Hall Ticket No | | | | | | | | | | | Question Paper Code: AECC02

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech III SEMESTER END EXAMINATIONS (REGULAR/ SUPPLEMENTARY) - FEBRUARY 2024
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) Explain the time shifting, time scaling, and time reversal properties of signals with an example. [BL: Understand| CO: 1|Marks: 7]

   (b) Identify whether each of the following signals is periodic? If a signal is periodic, determine its fundamental period.

   i) $x(t) = \cos\frac{\pi}{3}t + \sin\frac{\pi}{4}t$

   ii) $x[n] = \cos\frac{\pi}{3}n + \sin\frac{\pi}{4}n$

   iii) $x[n] = \cos^2\frac{\pi}{8}n$. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) State the following properties of the continuous-time Fourier transform:

   i) Linearity
   ii) Time shifting
   iii) Frequency shifting
   iv) Time scaling
   v) Time differentiation
   vi) Frequency differentiation
   vii) Multiplication property. [BL: Understand| CO: 2|Marks: 7]

   (b) Find the Fourier transform of a Gaussian pulse signal $x(t) = e^{-at^2}$; a>0. [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Summarize about convolution integral. Mention the steps involved in convolution integral operation. [BL: Understand| CO: 3|Marks: 7]

   (b) Find the time constant t_h, rise time t_r, and cutoff frequency f_c for a low pass system that has impulse response $h(t) = te^{-t}u(t)$. Determine the maximum rate that pulses of 1 second duration can be transmitted through the system so that interference is essentially avoided between adjacent pulses at the system output. [BL: Apply| CO: 3|Marks: 7]

4. (a) Outline the characteristics of ideal low pass filter, high pass filter and band pass filter with a neat plot of the respective frequency responses. [BL: Understand| CO: 4|Marks: 7]

   (b) Compute the output y(t) for a continuous-time LTI system whose impulse response $h(t)$ and the input $x(t)$ are given by $h(t) = e^{-at}u(t), x(t) = e^{at}u(-t); a > 0$. [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) State and prove initial value and final value theorems. Distinguish between one sided and two-sided Z transform and their ROC. [BL: Understand| CO: 5|Marks: 7]

   (b) A causal discrete-time LTI system is described by $y[n] - \frac{3}{4}y[n-1] + \frac{1}{8}y[n-2] = x[n]$, where $x[n]$ and $y[n]$ are the input and output of the system respectively.

   i) Determine the system function $H[z]$.

   ii) Find the step response of the system. [BL: Apply| CO: 5|Marks: 7].

6. (a) Describe the Laplace transform of a continuous time signal and its region of convergence (ROC). Discuss the properties of the ROC. [BL: Understand| CO: 5|Marks: 7]

   (b) For $x(t) = e^{-a|t|}$, Find X(s) and sketch the zero-pole plot and the ROC for $a > 0$ and $a < 0$. [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Interpret about auto correlation and cross correlation functions and explain their properties. Compare the energy spectral density and power spectral density. [BL: Understand| CO: 6|Marks: 7]

   (b) Given a continuous time signal x(t) with Nyquist rate ω_0. Determine the Nyquist rate for the following continuous-time signals:

   i) $x^2(t)$

   ii) $x(t)\cos\omega_0 t$ [BL: Apply| CO: 6|Marks: 7]

8. (a) Write a short note on aliasing. State and prove sampling theorem for bandlimited signals. [BL: Understand| CO: 6|Marks: 7]

   (b) Determine and sketch the energy density spectrum $S_{xx}(\omega)$ of the signal $x[n] = a^n$ u[n],-1<a<1. [BL: Apply| CO: 6|Marks: 7]

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