

**EMBEDDED SYSTEMS DESIGN  
(VLSI 5102)**

**Time Allotted : 2½ hrs**

**Full Marks : 60**

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

*Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.*

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

**Group – A**

1. Answer any twelve:

**12 × 1 = 12**

*Choose the correct alternative for the following*

- (i) System which is strictly not embedded is a
  - (a) digital camera
  - (b) treadmill
  - (c) vending machine
  - (d) personal laptop.
- (ii) Property which does not characterize an embedded system is
  - (a) random output
  - (b) real time output
  - (c) low manufacturing cost
  - (d) low power consumption.
- (iii) A Personal Laptop is strictly not an
  - (a) computer system
  - (b) embedded system
  - (c) number cruncher
  - (d) adding machine.
- (iv) The number of active elements in a DRAM cell is
  - (a) 1
  - (b) 2
  - (c) 6
  - (d) 9.
- (v) The logic family which takes the least power is
  - (a) TTL
  - (b) RTL
  - (c) CMOS
  - (d) ECL.
- (vi) Primary agent responsible for correct working of an embedded system is
  - (a) GPOS
  - (b) RTOS
  - (c) UNIX
  - (d) WINDOWS.
- (vii) Basic instruction execution cycle consists of
  - (a) read, write, store
  - (b) fetch, decode, execute
  - (c) decode, fetch, store
  - (d) read, fetch, store.
- (viii) The 8051 microcontroller has a word size of
  - (a) 64 bit
  - (b) 32 bit
  - (c) 8 bit
  - (d) 16 bit.

- (ix) Watch dog timers enable an embedded system to
  - (a) reduce overhead
  - (b) reduce unit cost
  - (c) restart in case of failure
  - (d) improve efficiency.
- (x) How many separate address and data lines are needed for a RAM with a size of 16K x 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.

*Fill in the blanks with the correct word*

- (xi) An address decoder with 'n' number of input lines will have \_\_\_\_\_ number of output lines.
- (xii) In 8051 microcontroller, the size of the internal RAM is \_\_\_\_\_ bytes.
- (xiii) Three key technologies used for embedded systems are processor technology \_\_\_\_\_ technology, and design technology.
- (xiv) Computers with R/M architecture have instructions which can operate both on registers with one of operands in \_\_\_\_\_.
- (xv) Direct data transfer between memory and a peripheral can be done by \_\_\_\_\_.

### Group - B

- 2. (a) Which are the common characteristics of an embedded system? [[CO1](Understand/LOCQ)]
- (b) Describe about the time-to-market design metric for an embedded system and derive an expression for percentage revenue loss in terms of delay. [[CO1](Analyze/IOCQ)]
- (c) Explain the NRE and unit cost design metrics with proper examples. [[CO1](Understand/LOCQ)]  
**3 + (3 + 2) + 4 = 12**
- 3. (a) What is application specific processor? Why are these processors preferred for embedded system designs? [[CO1](Understand/LOCQ)]
- (b) Describe the different IC technologies used to fabricate embedded system processors. [[CO1](Remember/LOCQ)]
- (c) Explain the ideal top-down design process for any embedded system. [[CO1](Understand/LOCQ)]  
**4 + 4 + 4 = 12**

### Group - C

- 4. (a) Explain the concepts of watch dog timer and reaction timer. Mention applications of both the timers. [[CO3](Remember/LOCQ)]
- (b) What is a keyboard bouncing effect? What is the debouncing procedure? [[CO4](Apply/LOCQ)]  
**(4 + 3) + (2 + 3) = 12**

5. (a) Design a PAL to realize these two following functions:  
 $Y1 = A B'C + A'B$  and  $Y2 = A'BC + AB'$ . [[CO2](Apply/IOCQ)]
- (b) Realize the following function using a multiplexer:  
 $F(A,B,C, D) = \sum_m (0, 3, 5, 6, 9, 10, 12, 15)$  [[CO2](Create/HOCQ)]
- (c) Explain working principle of RS232 communication protocol between two devices. [[CO2](Understand/LOCQ)]
- (2 + 2) + 4 + 4 = 12**

### Group - D

6. (a) Elaborate the program status word (PSW) of 8051 microcontroller. [[CO3](Understand/LOCQ)]
- (b) Describe the internal RAM organization of 8051 microcontroller. [[CO3](Understand/LOCQ)]
- (c) Add the unsigned numbers found in internal RAM locations 25H, 26H and 27H together and put the result in RAM locations 30H (MSB of Sum) and 31H (LSB of SUM). [[CO3](Create/HOCQ)]
- 4 + 4 + 4 = 12**
7. (a) Explain briefly the ARM processor architecture with block schematic. [[CO4](Understand/LOCQ)]
- (b) Analyze the serial data transmission modes with 8051 microcontroller. [[CO3](Analyze/IOCQ)]
- (c) The number A6h is placed somewhere in the external RAM between locations 0100h and 0200h. Write a program for 8051 microcontroller to find the address of that location and put that address in R6 (LSB) and R7 (MSB). [[CO5](Create/HOCQ)]
- 4 + 4 + 4 = 12**

### Group - E

8. (a) What are the common memory types? [[CO5](Remember/LOCQ)]
- (b) Analyze the operation of floating gate n-channel MOSFET as a programmable switch in PROM. [[CO5](Analyze/IOCQ)]
- (c) Design an  $8 \times 4$  size EPROM using floating Gate MOSFETs as programmable switches. [[CO5](Create/HOCQ)]
- 3 + 4 + 5 = 12**
9. (a) Why DMA based I/O transfer is superior over other I/O transfer modes? [[CO3](Analyse/LOCQ)]
- (b) Mention the primary differences between memory mapped I/O and isolated I/O. [[CO4](Remember/LOCQ)]
- (c) Explain DMA data transfer Master and Slave mode. [[CO2](Apply/IOCQ)]
- 4 + 4 + 4 = 12**

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	60.42	21.88	17.7

**Course Outcome (CO):**

After the completion of the course students will be able to:-

1. Students will learn Embedded System Design Methodology
2. Students will learn Embedded Processor Design
3. Students will learn 8051 Micro-controller
4. Students will learn basics of PIC & ARM Micro-controller
5. Students will learn Embedded Memory Architecture and Interface
6. Students will learn I/O Device configurations and Interfacing

*\*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question*