

Indian Institute of Space Science and Technology,

Trivandrum

Department of Avionics

Modern Signal Processing (AVD611)

Class Test 1, Date: September 12, 2024

Time: 4:45 to 5:45 PM

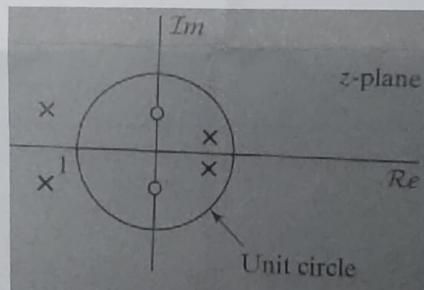
Class Test, I Semester (M.Tech)

Max mark: 20

1. (a) When the input to an LTI system is $x[n] = \left(\frac{1}{2}\right)^n u[n] + (2)^n u[-n-1]$ the output is $y[n] = 6\left(\frac{1}{2}\right)^n u[n] - \left(\frac{3}{4}\right)u[n]$. Determine the system function $H(z)$ of the system. Plot the poles and zeroes of $H(z)$, and indicate the ROC. Write the difference equation that characterizes the system. Is the system stable? Is the system causal?

(4)

- (b) The system function of an LTI system has the pole-zero plot shown in Figure. Specify whether each of the following statements is true/false/cannot be determined from the information given.
- (i) The system is stable
 - (ii) The system is causal
 - (iii) If the system is causal, then it must be stable.
 - (iv) If the system is stable, then it must have a two-sided impulse response.



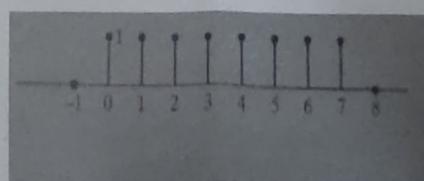
(4)

2. (a) State whether the given system function is minimum-phase system. Justify your answer $H(z) = \frac{(1+0.25z^{-1})(1-0.25z^{-1})}{(1-2/3z^{-1})(1+2/3z^{-1})}$

(2)

- (b) If the system function is given by the figure below determine its group delay

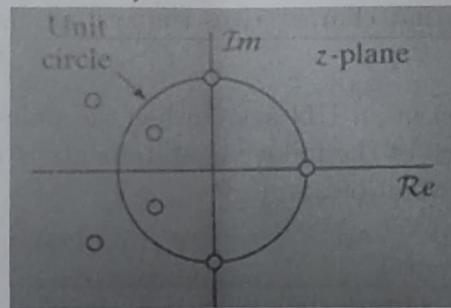
(2)



- (c) Determine the inverse of the system with impulse response $h[n] = \delta[n] - 0.5\delta[n-1]$. Is the inverse system causal and stable.

(2)

- (d) A FIR system is given by $H(z) = 1 - z^{-1} - 6z^{-2}$, indicate whether the system is minimum phase or maximum phase. (2)
- (e) Two FIR transfer functions are given by $H_1(z) = -1 + 2z^{-1} - 3z^{-2} + 6z^{-3} - 3z^{-4} + 2z^{-5} - z^{-6}$ and $H_2(z) = 1 - 2z^{-1} + 3z^{-2} - 6z^{-3} + 3z^{-4} - 2z^{-5} + z^{-6}$ comment on the following of the two systems:
 (i) Type of the filter
 (ii) Magnitude response
 (iii) Phase response
 (iv) Group delay (3)
- (f) If the pole zero plot of a FIR system is given as in figure, determine which Type it belongs to. (1)



END