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06EC74

# Seventh Semester B.E. Degree Examination, December 2010
# DSP Algorithms and Architecture

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer any FIVE full questions, selecting at least TWO questions from each part.***



## PART – A

1 a. An analog signal is sampled at the rate of 8 kHz. If 512 samples of this signal are used to compute DFT, X(k), determine the analog and digital frequency spacing between adjacent X(k) elements. Also, determine analog and digital frequencies corresponding to k = 64. **(06 Marks)**

b. With a neat block diagram, explain the scheme of a DSP system. **(08 Marks)**

c. Let x(n) = [3, 2, - 2, 0, 7]. It is interpolated using an interpolation filter $b_k$ = [0.5, 1, 0.5], with interpolation factor 2. Determine the interpolated sequence. **(06 Marks)**

2 a. Draw the schematic diagram of the saturation logic and explain the same. **(06 Marks)**

b. Explain how the circular addressing mode and bit reversal addressing mode are implemented in a digital signal processor. **(08 Marks)**

c. Explain the purpose of program sequencer. **(06 Marks)**

3 a. Identify the addressing mode of the source operand in each of the following instructions:
i) ADD *AR2, A ii) ADD *AR2+, A iii) ADD *AR2+%, A
iv) ADD #OFFh, A v) ADD ABCDh, A vi) ADD *AR2+OB, A **(06 Marks)**

b. Explain the PMST register. **(08 Marks)**

c. With an example each, explain immediate addressing mode, absolute addressing mode, direct addressing mode. **(06 Marks)**

4 a. Differentiate between MAC & MACD instructions by way of explaining them. **(06 Marks)**

b. Write a program to find the sum of series of signed numbers as specified below.

$$A = \sum_{i=410h}^{41Fh} x(i)$$

Assume AR1 as pointer to x(i) and AR2 as counter for the numbers. **(06 Marks)**

c. By means of a figure, show the pipeline operation of the following sequences of TMS320C54XX instructions. Assume initial value of AR3 is 80h and the values stored in memory locations 80h, 81h, 82h as 1, 2 & 3.

```
LD *AR3+, A
ADD #1000h, A
STL A, *AR3+
```

**(08 Marks)**

## PART – B

5 a. i) Determine the value of each of the following 16-bit numbers represented using the given Q-notation 4400h as a Q0 number, 4400h as a Q15 number and 4400h as a Q7 number.

ii) Represent each of the following as 16-bit numbers in the desired Q-notation. 0.3125 as a Q15 number, -0.3125 as a Q15 number and 3.125 as a Q7 number. **(06 Marks)**

b. Analyze the following program to answer the questions at the end. Assume that all specified data locations are on the same page starting at ao. Q15 notation is assumed.

```
.data
    ao      .word  6000h
    b1      .word  2000h
    xn      .word  4000h
    yn      .word  0h
    ynm1    .word  3000h
.text
    ld      #ao, dp
    ld      ao, t
    mpy     xn, a
    ld      b1, t
    mac     ynm1, a
    sth     a, 1, yn
```

i) Determine the decimal values represented by yn.

ii) Determine the equation for yn implemented by the above program. **(06 Marks)**

c. Write a program to multiply two Q15 numbers. **(08 Marks)**

6 a. i) Derive the equation to implement a butterfly structure in DITFFT algorithm.

ii) How many add/subtract and multiply operations are needed to compute the butterfly structure?

iii) Determine the optimum scaling factor. **(08 Marks)**

b. i) What minimum size FFT must be used to compute a DFT of 40 samples?

ii) How many stages are required for FFT computation?

iii) How many butterflies are there per stage?

iv) How many butterflies are needed for the entire computation? **(04 Marks)**

c. Write the subroutine for bit reverse address generation. Explain the same. **(08 Marks)**

7 a. Draw the timing diagram for memory interface for read-read-write sequence of operation. Explain the purpose of each signal involved. **(08 Marks)**

b. Explain the register subaddressing technique for configuring DMA operation. **(06 Marks)**

c. Explain the ADC interface in programmed I/O mode. **(06 Marks)**

8 a. With a neat block diagram and timing diagram for both transmit and receive, explain the signals involved in synchronous serial interface. **(08 Marks)**

b. Explain how PPM signal is decoded at the receiving end using digital signal processor. **(06 Marks)**

c. Write a pseudo algorithm for determining heart rate (HR), using the digital signal processor. **(06 Marks)**

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