PART - A

Answer all questions from Part - A:

1. State the advantages and limitations of DSP.

2. The impulse response of a discrete LTI system is given by
   \[ h(n) = \left(\frac{1}{2}\right)^n \cdot u(n) + \left(\frac{1}{3}\right)^n \cdot u(n). \] Is the system stable?

3. Check whether the signal, \( x(n) = \cos\left(\frac{\pi}{3}\right)^n + \cos\left(\frac{3\pi}{4}\right)^n \) is periodic or not. If periodic, what is the fundamental period?

4. Sketch the line spectrum of the signal, \( x(t) = 3 - 5 \cos(40\pi t - 30^\circ) + 4 \sin 120\pi t. \)

5. Obtain the output of the discrete LTI system when \( x(n) = \{1, 4, 3, 2\} \) and
   \[ h(n) = \{1, 3, 2, 1\}. \] Use Z-Transform method.

6. Clearly explain the significance of ROC in Z-Transforms.

7. Distinguish between DFT and FFT.

8. How are IIR filters different from FIR filters?
9. Explain how the characteristics of practical filters different from ideal ones.

10. What is bilinear transformation?

**PART – B**

Answer **one full** question from **each** Module:

**Module – 1**

11. a) With the help of a block diagram, explain how a Digital Signal Processing System works.

b) For the given sequence, \( x(n) = \{0, 1, 2, 3, 4, 5, 6\} \) draw \( x(-n + 2) \).

c) Obtain the Fourier Transform of the gate function shown in Fig.

![Gate Function Diagram](image)

12. a) Check the following systems for linearity:

   i) \( y(n) = x(n^2) \)

   ii) \( y(n) = x^2(n) \)

   iii) \( y(n) = n \cdot x(n) \)

   iv) \( y(n) = \cos x(n) \).

b) Find out whether the following systems are time invariant or not.

   i) \( y(n) = 4n \cdot x(n) \)

   ii) \( y(n) = x(n^2) \)

   iii) \( y(n) = x(-n) \)

   iv) \( y(n) = x(n) \cdot x(n-1) \).
Module – 2

13. a) Obtain the Z-Transform including ROC of the sequence,
\[ x(n) = \left( \frac{1}{5} \right) u(n) + 5 \left( \frac{1}{2} \right)^n \cdot u(-n - 1). \]

b) Find the 8-point DFT of the sequence using radix 2, decimation in Time FFT algorithm.
\[ x(n) = \{1, 1, 1, 1, 1, 1, 0, 0\}. \]

14. a) Determine the inverse Z-Transform of \( X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}} \) if

i) ROC : \(|z| > 1\)
ii) ROC : \(|z| < 0.5\)
iii) ROC : \(0.5 < |z| < 1\).

b) Obtain the 8-point DFT of the sequence using Decimation in Frequency Radix 2 FFT algorithm.
\[ x(n) = \{2, 2, 2, 2, 1, 1, 1, 1\}. \]

Module – 3

15. a) Obtain the direct form I and direct form II realisations of the system,
\[ H(z) = \frac{\left(1 + \frac{1}{5} z^{-1}\right)}{(1 - \frac{1}{2} z^{-1} + \frac{1}{3} z^{-2})(1 + \frac{1}{4} z^{-1})}. \]

b) Design a low pass FIR filter with cut off frequency of 1 kHz and sampling frequency of 4 kHz with 11 samples using Fourier series method.

16. a) Obtain the parallel form realisation of the system,
\[ H(z) = \frac{1 + 2z^{-1} + z^{-2}}{1 - 0.75z^{-1} + 0.125z^{-2}}. \]

b) For the analog transfer function, \( H(s) = \frac{2}{s^2 + 3s + 2} \), determine \( H(z) \) using impulse invariance transformation if

a) \( T = 1 \text{ sec} \) and \ b) \( T = 0.1 \text{ sec} \).