}

UNIT-V

9　a)　Find the inverse Laplace transform of $F(s) = s-5/ s (s+2)^2$ using Partial Fraction　　[7M]
　　　　expansion.
　　b)　Explain the concept of stability in S domain and What do you mean by region of　　[7M]
　　　　convergence?

OR

10　a)　State and prove the Convolution Property of Z -Transform.　　　　　　　[7M]

　　b)　Obtain the Z-transform of $x(n) = -a^n u(-n-1)$ and find its ROC.　　　　[7M]

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UNIT-I

1   a)   What are the basic operations on signals? Illustrate with an example.   [7M]

    b)   Define the error function while approximating signals and hence derive the expression for condition for orthogonality between two waveforms $f_1(t)$ and $f_2(t)$.   [7M]

OR

2   a)   Explain the properties of unit impulse function.   [7M]

    b)   Determine whether the following signals are energy or power signals
(i) $x(t) = \sin^2 \omega_0 t$ (ii) $x(t) = t\, u(t)$.   [7M]

UNIT-II

3   a)   Find the Fourier Transform of $f(t) = t \cos(2t)$ using properties.   [7M]

    b)   State and Prove Convolution property and Parseval's relation of Fourier series.   [7M]

OR

4   a)   State and prove Differentiation and integration properties of Fourier Transform.   [7M]

    b)   What is the significance of Hilbert Transform? Give the mathematical analysis.   [7M]

UNIT-III

5   a)   Discuss the Graphical representation of convolution with an example.   [7M]

    b)   Describe the different ideal filter characteristics of systems.   [7M]

OR

6   a)   Draw and explain the Ideal LPF characteristics of a signal.   [7M]

    b)   A signal $x(t)= 2 \cos 400\pi t + 6 \cos 640\pi t$ is ideally sampled at fs = 500 Hz. If the sampled signal is passed through an ideal low pass filter with a cut off frequency of 400 Hz, what frequency components will appear in the output?   [7M]

UNIT-IV

7   a)   What is the effect of under sampling? Discuss different types of samplings.   [7M]

    b)   Explain about Cross-correlation & list its properties.   [7M]

OR

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8   a) Determine the Nyquist rate for $x(t) = 1 + \cos 2000\pi t + \sin 4000\ \pi t$.   [7M]

     b) Derive the relation between rise time and bandwidth of a low-pass filter.   [7M]

UNIT-V

9   a) Explain the Time convolution and Scaling properties of Laplace transform.   [7M]

     b) State and prove final value theorem of Laplace transforms.   [7M]

OR

10 a) Find the inverse of Z transform of $X(Z) = Z / (3Z^2 - 4Z + 1)$.   [7M]

     b) State and prove time shifting and time convolution properties of z- transform.   [7M]

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