Subject: Digital Signal Analysis and Processing

Candidates are required to give answers in their own words as far as practicable.
The figure in the margin indicates full marks. Assume suitable data if necessary.
Attempt all the questions.

1.	a)	What is digital Signal processing? Name the basic elements of digital signal processing and briefly explain each of them. List any two advantages of Digital signal processing.	8
	b)	Given a discrete time signal $x[n] = \{1, 1, 1, 1, \frac{1}{2}, \frac{1}{2}\}$, i. sketch $x[n]$, ii. Sketch $x[2-n]$ and iii. Determine $x[n]u[2-n]$	7
2.	a)	Verify the commutative property of convolution where input signal, x[n] = {1, 1, 1, 1} and response of system, h[n] = {1, 1, 1, 1}.	8
	b)	What are the two major characteristics of ROC? Determine the inverse z-transform of: $H(z) = \frac{1+2z^{-1}+z^{-2}}{1+4z^{-1}+4z^{-2}}$ (choose any one of the methods)	7
3.	a)	Define DFT and IDFT. Explain DFT as a linear transformation.	8
	b)	Find the circular convolution of the sequence: $x(n) = \{0,1,2,3\}$ $h(n) = \{2\ 1,1,2\}$	7
4.	a)	Determine the 4-point DFT of the following sequence using DIF FFT radix-2 algorithm: $x(n) = u(n) - u(n-4)$	8
	b)	Draw the lattice structure from the given FIR filter's system function: $H(z) = 1 + \frac{13}{12}z^{-1} + \frac{5}{8}z^{-2} + \frac{1}{3}z^{-3}$ **OR** Given a 3-stage lattice filter with coefficient $K_1 = \frac{1}{4}, K_2 = \frac{1}{2}$ *and* $K_3 = \frac{1}{3}$. Draw the corresponding FIR filter direct form I or II model.	7
5.	a)	Design a normalized linear phase FIR filter having the phase delay of 4 and attenuation of at least 40 dB in the stopband. Also obtain the magnitude response of the filter. **OR** Design a linear FIR phase filter using kaiser window to meet the following specifications: - $0.99 \le \lvert H(e^{j\omega})\rvert \le 1.01$ for $0 \le \lvert\omega\rvert \le 0.19\pi$	8

	$\lvert H(e^{iw})\rvert \leq 0.01, for\ 0.21\pi \leq \lvert w\rvert \leq \pi$ **b)** Design a lowpass FIR filter using frequency sampling technique having cut off frequency of $\frac{\pi}{2}$ rad/sample. The filter should have linear phase of 4 and length of 17.	7
6.	**a)** The transfer function of an analog lowpass filter is $H_a(s) = \frac{1}{s+1}$, and its bandwidth is 1 rad/sec. Design the digital IIR filter using Bilinear transformation method whose cut-off frequency is 0.2π and sampling interval is 0.0167 sec. **b)** Find the order and cut-off frequency of a digital filter by using impulse invariance method with the following specifications: $0.89 \leq \lvert H(e^{jw})\rvert \leq 1$, for $0 \leq w \leq 0.4\pi$ $\lvert H(e^{jw})\rvert \leq 0.18$, for $0.4\pi \leq w \leq \pi$ Also, plot its poles.	7 8
7.	**Write short notes on:** *(Any two)* **a)** Necessary and sufficient condition for a system to be stable **b)** Gibbs Phenomena in FIR filter design. **c)** LTI system	**2×5**

*** ***Best of Luck*** ***