PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JUN 2023

Semester : Semester IV - 2021
Course Code : EEE2001
Course Name : Sem IV - EEE2001 - Signals and Systems
Program : ISR

Date : 14-JUN-2023
Time : 9.30AM - 12.30PM
Max Marks : 100
Weightage : 50%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS   (5 X 2 = 10M)

1. Consider a continuous-time LTI system with impulse response $h(t) = \delta(t)$. Find the response $y(t)$ when the input signal $x(t) = u(t)$, where $u(t)$ is the unit step function.
(CO2) [Knowledge]

2. The Laplace transform of t^n is given by: $L\{t^n\}u(t) = n! / s^{(n+1)}$. Find the Laplace transform of the function $f(t) = t^2 u(t)$.
(CO3) [Knowledge]

3. In mathematics and signal processing, the Z-transform converts a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency-domain (z-domain or z-plane) representation. Find the Z-transform of the sequence $x[n] = \{1, -2, 4, -8, 16\}$.
(CO3) [Knowledge]

4. Compute the fourier transform of 1.
(CO2) [Knowledge]

5. The energy of a signal is defined using the square of the signal magnitude, the envelope of squared signal magnitude or the integral of squared signal magnitude. Find the Energy of the signal $x(t)=2$; $0<=t<=2$ and $x(t)=0$ elsewhere.
(CO1) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS   (5 X 10 = 50M)

6. Fourier transform is extensively used in the analysis of time-varying signals and systems. It enables the decomposition of signals into their constituent frequencies, helping in tasks such as spectrum analysis, power spectral density estimation, and harmonic analysis. As the signum function is not absolutely integrable, hence its fourier transform cannot be found directly. A signum signal is a signal whose magnitude is 1 for t>0 and -1 for t<0. The application of the signum function can be observed in a thermostat. Above a certain temperature the system is turned on and it starts cooling and below a certain temperature the system is turned off and it stops cooling. With the help of proper explanations, show the steps of computing fourier transform of a signum signal.
(CO2) [Comprehension]

7. The Final Value Theorem is an important concept in control systems theory and signal analysis. It provides a way to determine the final or steady-state value of a signal or system response without explicitly solving differential equations or analyzing transient behavior. This theorem is particularly useful when analyzing the behavior of systems that are stable and have reached a steady-state condition.In practical terms, the Final Value Theorem allows us to determine the final value of a system response without explicitly solving the differential equations or analyzing the transient behavior. It is particularly useful when the system has reached a steady-state condition and we are interested in finding the long-term behavior or steady-state value. If the laplace transform of the signal y(t) is Y(s)=1/{s{s-1)}, determine the final value of y(t).

(CO3) [Comprehension]

8. A voltage having the Laplace transform (4s^2 + 3s + 2)/ (7s^2 + 6s + 5) is applied across a 2H inductor having zero initial current. It is desired to compute the current flowing through the inductor at steady state. Utilizing the Final value theorem compute the current flowing through the inductor at steady state. [Hint-The current through the inductor is given by {4s^2 + 3s + 2)/ (7s^2 + 6s + 5)}/(2s)].

(CO3) [Comprehension]

9. Applications of digital signal processing make use of activities such as time shifting, amplification, and scaling. In consideration of the arguments presented above, demonstrate the concepts of time shifting, scaling, and reversing can be with the help of the signal u(-5t-4).

(CO1) [Comprehension]

10. One of the motors in a line follower robot was supplied with a direct current voltage signal of 5 Volts employing a battery, a relay, and a resistor in the process. Each component is linked to the next in a sequential fashion. A value of 10 ohms has been assigned to the resistor. At the beginning, the switch was in its open position; however, by the time t=0 arrived, the switch was in its closed position, and a response could be seen. A particular form of Signal is produced when a DC voltage source is connected in series with a switch. After you have drawn the source signal, use conceptual explanations to explain what will occur to the source signal if the switch is closed at t=1 units rather than t=0. This should be done after you have described what will occur to the source signal.

(CO1) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS   (2 X 20 = 40M)

11. Consider a continuous-time signal x(t) = 3sin(2πt) + 4cos(3πt). Determine the classification of the signal and its properties such as periodicity, symmetry, and whether it is an energy or power signal.

(CO1) [Application]

12. The Z-transform is a mathematical tool used for the analysis and representation of discrete-time signals and systems. It provides a convenient way to convert a discrete-time signal or system from the time domain to the Z-domain, which is a complex frequency domain representation. The Z-transform of a discrete-time signal x[n] is defined as the summation of the signal multiplied by the complex exponential function, i.e.
X(z) = ∑[x[n] * z^(-n)]
where X(z) represents the Z-transform of x[n], and z is a complex variable. Compare laplace transform and z-transform by taking example of 3 different cases.

(CO3) [Application]