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) 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.

(ii) Which of the following is used as system core in a 1st generation ES?
(a) 8 bit Microprocessor (b) 16 bit Microcontroller
(c) Multi-core processor (d) SoC.

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

(iv) Example of an onboard 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) In SPI protocol, which pin is used to enable Slave device?
(a) SCK (b) SS (c) MISO (d) MOSI.

(vii) In RS232C protocol, the logic '0' is represented as
(a) 0V to +5V (b) 0V to +15V
(c) +5V to +15V (d) -5V to -15V

(viii) TCB is an abbreviation for
(a) Total Control Block (b) Task Control Block
(c) Total Care Block (d) Task Care Block

(ix) Which of the following is an example for RTOS?
(a) QNX (b) Windows XP
(c) Windows 2000 (d) Linux.

(x) What is the microcontroller used in the Arduino UN0 board?
(a) ATmega16 (b) 8051
(c) ATmega328 (d) PIC16F877.

Fill in the blanks with the correct word

(xi) In FPGA, CLB stands for _____.

(xii) The maximum number of nodes that can be connected in I2C protocol is _____.

(xiii) The full form MOSI line in SPI protocol is _____.

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

(xv) _____ programming language is typically used in Arduino code.

Group - B

2. (a) Describe briefly the differences between an embedded system and a conventional computer. *[(CO1)(Remember/LOCQ)]*

(b) Briefly discuss the process of improving the code efficiency of a processor. *[(CO2)(Understand/LOCQ)]*

(c) With one suitable diagram explain the working of LUT in FPGA. *[(CO1)(Remember/LOCQ)]*

4 + 4 + 4 = 12

3. (a) What are the differences between Von-Neumann and Harvard Architectures? *[(CO2)(Remember/LOCQ)]*

(b) Classify the embedded system based on complexity. *[(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 X00 weeks and the product is launched in the market by a delay of X week.
(i) What is actual per unit cost to manufacture 1000 units of the embedded system?
(ii) Calculate the percentage revenue loss due to delayed product launch.
Where, X is the last digit of your autonomy roll number. If the last digit of your autonomy roll number is '0', then take X as 1. *[(CO1)(Analyze/IOCQ)]*

4 + 4 + (2 + 2) = 12

Group - C

4. (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

5. (a) Briefly outline the features of SPI communication protocol. *[(CO3)(Remember/LOCQ)]*
   (b) Briefly explain the data format of the RS232 protocol. *[(CO3)(Remember/LOCQ)]*
   (c) Write an AVR program for ATmega328P to initialize it as master SPI. Transmit the data 'X' via SPI repeatedly. Display the received data on Port D. 'X' is the last digit of your autonomy roll number. *[(CO3)(Solve/IOCQ)]*

3 + 3 + 6 = 12

Group - D

6. (a) What is the function of a kernel? What is kernel space and user space? *[(CO4)(Remember/LOCQ)]*
   (b) List the basic functions of real time kernel. *[(CO4)(Remember/LOCQ)]*
   (c) Explain the structure of TCB. *[(CO4)(Remember/LOCQ)]*

(2 + 2) + 4 + 4 = 12

7. (a) What is 'Process' in the operating system context? Briefly discuss the various states of Process Life Cycle. *[(CO4)(Remember/LOCQ)]*
   (b) What is 'Thread' in the operating system context? *[(CO4)(Remember/LOCQ)]*
   (c) Three processes with process IDs P1, P2, P3 with estimated completion time 10, 5, 7 milliseconds respectively enters the ready queue together in the order P1, P2, P3. Calculate the waiting time and Turn Around Time (TAT) for each process and the Average waiting time and Turn Around Time (Assuming there is no I/O waiting for the processes). *[(CO5)(Solve/IOCQ)]*

(2 + 4) + 2 + 4 = 12

Group - E

8. (a) Design a circuit to interface one LM35 temperature sensor and one LED to Arduino Uno board. *[(CO6)(Design/HOCQ)]*
   (b) Write a program for the above circuit to check the current ambient temperature and turns on the LED when the temperature exceeds X0°C; otherwise, the LED is turned off.
   Where, X is the last digit of your autonomy roll number. If the last digit of your autonomy roll number is '0', then take X as 1. *[(CO6)(Apply/IOCQ)]*
   (c) What is the sensitivity and temperature measurement range of LM35 sensor? *[(CO1)(Remember/LOCQ)]*

4 + 6 + 2 = 12

9. (a) Design a circuit to interface one stepper motor and one DIP switch to Arduino Uno board. *[(CO6)(Design/HOCQ)]*
   (b) Write a program for the above circuit to rotate the stepper motor in clockwise direction when the switch is closed; else rotate it in anticlockwise direction. *[(CO6)(Solve/IOCQ)]*
   (c) Create an Arduino Uno program to blink one LED. *[(CO6)(Solve/IOCQ)]*

4 + 6 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	55.21	29.17	15.62

Course Outcome (CO):

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

1. Explain the definitions, components and requirements of the Embedded System
2. Describe the processor, architecture and memory organization of the Embedded System
3. Develop the interfacing and communication techniques of the Embedded System
4. Learn the basic concept of RTOS
5. Understand the message passing technique, task synchronization techniques
6. Develop algorithms for real time applications of Embedded System

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