EMBEDDED SYSTEMS DESIGN
(VLI5102)

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

(ii) Which design metric is crucial for safety-critical systems like medical devices and automotive systems?
(a) Cost (b) Reliability
(c) Power consumption (d) Security

(iii) What is the primary advantage of using a finite state machine (FSM) model for designing custom single-purpose processors?
(a) High performance (b) Low power consumption
(c) Modular design (d) Ease of verification

(iv) Which hardware description language (HDL) is commonly used for RTL design of custom single-purpose processors?
(a) C++ (b) Python
(c) Verilog (d) Java

(v) What is the baud rate in serial communication?
(a) The number of bits transmitted per second
(b) The number of bytes transmitted per second
(c) The number of packets transmitted per second
(d) The number of errors detected per second

(vi) Which special function register (SFR) is used to control the timer mode of operation?
(a) TMOD (b) TCON
(c) TH0 (d) TL0

(vii) How many 16-bit timers does the 8051 microcontroller have?
(a) 1 (b) 2
(c) 3 (d) 4

(viii) What is the primary function of cache memory?
(a) To store data permanently (b) To increase the speed of data access
(c) To store the operating system (d) To store user data

(ix) Which technique is commonly used to eliminate spurious key presses in keypad interfacing?
(a) Debouncing (b) Multiplexing
(c) Filtering (d) Amplification

(x) The storage element in SRAM is typically made using
(a) Capacitor (b) Flip-flop
(c) Diode (d) Magnetic core

Fill in the blanks with the correct word

(xi) The number of tasks can be performed per unit time by any embedded system is called as _____.

(xii) The first designed working version of any embedded system is termed as _____.

(xiii) _____ is a serial communication protocol standard for serial communication over long distances.

(xiv) The timers in 8051 microcontroller can be used in _____ different modes.

(xv) In SRAM, each memory cell is made up of _____ transistors.

Group - B

2. (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)]*

6 + 6 = 12

3. (a) What is the difference between a microcontroller and a microprocessor? *[(CO1)(Analyse/IOCQ)]*
(b) What are the common debugging techniques for embedded systems? *[(CO1)(Remember/LOCQ)]*
(c) How can you ensure the quality and reliability of an embedded system? *[(CO1)(Understand /LOCQ)]*

4 + 4 + 4 = 12

Group - C

4. (a) Explain the concept of instruction pipelining. *[(CO2)(Understand /LOCQ)]*

(b) Describe the different pipelining hazards in embedded processors. *[(CO2)(Understand /LOCQ)]*

(c) Explain the application of watchdog timer in embedded system. *[(CO2) (Apply/IOCQ)]*

4 + 4 + 4 = 12

5. (a) Describe the steps involved in designing a custom processor, from specification to physical implementation. *[(CO2)(Understand/LOCQ)]*

(b) What are the challenges and trade-offs in custom processor design? *[(CO2)(Analyse/IOCQ)]*

(c) What is pipelining and how does it improve processor performance? *[(CO2)(Analyse/IOCQ)]*

4 + 4 + 4 = 12

Group - D

6. (a) Explain the various modes of timer operations in the 8051 microcontroller. *[(CO3) (Understand/LOCQ)]*

(b) Elaborate the program status word (PSW) of 8051 microcontroller. *[(CO3)(Understand/LOCQ)]*

7 + 5 = 12

7. (a) Explain the timer/counter control logic circuit for 8051 microcontroller. *[(CO3)(Analyze/IOCQ)]*

(b) Explain the role of the TMOD register in 8051. *[(CO3)(Understand /LOCQ)]*

(c) Write an assembly language program for 8051 microcontroller to double the number in register R2 and put the result in registers R3 (high byte) and R4 (low byte). *[(CO3)(Apply/IOCQ)]*

4 + 4 + 4 = 12

Group - E

8. (a) Describe the interfacing of any analog to digital data converter (ADC) with the 8051 microcontroller. *[(CO6)(Apply/IOCQ)]*

(b) An 8 bit digital to analog data converter (DAC) has a resolution of 15 mV/LSB. Determine:
(i) the full scale output voltage?
(ii) the output voltage when the input digital word is '0001 0010'.
[(CO6)(Apply/IOCQ)]

6 + 6 = 12

9. (a) Explain the necessity of memory refresh cycles in DRAM. *[(CO5)(Understand/LOCQ)]*

(b) Discuss the role of SRAM in cache memory and its impact on system performance. *[(CO5)(Analyze/IOCQ)]*

(c) Design a 4 × 4 size ROM and explain how data can be stored in it with proper example. *[(CO5)(Create/HOCQ)]*

4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	54.17	41.67	4.16