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**PRESIDENCY UNIVERSITY
BENGALURU**

SET A

**SCHOOL OF ENGINEERING
END TERM EXAMINATION - JAN 2024**

Semester : Semester III - 2022

Course Code : EEE2001v02

Course Name : Signals and Systems

Program : B.Tech.

Date : 04-JAN-2024

Time : 9:30AM - 12:30 PM

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 2M = 10M

1. A system is said to be linear system, if it satisfies some properties. Summarize the properties.
(CO1) [Knowledge]
2. Explain the Fourier series representation of a discrete-time periodic signal.
(CO2) [Knowledge]
3. Explain the concept of impulse response in the context of continuous-time LTI systems. How does the impulse response provide insights into the system's behavior?
(CO3) [Knowledge]
4. Describe the process of mapping from the s-plane to the z-plane in the context of signal processing. How is the stability of a system in the s-plane related to its counterpart in the z-plane?
(CO3) [Knowledge]
5. A operation is performed on a signal during processing of a signal. Explain the concept of Time shifting and Time scaling?
(CO1) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS

5 X 10M = 50M

6. A DC voltage of 5 Volts was applied to an electrical circuit using a Battery comprising a Resistor, capacitor and a switch. All the elements are connected in series The value of Resistor is 1000 Ohms and capacitance is 3 micro-farads. The switch was initially open but at $t=0$ the switch has been closed and a transient response was observed. The battery was charging the capacitor to a steady state value. The voltage source in series with the switch gives rise to a type of Signal. After drawing the source signal, explain what will happen to the source signal if the switch is closed at $t=t_0$ instead of $t=0$ with the help of conceptual explanations. Also compute the value of the signal at $t=0$.
(CO1) [Comprehension]
7. A DC voltage of 5 Volts was applied to an electrical circuit using a Battery comprising a Resistor, capacitor and a switch. All the elements are connected in series The value of Resistor is 2000 Ohms and capacitance is 2 micro-farads. The switch was initially open but at $t=0$ the switch has been closed and a transient response was observed. The battery was charging the capacitor to a steady state value. The voltage source in series with the switch gives rise to a type of Signal. After drawing the source signal, explain what will happen to the source signal if the switch is closed at $t=t_x$ instead of $t=0$, with the help of conceptual explanations. Also compute the value of the signal at $t=0$.
(CO1) [Comprehension]
8. Fourier series are the ones that are used in applied mathematics, and especially in the field of physics and electronics, to express periodic functions such as those that comprise communications signal waveforms. It is used to represent non-sinusoidal periodic signals into harmonic components of sinusoidal signals. Referring to the above statements, state the special conditions where fourier series may not exist.
(CO2) [Comprehension]
9. An Even + Half wave symmetric square Signal with time period T can be represented by fourier series expansion
a) Identify the fourier coefficients that will be existing
b) Compute the fourier coefficients
(CO2) [Comprehension]
10. Explain the significance of mapping the s-plane to the z-plane in the context of signal processing. Discuss how this transformation is employed in practical applications, and analyze its impact on stability and causality
(CO4) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS

2 X 20M = 40M

11. A mathematician engaged in plotting the Region of Convergence (ROC) for a given signal, $x(t)$. The Region of Convergence (ROC) is characterized as the set of points in the s-plane where the Laplace transform of a function, $x(t)$, converges. To elaborate, it represents the range of $\text{Re}(s)$ (σ) values for which the function $X(s)$ converges. The signal $x(t)$ is a composite of two distinct signals, with the ROC observed to be $\sigma > -2$ for one component and $\sigma > 4$ for the other. Drawing from the provided information, derive the final equation of $x(t)$ expressed in terms of t. Additionally, comment on the stability of the signal, considering that $x(t)$ is a composition of exponential one-sided signals.
(CO5) [Application]
12. Given the discrete-time signal $x[n] = 2, 4, 6, 8$, compute the Z-transform $X(z)$ using the Z-transform formula:
$$X(z) = \sum_{n=-\infty}^{\infty} x[n] \cdot z^{-n}$$

Additionally, determine the Region of Convergence (ROC) for $X(z)$ and analyze the stability of the corresponding discrete-time system.
(CO5) [Application]