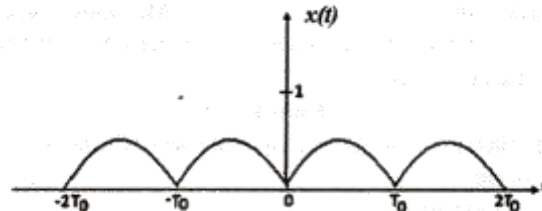


## Tutorial- 3

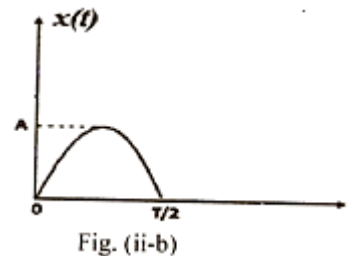
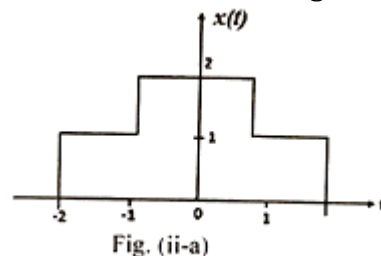
# Signals & Systems

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- Q.1 (a) find the trigonometric Fourier series representation for the Rectifier sine wave shown in figure(I)



- (b) Find the Fourier transform of the signals shown in figure (II-a) and (II-b)



- (c) Explain the properties of Fourier transform and give the physical significance of each.

- Q.2 (a) Define Fourier transform of a signals  $x(t)$ . what is the condition for existence of Fourier transform of signal  $x(t)$

- (b) State and prove following properties of Fourier Transform:

- (i) Linearity                      (ii) Time shifting                      (iii) Time scaling

- (c) For the transfer function:

$$f(s) = \frac{s + 10}{s^2 + 3s + 2}$$

Find the response  $y(t)$  due to input  $x(t) \sin 2t - u(t)$

- (d) For the continuous time periodic signal

$$x(t) = 2 + \cos\left(\frac{2\pi}{3}t\right) + 4 \sin\left(\frac{5\pi}{3}t\right)$$

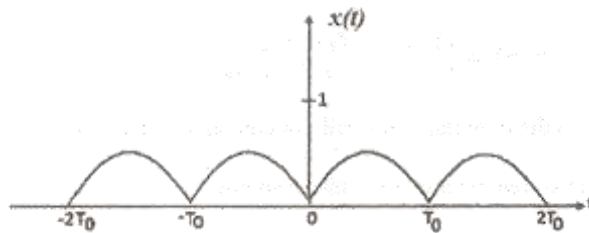
Determine the fundamental frequency  $\Omega_0$  and Fourier

Series coefficient  $C_n$  such that

$$x(t) = \sum_{n=-\infty}^{\infty} C_n e^{j\Omega_0 n t}$$

Q.3 (a) State the multiplication theorem of Fourier transform

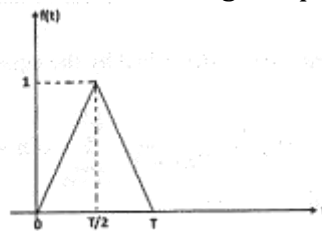
(b) Find the trigonometric Fourier series Representation for the rectified sine wave shown



(c) Determine the Fourier Transform of the signal

$$x(t) = t \cos At$$

(d) Determine the Laplace transform of the triangular pulse shown in figure



Q.4 (a) Obtain the complex exponential Fourier series of:

(i)  $x(t) = \sin^2 t$

(ii)  $x(t) = \sum_{k=-\infty}^{+\infty} \delta(t - kT_0)$

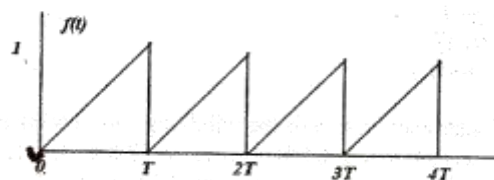
(b) Obtain the Fourier transform of  $X(t) = e^{-at^2}$

(c) Find the inverse Laplace transform of

$$X(s) = \frac{2 + 4e^{-us}}{(s+1)(s+3)} \text{ ROC : } \text{Re}(s) > -1$$

Q.5 (a) Define ROC in relation to Laplace transform

(b) Obtain the trigonometric Fourier series of the triangular waveform shown in figure



(c) Obtain the Fourier transform for the following function

(i) Gate function i.e.  $f(t) = A$  for  $-T/2 \leq t \leq T/2$

(ii) Signum function i.e.  $\text{sgn}(t)$

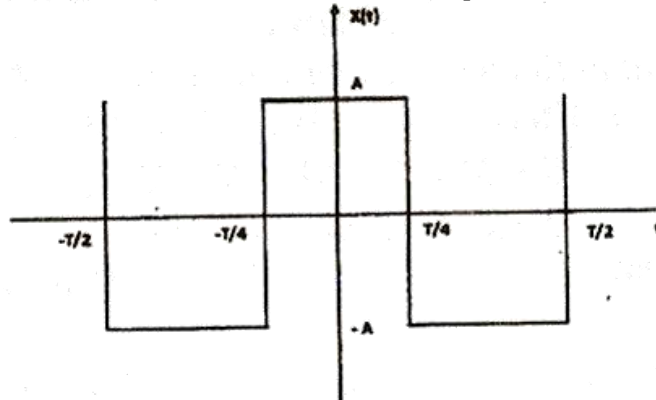
(d) Find the inverse Laplace transform of:

$$X(s) = \frac{-3}{(s+2)(s-1)} \text{ if ROC is:}$$

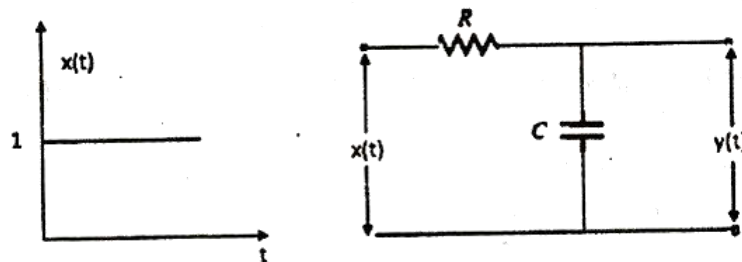
$$\begin{aligned} -2 < \sigma < 1 \\ \sigma > 1 \\ \sigma < -2 \end{aligned}$$

Q.6 (a) State Dirichlet's condition for the existence of continuous time Fourier series.

(b) The figure below shown a periodic square wave signal. Which is symmetrical with respect to the vertical axis. Obtain its Fourier series representation.



(c) Find the output  $y(t)$  for the RC network shown in fig. below due to unit step signal as the input by using the convolution integral method



(d) State and prove the following properties of continuous time Fourier transform

- (i) Time shifting (ii) Time differentiation

Q.7 (a) Explain the significance of ROC in Laplace transform using an exam

(b) Find the Trigonometric Fourier series representation for a half wave rectified sine wave.

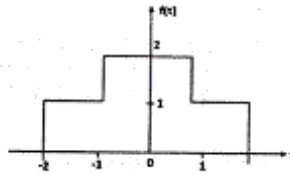
(c) Show that a normalized Gaussian pulse is its own Fourier transform

(d) Find the inverse Laplace transform:

$$X(s) = \frac{(5s + 13)}{s(s^2 + 4s + 13)}$$

$$X(s) = \frac{1}{(s + a)^2}$$

- Q.8 (a) State the convolution theorem of Fourier transform
- (b) State and prove Parseval's theorem for energy signal
- (c) Determine the Fourier transform of the signal shown in figure



- (d) Find the Laplace transform of a continuous-time signal given below

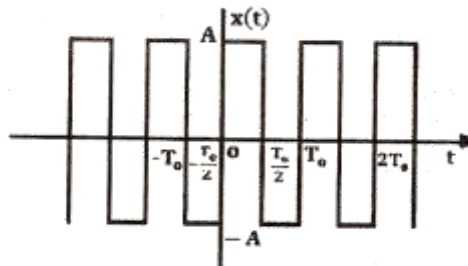
$$x(t) = 2e^{-3t} u(t) - e^{-2t} u(t)$$

- Q.9 (a) Determine the Fourier transform using the properties of Fourier transform:

$$X(t) = te^{-3|t|}$$

- (b) Find the energy of the signal  $x(t) = 10e^{-at}u(t)$  contained in frequencies  $|f| < a/2\pi$ . What percentage of the total energy is this? (a is positive)

- (c) Find trigonometric Fourier series of the waveform shown below:



- (d) A system has a transfer function given by:

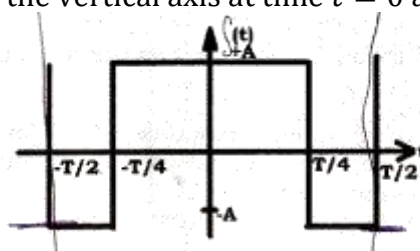
$$H(s) = \frac{1}{(s+1)(2s+3)}$$

Find the response of the system when the excitation is:

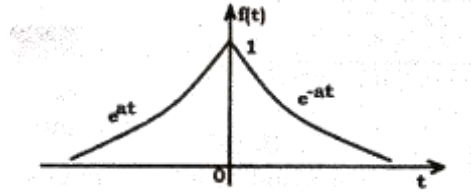
$$X(t) = (1 + e^{-3t})u(t)$$

- Q.10 (a) Give the dirichlet conditions and define the Fourier series

- (b) Obtain the Fourier components of the periodic square wave signal which is symmetrical with respect to the vertical axis at time  $t = 0$  as show in figure



(c) Determine the Fourier transform for the double exponential pulse shown in the figure whose function is given by  $f(t) = e^{-a|t|}$



(d) Find the Laplace transform of the following functions:

(i)  $f(t) = \sin at \cos bt$

(ii)  $f(t) = \frac{1-e^{-t}}{t}$