

- Instructions**
- (i) All abbreviation and notations have their usual meanings.
 - (ii) Figures to the right indicate marks.
 - (iii) Assume necessary data.
 - (iv) **Maintain continuity in writing sub questions.**

1(a) What do you mean by aliasing? How can we overcome an aliasing effect? (04)

(b) A signal $x_1(t)$ is bandlimited to 2 kHz while $x_2(t)$ is bandlimited to 3 kHz. Find the Nyquist rate with proper explanation, for (i) $x_1(2t)$ (ii) $x_2(t-3)$ (iii) $x_1(t) + x_2(t)$ (iv) $x_1(t)x_2(t)$ (v) $x_1(t)*x_2(t)$.
 10 kHz 8 kHz 6 kHz 16 kHz

(c) Explain the different interpolation methods for the reconstruction of a signal from its samples. Mention all necessary equations and figures. (05)

2. **Attempt any three.**

(a) Draw six different types of finite duration and infinite duration signal and show Z Transform with ROC. Justify your answer with proper explanation.

(b) Derive time-reversal, time-shifting and differentiation property of Z-Transform.

(c) Determine and represent the Z-Transform in a standard form for the following signals.

(i) $x(n) = \cos(n\omega_0) u(n)$; (ii) $x(n) = (-1/3)^n u(n) - (1/2)^n u(n-1)$

(d) Determine the signal $x(n]$ if its z-transform $X(z)$ is given by:

$X(z) = (z+2)/(2z^2 - 7z + 3)$ for the following different ROC

(i) $|z| > 3$; (ii) $1/2 < |z| < 3$; (iii) $|z| < 1/2$

(e) Determine an impulse response of the following causal system. Plot the pole-zero patterns.
 $y(n) = 0.75y(n-1) - 0.125y(n-2) + x(n)$

3. **Attempt any three.**

(a) A bandlimited signal $x(t)$ is sampled by a train of rectangular pulses of width τ and period T . (i) Find an expression for the sampled signal. (ii) Determine the spectrum of the sampled signal and sketch it.

(b) (i) Determine the Fourier Transform for $-\pi \leq \omega \leq \pi$ in the case of following periodic signals:

$$\sin\left(\frac{\pi}{3}n + \frac{\pi}{4}\right).$$

(ii) Calculate the Fourier Transform of signal $\delta[n+2] - \delta[n-2]$. Sketch and label one period of the magnitude of the FT.

(c) The following four facts are given about a real signal $x[n]$ with Fourier Transform $X(e^{j\omega})$:

1. $x[n]=0$ for $n > 0$.

2. $x[0] > 0$

3. $\text{Im}\{X(e^{j\omega})\} = \sin \omega - \sin 2\omega$

4. $\frac{1}{2\pi} \int_{-\pi}^{\pi} |X(e^{j\omega})|^2 d\omega = 3$.

Determine $x[n]$.

(d) Determine the response of the system whose unit impulse response and input are given as follows:

$$x[n] = u(n+1) - u(n-4) - \delta(n-5)$$

$$h[n] = [u(n+2) - u(n-3)](3 - |n|)$$
