EMBEDDED SYSTEMS
(AEIE 3231)

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) In FPGA, the CLBs are interconnected using
(a) MUX (b) Data lines
(c) Interconnects (d) Wires

(ii) Which of the following is an example of Application Specific Instruction Set Processor (ASIP)?
(a) Adreno 610 (b) Intel Core 2 Duo
(c) 8086 Microprocessor (d) ATmega328 microcontroller

(iii) The instruction set of CISC processor is
(a) Simple and lesser in number (b) Complex and lesser in number
(c) Simple and larger in number (d) Complex and larger in number

(iv) Example of an on-board communication protocol is
(a) WiFi (b) I2C
(c) LAN (d) USB

(v) In I2C protocol, which pin is used to send clock signal?
(a) SCL (b) SDA
(c) MISO (d) MOSI

(vi) What are valid points about thread?
(a) Thread are subdivision of Process
(b) Thread can execute any part of process & same can be executed by multiple Threads.
(c) One or more Threads runs in the context of process.
(d) All of the above

(vii) Which one of the following takes more time to execute the process?
(a) Multiprogramming (b) Multiprogramming
(c) Multiprogramming (d) None of the above

(viii) What is the microcontroller used in the Arduino Uno board?
(a) ATmega32 (b) ATmega328P
(c) ATmega2560 (d) PIC16F877A

(ix) Which software is primarily used to program the Arduino Uno?
(a) Keil (b) MPLAB
(c) Arduino IDE (d) Code Composer Studio

(x) What is the maximum current output per I/O pin on the Arduino Uno?
(a) 10 mA (b) 20 mA
(c) 30 mA (d) 40 mA

Fill in the blanks with the correct word

(xi) The central processing unit of embedded system is called _____.

(xii) In embedded system gated clock improves _____.

(xiii) RS232 protocol is suitable for a distance up to _____ meter.

(xiv) To introduce a delay of 1 second in your code, you would use delay (_____).

(xv) The function used to read an analog input in Arduino programming is _____.

Group - B

2. (a) Describe briefly the differences between an embedded system and a conventional computer. *[(CO1)(Remember/LOCQ)]*
(b) Classify the embedded system based on generation. *[(CO1)(Remember/LOCQ)]*
(c) The NRE cost to manufacture a product is Rs.10,00,000/- and per unit cost is Rs.1200/-. Let, the product life is 200 weeks and the product is launched in the market by a delay of 4 week.
(i) What is the actual per unit cost to manufacture 5000 units of the embedded system?
(ii) Calculate the percentage revenue loss due to delayed product launch?
[(CO1)(Apply/IOCQ)]
4 + 4 + (2 + 2) = 12

3. (a) What are the advantages of compiler optimization? *[(CO1)(Remember/LOCQ)]*
(b) How does the constant propagation optimization technique improve code performance? Provide a specific code example to illustrate its application.
[(CO2)(Analyze/IOCQ)]
(c) Compare single-purpose processors (SPPs) and application specific instruction set processor (ASIP), outlining their key features, advantages, and limitations.
[(CO1)(Remember/LOCQ)]
2 + 4 + 6 = 12

Group - C

4. (a) Draw and discuss the 'Address Packet' format in I2C communication protocol.
[(CO3)(Remember/LOCQ)]
(b) Write the constraints of I2C communication protocol. *[(CO3)(Remember/LOCQ)]*

(c) Design an interfacing circuit to connect LM35 temperature sensor to PIC16F877 microcontroller using I2C data communication protocol. Write a program for PIC16F877 microcontroller to read data from the temperature sensor.

[(CO3) (Create/HOCQ)]

(1 + 2) + 2 + (2 + 5) = 12

5. (a) What is the function of 'SDA' and 'SCL' lines in I2C communication protocol?

[(CO3)(Remember/LOCQ)]

(b) Explain the 'START' and 'STOP' conditions of I2C communication protocol.

[(CO3)(Remember/LOCQ)]

(c) Design an interfacing circuit to connect one EEPROM (24AA256) to PIC16F877 microcontroller using I2C data communication protocol. Write a program for PIC16F877 microcontroller to write "78" at EEPROM location 0000. Read the data from memory location 0000 and display it on LEDs connected at Port D.

[(CO3) (Create/HOCQ)]

2 + 3 + (2 + 5) = 12

Group - D

6. (a) Define: Thread and Process. Describe structure and purpose of a Process Control Block. *[(CO5)(Remember/IOCQ)]*

(b) Write the Kernel services in an OS? *[(CO4) (Remember/LOCQ)]*

(1 + 1 + 6) + 4 = 12

7. (a) Write the significance of Memory Management in OS? Discuss about various types of Memory allocation techniques including their advantages and disadvantages.

[(CO4)(Analyse/HOCQ)]

(b) Explain the basic functions of real time kernel. *[(CO4) (Remember/LOCQ)]*

(2 + 6) + 4 = 12

Group - E

8. (a) Design a circuit to interface a potentiometer and an LED to an Arduino Uno board.

[(CO6)(Design/HOCQ)]

(b) Write an Arduino program to adjust the brightness of the LED based on the potentiometer's input. *[(CO6)(Solve/IOCQ)]*

(c) What is the resolution of the Arduino Uno's ADC (Analog-to-Digital Converter)?

[(CO1) (Remember/LOCQ)]

4 + 6 + 2 = 12

9. (a) Design a circuit to interface a 16×2 LCD display to an Arduino Uno board.

[(CO6)(Design/HOCQ)]

(b) Write a program for the above circuit. Display "AEIE-HITK" on the first line of the LCD and a counter that increments every second on the second line.

[(CO6) (Solve/IOCQ)]

(c) What is the typical resistance range of an LDR in bright light and darkness?

[(CO1)(Remember/LOCQ)]

4 + 6 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	39.58	29.17	31.25