(ii) What is the convolution of $x(t-1)$ and $\delta(t+1)$?

(iii) What is a Gibbs Phenomenon ?

(iv) Differentiate between analog and digital signal.

(v) Why is Fourier analysis important ?

(vi) What is the relation among Laplace transform and Fourier transform ?

(vii) Find the time period of $x(t) = 2\cos(2\pi t + 0.5\pi)$.

(viii) What is the ROC of z transform of $x(n) = \delta(n-1) + \delta(n+1)$.

(ix) What is the need of anti-aliasing filter before sampling ? What is its cut off frequency ?

(x) Show that convolution in time is equivalent to multiplication in frequency. **2×10=20**

July-22-00239

B. Tech. EXAMINATION, 2022

Semester III (CBCS)

SIGNALS & SYSTEMS

EC-304

Time : 3 Hours   *Maximum Marks :* 60

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt *Five* questions in all, selecting *one* question from each Sections A, B, C and D. Q. No. 9 is compulsory.

Section A

1. Show that a discrete time signal is period if and only if its frequency "*f*" is a rational number. Discuss the relation among frequency variables of continuous time and discrete time complex exponentials. Find the time period of $x(t) = \cos^2 t$ if it is period. **10**

2. Express the signal defined as : $\{x(t) = -t + 1$, for $0 \le t \le 1$, otherwise zero$\}$ in terms of unit step and unit ramp signal only. Plot $x(-2t-2)$ for the given $x(t)$ and apply first scaling, then folding and shifting to plot $x(-2t-2)$. **10**

Section B

3. Discuss the following in detail with relevant examples :

   Linear Systems, Causal system, Time invariant system and Invertible system. If $x(t) = e^{j\Omega t}$ is passed through an LTI system, what will be the output ? **10**

4. Find the convolution of $\{x(t) = 1$, for $0 \le t \le 1$ otherwise zero$\}$ and $\{h(t) = 1$ for $0 \le t \le 2$, otherwise zero$\}$. State the associative and distributive property of convolution integral. **10**

Section C

5. How the Fourier transform is related to Fourier series for periodic signals. Find the Fourier series of a periodic signal shown in Figure below. Also sketch the spectrum of signal for T = 4T1. **10**
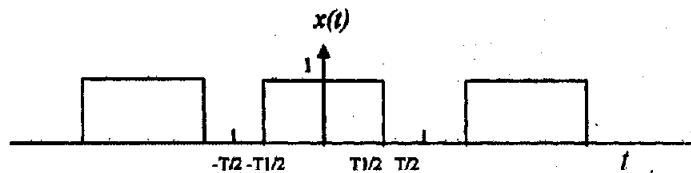
6. Discuss the properties of ROC of Laplace transform. What is the significance of imaginary axis in Laplace transform ? Demonstrate that two different signals can have same algebraic expression for Laplace transform but their ROC will differ. **10**

Section D

7. If $x(n)$ has a Z transform $X(z)$, what will be the Z transform of $nx(n)$. Find the Z transform of :

   (i) $-a^n u[-n-1]$ **5**

   (ii) $a^{-n} u[-n-1]$ **5**

8. An analog signal contains useful frequencies upto 100 Hz. What is the Nyquist rate for this signal ? Suppose that we sample this signal at a rate of 250 samples/s, what is the highest frequency that can be represented uniquely at this sampling rate ? Discuss sampling theorem and show how the analog signal is removed from its samples ? **10**

(Compulsory Question)

9. (i) What is the Laplace transform of $e^{-t}u(t)$.