DSP and Embedded Systems (EE 703)

Full Marks: 70   **Time: 3 hrs**

Use separate answer script for each half
Attempt no. of questions as indicated in each half
Two marks reserved for neatness in each half

FIRST HALF

Answer Q. no1 and *any Two* from the rest

1. With respect to the PIC 16F877 microcontroller, fill in the blanks.

   a) The peripheral module that detects the transition of an external signal from a low state to a high state is the …………………………… [2]

   b) The reset that is triggered when the supply voltage falls below a limit is the ………… [1]

   c) The ……………oscillator makes the microcontroller operate at the highest frequency of …………… [2]

   d) The Data Memory is categorized into……….…..., …………. and ………… [3]

   e) The type of program memory is ………….. and its size is………………… [2]

   f) The CPU of the microcontroller is of the ……………… Type. [1]

2. a) Desribe the various types of RESET in the PIC Microcontroller and their significance.

   b) Write a program in ALL for the PIC 16F877 microcontroller to perform ANDing operation of the contents of memory location 20H and 25H. [5 + 6]

3. a) Draw the base architecture of the ADSP 2101 showing all the functional units.

   b) Enumerate in brief the functional units in the ADSP 2101 that are most suited to carry out the digital filtering operations. [6 + 5]

4. a) What is the principle for extracting a waveform of desired frequency from an aperiodic signal composed of several unknown frequencies? Give an example of signal processing required to extract a particular frequency in power system application.

   b) What is aliasing in signal processing? Is it desirable, if not what precautions to be taken to prevent it?

   c) Given a sequence of samples
      x[k]= [1,2,2,1]
      h[k]= [1,2,3]
   Find out the convolution sum y[k]=x[k]*h[k] [3 + 3 + 5]

5. a) Write a program in ALL for the ADSP2101 to find the sum of the series $S = 1^2 + 2^2 + 3^2 + $ ………+N^2. Draw a flowchart then proceed.

   b) The Fourier Series is a special type of Fourier Transform -- Justify [7 + 4]

6. a) What are the relative advantages and disadvantages of using fixed point / floating point arithmetic in DSPs?

   b) Express the fraction (-9/32) in (i) sign magnitude (ii) 2's complement notations, using 6 bits.

   c) Distinguish between INF and NaN errors.

   d) What is scaling in connection with a DSP and why is it necessary?   [2 + 3 + 3 + 3]

7. a) If A=5.625, B=3.375 and C= 1.75, then find out 2A − (B +C) using 16 bit 2's complement fixed point arithmetic. (Choose a suitable Q format)

   b) How is DSP used in speech processing? With a neat block diagram, briefly explain one application of DSP in this field.

   c) If a 12-bit DSP with +/- 5V output, feeds data to a 16 bit DSP using Q3.12 fixed point data format, then what is the maximum possible error?   [5 + 4 + 2]

8. a) What is Ethernet? Which network topology is adopted in it? What are the drawbacks of such a topology and which topology eliminates these drawbacks? Which topology is adopted in the world-wide-web?

   b) Distinguish between MAC address and IP address.

   c) What is the function of a 'router'?   [5 + 3 + 3]

9. a) What is meant by a real-time system? Give an example. Are all real-time systems embedded?

   b) What are the advantages of 'Programmable Logic Devices' over ASICs?

   c) Realize a T (Toggle) Flip-flop circuit in VHDL using dataflow / structural / behavioural mode (you may mix all three) of programming.   [4 + 3 + 4]

10.a) Realize the following digital function in a PAL and an FPGA: Y = A'B'C + BD + ABC'

   b) Distinguish between JTAG and AS modes of FPGA programming.

   c) Show how in real time simulation, an FPGA is able to calculate and update the state variables within one clock cycle.   [5 + 3 + 3]