53 (EC 603) DSPR

2021

DIGITAL SIGNAL PROCESSING

Paper : EC 603

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* Establish the relation between analog frequency and digital frequency. 5

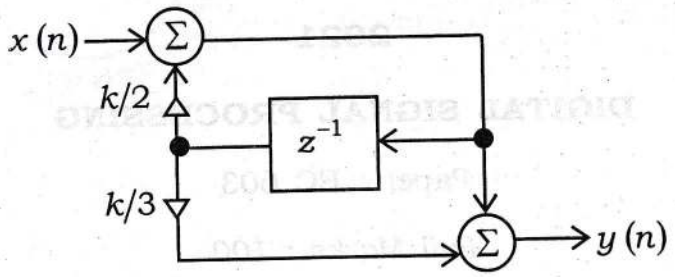
   (b) Consider an LTI system whose frequency response is given by

   $$H(\omega) = \left\{ exp.\left(\frac{-j\omega}{2}\right)\right\};\ |\omega| < \pi\ .$$

   Determine whether or not the system is causal. Show your reasoning. 15

Contd.

2. *(a)* For what values of 'k' is the system BIBO stable? 15



(b) What are moving average (MA) systems? 5

3. *(a)* Find the impulse response $h(n)$ for each of the causal, discrete-time LTI systems satisfying the following difference equations and also indicate whether each system is FIR or IIR system: 5+5+5

(i) $y(n) = x(n) - 2x(n-2) + x(n-3)$

(ii) $y(n) + 2y(n-1) = x(n) + x(n-1)$

(iii) $y(n) - 0{\cdot}5y(n-2) = 2x(n) - x(n-2)$

(b) What are 'recursive' and 'non-recursive' systems? 5

4. *(a)* Prove that a linear phase FIR system has symmetric impulse response characteristics. 10

(b) Design a single-pole low-pass digital filter with a 3-dB bandwidth of $0{\cdot}2\pi$ using bilinear transformation technique. The analog filter has a system response given by

$$H(s) = \frac{\Omega_c}{s + \Omega_c}$$; where 'Ω_c' is the 3-dB bandwidth of the analog filter. 10

5. (a) Develop a Direct Form-II realisation structure for the following difference equation : 10

$$y(n) = 2x(n) - 3x(n-1) - x(n-2) - 2{\cdot}5y(n-1)$$

(b) Draw and establish the complete signal flow graph of a 8-point DIT-FFT algorithm. 10

6. Write short notes on ***any two*** of the following : 10+10

(i) Overlap-add and overlap-save methods

(ii) Digital resonator (2nd order)

(iii) Gibbs' phenomenon.