CST Third Semester Final Examination, January 2021

Signals and Systems (CS-2104)

Answer any six questions.

Two marks are reserved for neatness.

Full Marks 50 Time 90 minutes

1. Explain how an unstable system can be stabilized. Map the stable zone of s-plane to the stable zone of z-plane with proper mathematical justifications.
   . **[3+5]**

2. Enlist the properties of state transition matrix. Consider a system with two state variables described by $\dot{\mathbf{x}} = A\mathbf{x}$ where $A = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix}$ Obtain the state transition matrix.
   . **[3+5]**

3. What are the limitations of amplitude modulation? Compare the narrowband and wideband frequency modulation (FM) systems. Discuss demodulation of FM systems using block diagram.
   . **[2+3+3]**

4. Write an expression for Parseval's relation for signal energy. Explain the convolution property of signals. Why is it sometimes also called modulation property?
   . **[3+3+2]**

5. Design a first order lowpass filter having cutoff frequency of 5 KHz and plot the magnitude and phase against frequency. What are the metrics of performance of filter design? In this context explain how design of Butterworth filters can improve upon the performance of a lowpass filter.
   . **[4+2+2]**

6. Write short notes on any two:
   (a) Design of PID controller circuits using opamps
   (b) Properties of discrete Fourier transform
   (c) Sampling of continuous signals to discrete domain signals.
   . **[4+4]**

7. What do you understand by linear time invariant system? Briefly explain the terms infinite impulse response (IIR) and finite impulse response (FIR) system. Justify mathematically how derivative and integral of an impulse signal are inverse operations of one another.
   . **[2+3+3]**