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**
a) Define symmetric and anti-symmetric signals.
b) Summarize the properties of ROC.
c) Find the Fourier transform of $x(t) = e^{-2t} \cos 3t\, u(t)$.
d) 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 $x(t) = t^2$. **10**

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 algorithm $x(n) = \{1, -1, -1, -1, 1, 1, 1, -1\}$. **10**

Q 6 a) Design a digital Butterworth filter satisfying the constraints using bilinear transformations. **10**
$0.707 \le |H(\omega)| \le 1.0;\ 0 \le \omega \le \pi/2$
$|H(\omega)| \le 0.2;\ 3\pi/4 \le \omega \le \pi.$

Q 6 b) Design an FIR filter for the ideal frequency response using Hamming window with N=7 **10**
$H_d(\omega) = \{e^{-j2\omega};\ -\pi/8 \le \omega \le \pi/8$
$0;$ otherwise.
