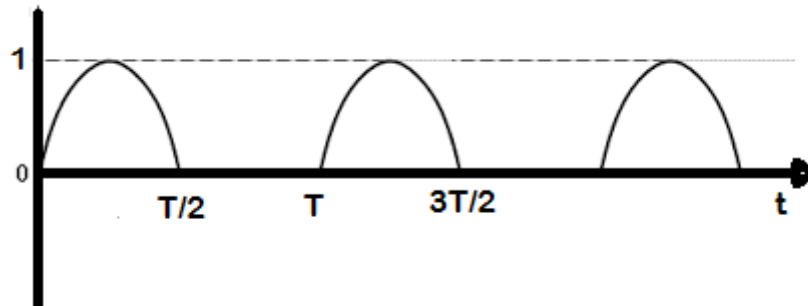




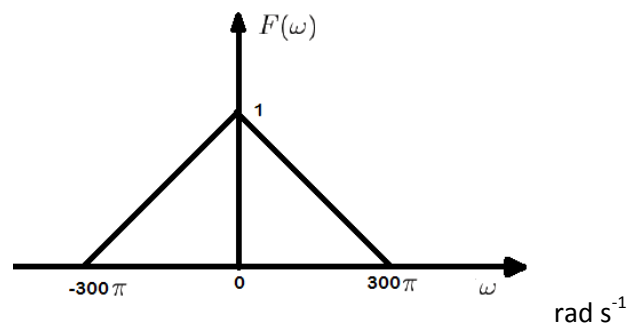
## PART B

Answer any two questions, each carries 15 marks

- 4 a) Determine the exponential Fourier series representation of half wave rectified sine wave as shown in the figure below. (10)



- b) State and prove the Parseval's theorem for continuous time Fourier transforms. (5)
- 5 a) Let  $f(t)$  be a signal with the spectrum as shown below.



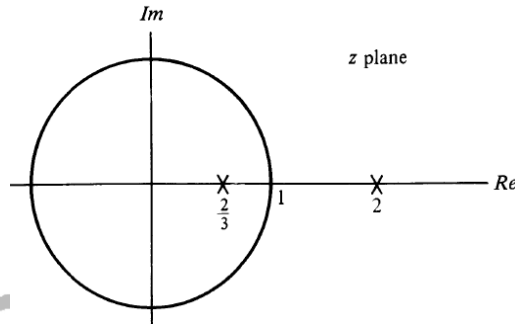
- (i) What is the Nyquist frequency (in Hz) of the signal  $f(t)$ ? (6)
- (ii) Suppose the signal is sampled by an impulse train  $\delta_{F_s}(t) = \sum_{k=-\infty}^{\infty} \delta(t - kT)$  where  $T$  is the sampling period and  $F_s$  is the sampling frequency. Sketch the spectrum of the sampled signals with (A)  $F_s = 200$  Hz and (B)  $F_s = 400$  Hz. (1)
- (iii) Specify whether the original signal can be recovered from samples in each case ( $F_s = 200$  Hz and  $F_s = 400$  Hz).
- b) An LTI system has  $h(t)$  such that  $\mathcal{L}\{h(t)\} = H(s) = \frac{1}{s+1}$ ,  $\text{Re}\{s\} > -1$ . Determine the system output  $y(t)$  if the input is  $x(t) = (e^{-t/2} + 2e^{-t/3})u(t)$ . (6)
- 6 a) Find the Laplace transform and ROC of the following signals. (9)
- (i)  $e^{-a|t|}$ ,  $a > 0$
- (ii)  $\sin(\omega_0 t + b)e^{-at}u(t)$ ,  $a, b$  real numbers
- b) Let  $F(\omega) = \mathcal{F}\{f(t)\}$ . Determine the Fourier transform of  $g(t) = f(at - b)$  in terms of  $F(\omega)$  where  $a \neq 0$ ,  $a, b$  real. Handle the cases for  $a > 0$  and  $a < 0$  separately. (6)

## PART C

Answer any two questions, each carries 20 marks

- 7 a) Find the Z transform and ROC of the following signals. (5)
- $x[n] = 2^n u[n]$
  - $\delta[n]$

- b) Pole zero plot for Z transform  $X(z)$  of a discrete time signal  $x[n]$  shown below. (6)



Determine the ROC in each of the following cases.

- $x[n]$  is right sided
  - Fourier transform of  $x[n]$  converges
  - $x[n]$  is left sided
- c) Determine the DTFS coefficients for the discrete time signal (9)
- $$x[n] = \cos\left(\frac{2\pi n}{3}\right) + \sin\left(\frac{2\pi n}{7}\right)$$
- Also plot the magnitude and phase spectra.
- 8 a) Consider a LTI system characterised by input output relationship (2)
- $$y[n] - \frac{1}{4}y[n-1] = x[n] + \frac{1}{6}x[n-1]$$
- Compute the system function  $H(z)$ . (2)
  - Sketch the possible ROCs for  $H(z)$ .
  - Compute the impulse response  $h[n]$  if it is known that impulse response is left sided. (4)
- b) Consider a system with impulse response  $h[n] = (0.5)^n u[n]$ .
- Determine the system function  $H(e^{j\omega})$  (4)
  - If the input  $x[n] = \cos\left(\frac{n\pi}{2}\right)$ , determine the output  $y[n]$ . (8)
- 9 a) List any four properties of Z-transform, state and prove the convolution property of Z transforms. (10)
- c) A signal  $x(n)$  has DTFT  $X(e^{j\omega}) = \frac{1}{1-ae^{-j\omega}}$ ,  $|a| < 1$ . Determine the DTFT of (4)
- $$x[n+2] e^{j\frac{\pi}{2}n}$$
- d) Determine the DTFT of the signal  $x[n] = u[n] - u[n-N]$  (6)

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