(3 Hours) [Total Marks :80

N.B. : (1) Question no. 1 is compulsory.
(2) Solve any three questions from remaining five questions.
(3) In all four questions to be attempted.
(4) Figures to the right indicate full marks.

1. (a) The first five points of eight point DFT of real valued signal are {0.25, 0.125 -j0.3018, 0, 0.125-j0.0150, 0}. Determine the remaining three points. 20

(b) Sketch the frequency response and identify the following filters based on their passband

(i) $h(n) = \left\{1, -\frac{1}{2}\right\}$

(ii) $H(z) = \frac{z^{-1} - a}{1 - az^{-1}}$

(c) What is multirate DSP? State its applications

(d) An analog filter has transfer function

$$H(s) = \frac{S + 0.1}{(S + 0.1)^2 + 16}$$

Determine transfer function of digital filter using bilinear transformation.

The digital filter should have a specification of $\omega_r = \pi/2$

2. (a) Compute DFT of sequence $x(n) = \{1, 2, 2, 2, 1, 0, 0, 0\}$ using DIT-FFT algorithm. 10

(b) Explain the effects of coefficients quantization in FIR filters. 10

3. (a) Implement a two stage decimatior for the following specification: 10
Sampling rate of the input signal = 20,000Hz,
Decimating factor M = 100,
Passband = 0 to 40Hz,
Passband ripple = 0.01,
Transition band = 40 to 50Hz,
Stop band ripple = 0.002

(b) (i) If $x(n) = \{1 + 2j, 3 + 4j, 5 + 6j, 7 + 8j\}$. Find DFT X(k) using DIF-FFT algorithm. 10

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4. (a) Explain upsampling process in detail and derive for input-output relationship in time domain and frequency domain. 10

(b) Obtain cascade and parallel realization structures for the system described by $y(n) = -0.1y(n-1) + 0.72y(n-2) + 0.7\,x(n) - 0.252\,x(n-1)$ 10

5. (a) Design a FIR digital filter using window method for following specifications. 10

$$H(e^{j\omega}) = e^{-j3\omega} \quad 0 \le |\omega| \le \frac{3\pi}{4}$$
$$= 0 \qquad \text{otherwise}$$

Use Hamming window of length 7

(b) Design a digital low pass IIR Butterworth filter for the following specification 10

Passband ripple	:	≤ 1 dB
Passband edge	:	4 KHz
Stopband attenuation	:	40 dB
Stop edge	:	8 KHz
Sampling Rate	:	24 KHz

Use bilinear transformation

6. (a) Write a short note on: 10

(i) Dual tone multi frequency signal detection

(ii) Different methods for digital signal synthesis

(b) Determine the zeros of the following FIR systems and indicate whether the system is minimum phase, maximum phase or mixed phase. 10

(i) $H_1(z) = 6 + z^{-1} - 6z^{-2}$

(ii) $H_2(z) = 1 - z^{-1} - 6z^{-2}$

(iii) $H_3(z) = 1 - \frac{5}{2}z^{-1} - \frac{3}{2}z^{-2}$

(iv) $H_4(z) = 1 - \frac{5}{2}z^{-1} - \frac{2}{3}z^{-2}$

Comment on stability of minimum and maximum phase system
