# EMBEDDED SYSTEMS DESIGN
## (VLSI 5102)

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

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and*
*any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

## Group – A
## (Multiple Choice Type Questions)

1. Choose the correct alternative for the following:                 **10 × 1 = 10**

   (i)    The locality of reference justifies the use of
          (a) Flash memory                      (b) Cache memory
          (c) Main memory                       (d) Virtual memory.

   (ii)   Primary agent responsible for correct working of an embedded system is
          (a) GPOS          (b) RTOS          (c) UNIX          (d) WINDOWS.

   (iii)  Property which does not characterize an embedded system is
          (a) random output                     (b) real time output
          (c) low manufacturing cost            (d) low power consumption.

   (iv)   An RTOS shall always have
          (a) time sensitive response           (b) use of virtual memory
          (c) non-deterministic output          (d) high interrupt latency.

   (v)    Three key technologies used for embedded systems are processor technology, _____ technology, and design technology.
          (a) system        (b) IC            (c) gaming        (d) computer

   (vi)   Which is not an embedded processor?
          (a) ARM 7         (b) ARM 9         (c) AMD 29050     (d) IBM 370.

   (vii)  The logic family with the fastest speed of execution is
          (a) TTL           (b) RTL           (c) CMOS          (d) ECL.

   (viii) DMA can be used to transfer data directly between memory and a
          (a) peripheral unit                   (b) flipflop
          (c) counter                           (d) register.

   (ix)   How many separate address and data lines are needed for a RAM memory 16 K × 8?
          (a) 10 addresses, 16 data lines       (b) 14 addresses, 8 data lines
          (c) 12 addresses, 16 data lines       (d) 12 addresses, 12 data lines.

   (x)    A Reaction timer may record the _____ elapsed between the turning an indicator lamp and the corresponding pressing of an response button.
          (a) picture       (b) sound         (c) image         (d) time.

## Group – B

2. (a)   Which are the common characteristics of an embedded system?

   (b)   Which are the design-metrics normally optimized to meet the design challenges of an embedded system?

   (c)   Illustrate the basic steps for design of a custom Single Purpose Processor Design.
                                                                 **3 + 3 + 6 = 12**

3. (a)   Explain with examples what is a real time system? What are the differences between a RTOS and a GPOS?

   (b)   Explain Real Time classification as "hard", "firm" and "Soft" with examples. Where would one categorize the "Automatic Flight Control of Air plane".
                                                                 **6 + 6 = 12**

## Group – C

4. (a)   What is Harvard Architecture? Explain briefly using a block diagram.

   (b)   Explain ARM Cortex 8 instruction Fetch Decode unit and Execute unit.

   (c)   A 4 stage pipeline system takes 20 ns to process a sub operation in each stage. The pipeline executes 100 tasks in sequence. What is the speed up ratio?
                                                                 **4 + 4 + 4 = 12**

5. (a)   Explain what is a Watch Dog Timer.

   (b)   Describe I2C BUS protocol.
                                                                 **6 + 6 = 12**

## Group – D

6. (a)   Describe the main registers and the register bank operation of 8051 Controller. With example explain what are SFR registers.

(b)   List the I/O ports and their sizes for 8051, and briefly describe their functions.

**6 + 6 = 12**

7.   (a)   Explain briefly the ARM processor architecture and memory organization with block schematic.

(b)   Explain the functions of Distributed Interrupt Controller for ARM 11 processors.

(c)   What is a Snoop Control Unit in ARM 11?

**(3 + 3) + 4 + 2 = 12**

## Group – E

8.   (a)   Distinguish between SRAM and DRAM. Explain their reading and writing operation.

(b)   An 8 bit DAC has a resolution of 15 mV/LSB. Determine (i) Full scale output voltage $V_{fs}$ and (ii) Output voltage when the input digital word is "0001 0010".

**6 + 6 = 12**

9.   (a)   Why is DMA based I/O better than other I/O techniques?

(b)   Distinguish between I/O mapped I/O and memory mapped I/O with proper examples.

(c)   Explain the concepts of vectored and non-vectored interrupts.

**4 + 4 + 4 = 12**