

Name :

Roll No. :

Invigilator's Signature :

CS/M.Tech (ECE)/SEM-2/MVLSI-202/2013

2013

DIGITAL SIGNAL PROCESSING & 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.

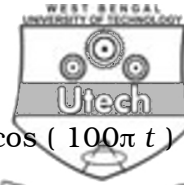
Answer any five questions taking at least one from each Group.

GROUP – A

1. Consider the system described by the following difference equation :

$$y(n) - y(n-1) + 0.25y(n-2) = x(n) - 0.25x(n-1)$$

- a) Realize the system using adder, subtractor and delay units. If the adder/subtractor and multiplier units need t_a and t_m units respectively then find out the minimum sampling period. 4 + 2
- b) Find out the unit sample response of the system. 4
- c) Find out the response of the system to $x(n) = (0.25)^n U(n)$. 4



2. Consider the CT signal $x(t) = \cos(20\pi t) + \cos(100\pi t)$:

a) What are the corresponding “digital” frequencies ω_1 and ω_2 (in radians/sample) ? What should be the minimum sampling frequency ? 3 + 3

b) Write expression for the equivalent digital signal $x(n)$. 2

c) Find out the Z-transform of

i) $\cos(\omega_0 n) U(n)$

ii) $U(n)$. 6

3. a) Determine whether or not the signals below are periodic or not. For each signal that is periodic, find out the fundamental period.

i) $x(n) = \cos(0.125\pi n)$

ii) $x(n) = \sin(\pi + 0.02n)$. 2 × 2

b) Express the signal $x(n)$ as a sum of scaled and shifted unit steps : 4

$$x(n) = \{ 1 \text{ for } n = 0, 2 \text{ for } n = 1, 3 \text{ for } n = 2, 0 \text{ else } \}$$

c) Consider a signal which is pulse having sample on and off periods, time period (T) is 20 msec and the peak value is 5 unit. Find out the d.c. value and 3rd harmonics of the signal. 3 × 2



GROUP – B

4. a) A system is characterized by the difference equation

$$y(n) = y(n - 1) - y(n - 2) + 0.5x(n) + 0.5x(n - 1)$$

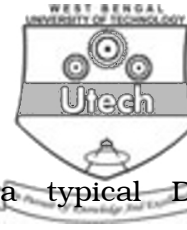
 Find the response of the system to the input

$$x(n) = (0.5)^n u(n)$$
 with initial condition

$$y(-1) = 0.75$$
 and
$$y(-2) = 0.25.$$
 6
- b) Consider a discrete sequence

$$x(n) = \{4, 2, 4, 4, 2, 4, 4, 2\}$$
 for $n = 0, 1, 2, \dots$. Find
 out the Fourier transform $X(k)$ for $k = 3$. 4
- c) Find out the Z-transform of the above sequence. 4
5. a) Realize the equivalent digital (using adder, multiplier,
 delay etc.) for the LSI system described by the
 difference equation

$$y(n) = y(n - 1) - y(n - 2) + 0.5x(n) + 0.5x(n - 1)$$
 5
- b) What is bi-linear transformation ? Prove the relation
 between S and Z. 1 + 4
- c) Transfer function of a continuous time system is given
 by $H(S) = 1/S^2$. Derive the equivalent digital circuit. 4
6. A normalized Butterworth filter needs to be designed with the
 following specifications :
- Passband edge = 0.7 rad/sec, stopband edge = 0.2 rad/sec,
 maximum passband loss = 0.5 dB, Minimum stop band
 loss = 30 dB
- a) Find out the minimum filter order. 6
- b) Find out the transfer function $H(S)$ of the filter. 6
- c) Find out $H(Z)$ of the filter. 2



GROUP – C

7. a) What are the typical features of a typical DSP Processor ? 2
- b) Explain clearly the following :
- i) Circular addressing scheme
 - ii) Zero overhead loop
 - iii) Single cycle execution
 - iv) Harvard architecture. 6
- c) Give the block diagram of ADSP2181 and indicate the salient features. 6
8. a) What are the possible different platforms to implement DSP algorithms and discuss their advantages and drawbacks. 3 + 3
- b) What is Look Up Table (LUT) ? How a Boolean expression can be implemented using LUT ? Explain with an example. 2 + 2
- c) With a block diagram explain the operation of FPGA. 4
9. a) Derive the mathematical expression to arrive at the FFT algorithm for the Discrete Fourier Transform (DFT). Give the structure of a 8-point FFT computation. 3 + 3
- b) What is the drawback of Fourier Transform ? Explain with an example. What do you mean by “Short term Fourier Transform” ? 1 + 1
- c) Explain clearly the principle of “Wavelet transform” and discuss its advantage over the “Short term Fourier Transform”. 6
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