(REVISED COURSE)

(3 Hours) [Total Marks : 100

N.B. (1) Question No. 1 is **compulsory.**
(2) Attempt any **five** questions including question No. 1.
(3) **Figures** to the **right** indicate **full** marks.
(4) Assume any **suitable** data whenever **required** but **justify** the **same.**

T.E(Etc) Sem VI Rev Signal Processing-II 13/12/07

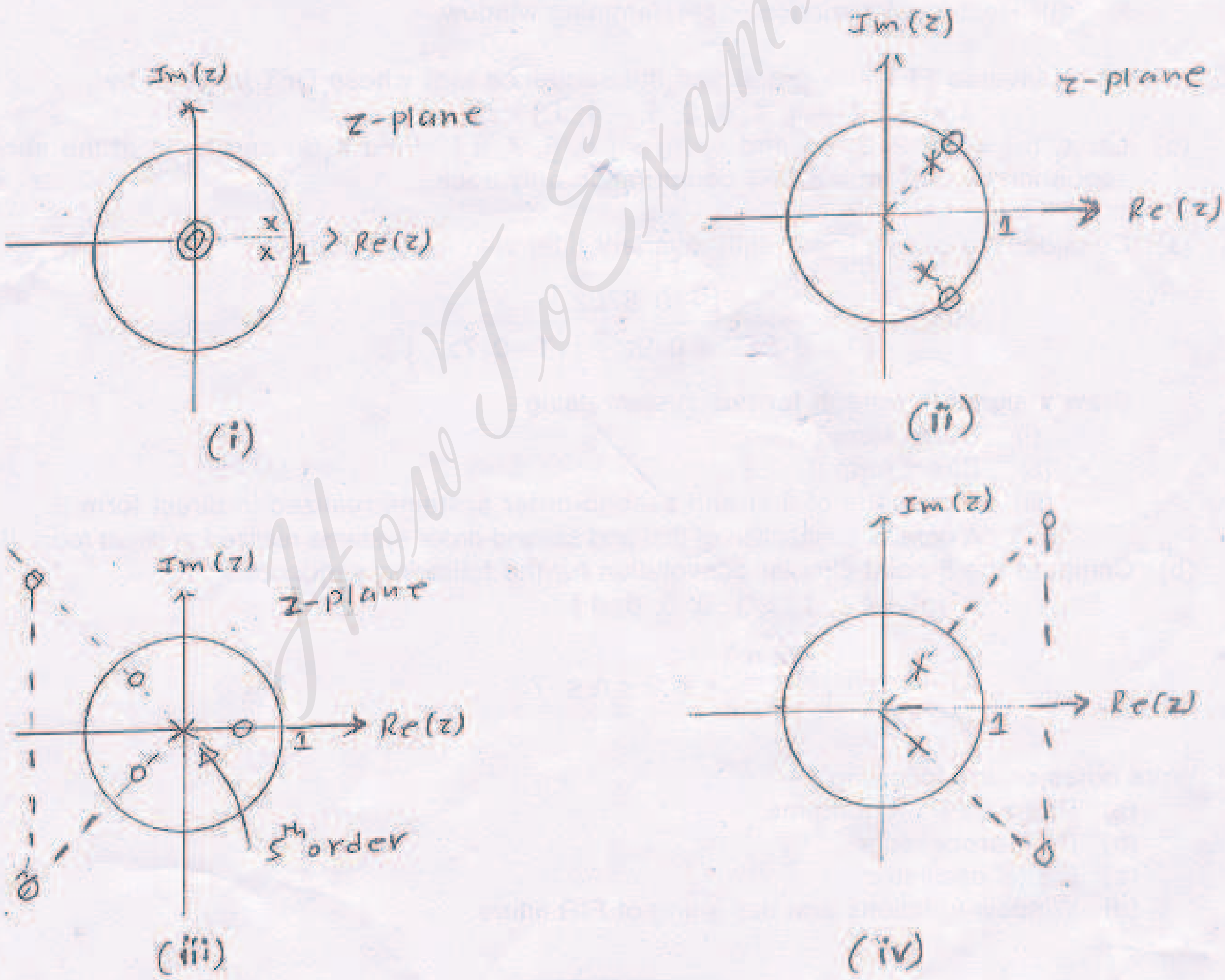
1. (a) A second order all-pass filter has a zero at $0{\cdot}5 \angle 160°$. Find the location of other poles and zeros and sketch the pole-zero plot in the z-plane. Also, find the system transfer function. 5

(b) Show that the zeros of a linear phase FIR filter occur at reciprocal locations. Also, show that FIR filter with anti-symmetric impulse response and odd length will have compulsory zeros at $z = \pm 1$. 5

(c) Compute the DFT of the sequence $x(n) = \cos(n\pi/2)$, where $N = 4$, without using any FFT algorithm. 5

(d) Show the mapping from s-plane to z-plane using impulse invariance method and explain its limitation. 5

2. (a) Identify the following systems based on their pass-bands, FIR/IIR, minimum/maximum phase, linear/non-linear phase, stable/unstable system etc. Explain your answer with appropriate reason. 12



(b) DT-LTI system is characterized by the transfer function 8

$$H(z) = \frac{z(3z-4)}{\left(z-\frac{1}{2}\right)(z-3)}$$

Specify the ROC of H(z) and determine h(n) for
(i) The system is stable (ii) The system is causal (iii) The system is anticausal.

T. E(Elect) Sem VI Rev Signal Processing – II 13/12/07

3. (a) For the difference equation given below : 10

$$y(n) + b^2 y(n - z) = 0 \qquad \text{for } n \geq 0.$$

where initial conditions are $y(-1) = 0$ and $y(-z) = -1$.

Prove that $y(n) = b^{n+2} \cos\left(\frac{n\pi}{2}\right)$

(b) Sketch the magnitude and phase response of a system with impulse response ; $h(n) = \{1, 2, 2, 1\}$ over the frequency range -3π to 3π. 10

4. (a) A digital low-pass filter is required to meet the following specifications : 10

Pass band ripple	:	≤ 1 dB
Pass band edge	:	4 kHz
Stop band attenuation	:	≥ 40 dB
Stop band edge	:	6 kHz
Sampling rate	:	24 kHz

Find the order of Butterworth and Chebyshev filter using bilinear transformation.

(b) A low-pass filter has the response 10

$$H_d(e^{jw}) = 2 \cdot e^{-jw\alpha} \qquad \text{for } \frac{-\pi}{2} \leq w \leq \frac{\pi}{2}$$

$$= 0 \qquad \text{otherwise}$$

Find h (n) for transition width $< \frac{\pi}{32}$.

Calculate the window length and the value of 'α' for—

(i) Rectangular window, (ii) Hamming window.

5. (a) Using inverse FFT flow-graph find the sequence x(n) whose DFT is given by : 10

$$X(k) = \{2, -1, 4, 6, 2, 6, -4, 1\}$$

(b) Let $x_1(n) = \{1, 2, 3, 4\}$ and $x_2(n) = \{5, 6, 7, 8\}$. Find $X_1(k)$ and $X_2(k)$ of the above sequence by performing DFT computation only once. 10

6. (a) Consider the causal linear shift-invariant filter with system function 10

$$H(z) = \frac{1 + 0.875z^{-1}}{\left(1 + 0.2z^{-1} + 0.9z^{-2}\right)\left(1 - 0.7z^{-1}\right)}$$

Draw a signal flowgraph for this system using :

(i) Direct form I

(ii) Direct form II

(iii) A cascade of first and second-order systems realized in direct form II.

(iv) A parallel connection of first and second-order systems realized in direct form II.

(b) Compute the 8-point circular convolution for the following sequences : 10

$$x_1(n) = \{1, 1, 1, 1, 0, 0, 0, 0\}$$

$$x_2(n) = \sin\left(\frac{3\pi n}{8}\right), \quad 0 \leq n \leq 7.$$

7. Write notes on the following :— 20

(a) Radix-2 FFT algorithms

(b) DSP processors

(c) Digital oscillator

(d) Window functions and designing of FIR filters.
