Reg. No: 23BEC0160

BG/K/TX

Final Assessment Test – November 2024

VIT® Vellore Institute of Technology

Course: BECE202L - Signals and Systems

Slot: B1+TB1

Class NBR(s): 4068 / 4072 / 4073 / 4112 / 4115

Max. Marks: 100

Time: Three Hours

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

Answer ALL Questions

(10 X 10 = 100 Marks)

1. Sketch the following signals:

   a) $x(t) = u(t) - u(t-2)$

   b) $x(t) = u(t+1) - 2u(t) + u(t-1)$

   c) $x(t) = -u(t+3) + 2u(t+1) - 2u(t-1) + u(t-3)$

   d) $y(t) = r(t+1) - r(t) + r(t-2)$

   e) $y(t) = r(t+2) - r(t+1) - r(t-1) + r(t-2)$

2. a) Check the periodicity and determine the fundamental period if it is periodic. **[5]**

$$x(t) = 5\,sin24\pi t + 7\,sin36\pi t$$

   b) Find the energy and power of the discrete-time signal: **[5]**

$$x[n] = \begin{cases} \left(\frac{1}{2}\right)^n, n \geq 0 \\ 3^n, n < 0 \end{cases}$$

3.(a) Compute and sketch the output $y(t)$ for a continuous-time LTI system whose impulse response $h(t)$ and the input $x(t)$ are given by:

$$h(t) = e^{-at}u(t), x(t) = e^{at}u(-t), \text{ a} > 0$$

OR

3.(b) Find the auto-correlation of the continuous-time signal $x(t) = Acos(\omega_0 t + \theta)$

4. Suppose we are given the following information about the signal $x[n]$:

   a) $x[n]$ is a real and even signal.

   b) $x[n]$ has a fundamental period N = 10 and Fourier coefficients a_k.

   c) $a_{11} = 5$.

   d) $\frac{1}{10}\sum_{n=0}^{9} |x[n]|^2 = 50$

   Compute $x[n]$.

5. The continuous-time signal $x(t) = \begin{cases} 2 & -1 < t < 1 \\ 0 & elsewhere \end{cases}$. Compute the CTFT and draw its spectrum. Use the properties of CTFT to show that the areas under $sinc(\lambda)$ and $sinc^2(\lambda)$ are unity.

6.

a) Determine $X(e^{j\omega})$ of $x[n] = \left(\frac{1}{2}\right)^{|n-1|}$. [5]

b) Determine $X(e^{j\omega})$ of $x[n] = (n+1)\alpha^n u[n]$, where $|\alpha| < 1$ [5]

7.

Find the Hilbert transform of $x(t) = \frac{1}{1+t^2}$.

8. A signal $x(t) = 2\cos(400\pi t) + 6\cos(640\pi t)$ is ideally sampled using the impulse train method with sampling frequency = 500 Hz. If the sampled signal is passed through an ideal low pass filter, with a cut-off frequency of 400 Hz and gain equal to the sampling period, to obtain the output $y(t)$.

a) Sketch the input spectrum $X(j\Omega)$. [4]

b) Sketch the output spectrum $Y(j\Omega)$ and compute $y(t)$. [6]

9. The output $y(t)$ of a continuous time LTI system is $2e^{-3t}u(t)$, when the input $x(t)$ is $u(t)$. Use Laplace transform to find:

a) Impulse response $h(t)$ of the system. [5]

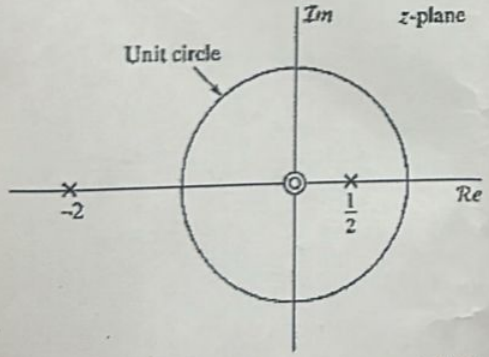
b) Output $y(t)$ when the input $x(t) = e^{-t}u(t)$ [5]

10.(a) Determine $x[n]$ of $X(z) = \frac{-1+5z^{-1}}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$ using inverse Z-transform with ROC

i) $|z| > 1$ ii) $|z| < \frac{1}{2}$ iii) $\frac{1}{2} < |z| < 1$.

OR

10.(b) Consider a system with impulse response $h[n]$ for which the z–transform $H(z)$ has the pole-zero plot shown in the following figure. Compute $H(z)$ and determine the possible ROCs associated with this system. Additionally, mention the stability and causality for the associated possible ROCs of the system.



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