

Systems

**Duration – 3 Hours****Total Marks assigned to the paper- 80**

- N.B.:-** (1) Question No.1 is compulsory.  
 (2) **Attempt** any **three** questions out of remaining **five** questions.  
 (3) Assume suitable data if necessary and justify the same.

- Q 1. Answer the following questions. **20**
- Define symmetric and anti-symmetric signals.
  - Summarize the properties of ROC.
  - Find the Fourier transform of  $x(t) = e^{-2t} \cos 3t u(t)$ .
  - List any three properties of DTFT.
- Q 2 a) (i) Write about elementary Continuous time Signals in detail. **10**  
 (ii) Describe whether the following signal is periodic. If periodic determine the fundamental period.  
 $x(t) = 3 \cos(4t) + 2 \sin(\pi t)$
- Q 2 b) Derive the odd and even components of the following signals. **10**  
 $x(t) = \sin(t) + 2\sin(t) + 2\sin 2(t) \cos(t)$   
 $x[n] = \{1, 0, -1, 2, 3\}$
- Q 3 a) (i) Find out the Fourier transform of  $x(t) = e^{-at} u(-t)$  **10**  
 (ii) Determine the Fourier series representation of the signal  
 $x(t) = 2 + \cos(4t) + \sin(6t)$
- Q 3 b) Formulate the trigonometric Fourier series over the interval  $(-1, 1)$  for the signal **10**  
 $x(t) = t^2$ .
- Q 4 a) (i) Deduce the initial value of  $X(z) = \frac{z+2}{(z+1)(z+2)}$  **10**  
 (ii) Evaluate the Z- transform of  $x(n) = (2/3)^n u(n) + (-1/2)^n u(n)$ .
- Q 4 b) (i) Infer the Z-transform and ROC of  $x[n] = 2^n u(n) + 3^n u(-n-1)$ . **10**  
 (ii) Determine the Z-transform of the sequence  $x(n) = \{5, 3, 2, 4\}$ .
- Q 5 a) Write short note on (i) properties of DFT (ii) Types of signals **10**
- Q 5 b) Determine eight-point DFT of the following sequences using radix-2 DIT-FFT **10**  
 algorithm  $x(n) = \{1, -1, -1, -1, 1, 1, 1, -1\}$ .
- Q 6 a) Design a digital Butterworth filter satisfying the constraints using bilinear **10**  
 transformations.  
 $0.707 \leq |H(\omega)| \leq 1.0; 0 \leq \omega \leq \pi/2$   
 $|H(\omega)| \leq 0.2; 3\pi/4 \leq \omega \leq \pi$ .
- Q 6 b) Design an FIR filter for the ideal frequency response using Hamming window with **10**  
 $N=7$   
 $H_d(\omega) = \{e^{-j2\omega}, -\pi/8 \leq \omega \leq \pi/8$   
 $0; \text{otherwise.}$