Name :	
Roll No. :	
Invigilator's Signature :	

CS/M.Tech (ECE)/SEM-2/MEC-1004B/2010 2010 DSP AND APPLICATIONS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks. Candidates are required to give their answers in their own words as far as practicable. Answer any five questions $5 \times 14 = 70$

Answer any *five* questions. $5 \times 14 = 70$

1. a) What are the advantages of digital signal processing

over analog signal processing ?

- b) What do you mean by LTI system ?
- c) Test if the following systems are LTI or not :
 - i) y[n] = nx[n]
 - ii) y[n] = Ax[n] + B.
- d) Determine the energy of the following sequence :

$$x[n] = \begin{cases} \left(\frac{1}{2}\right)^n & \text{for } n \le 0 \\ 0 & \text{for } n < 0 \end{cases} \qquad 3 + 2 + 3 + 3 + 3$$

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2. a) Define convolution.



b) Determine the convolution sum of the following two sequences using graphical method.

$$x[n] = \{3, 2, 1, 2\}; \quad h[n] = \{1, 2, 1, 2\}$$

c) Find the *z*-transform and ROC of the following signal :

$$x[n] = a^{n}u[n] - b^{n}u[-n-1]$$
 2 + 8 + 4

- 3. a) Compare the IIR filter with the FIR filter.
 - b) What is bilinear transformation ? Prove that in bilinear transformation the mapping from *s* plane to *z* plane is $s = \frac{2}{T} \frac{(1-z^{-1})}{(1+z^{-1})}.$
 - c) What is warping effect and what is its consequence ? How can you avoid this effect ? 3 + 7 + 4
- 4. a) Given the specification $\alpha_p = 1$ dB, $\alpha_s = 30$ dB, $\Omega_p = 200$ rad/sec and $\Omega_s = 600$ rad/sec. Determine the order of the filter.
 - b) Design a digital Butterworth filter satisfying the constraints

$$0 \cdot 707 \le \left| H\left(e^{j\omega}\right) \right| \le 1 \quad \text{for } 0 \le \omega \le \frac{\pi}{2}$$
$$\left| H\left(e^{j\omega}\right) \right| \le 0 \cdot 2 \qquad \text{for } \frac{3\pi}{4} \le \omega \le \pi$$

with T = 1 sec using the bilinear transformation. 3 + 11

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- b) Describe in detail any one type of window method of designing a FIR filter.
- c) What are the desirable properties of a "window" ?

3 + 8 + 3

6. Design an ideal high-pass filter with a frequency response

$$H_d(e^{j\omega}) = 1 \quad \text{for } \frac{\pi}{4} \le |\omega| \le \pi$$
$$= 0 \quad \text{for } |\omega| \le \frac{\pi}{4}$$

5.

a)

Find the values of h[n] for N = 11. Use rectangular window. Determine the frequency response of the designed filter. 14

- 7. a) Find the DFT of a sequence $x[n] = \{1, 1, 0, 0\}$ and IDFT of $Y(k) = \{1, 0, 1, 0\}$.
 - b) Find the DFT of a sequence x[n] = { 1, 2, 3, 4, 4, 3, 2, 1 }
 using DIT algorithm. 6 + 8
- 8. Write short notes on any *two* of the following : 7 + 7
 - i) Two-dimensional signal processing
 - ii) Architecture of Digital Signal Processor
 - iii) Weiner filter.

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