EMBEDDED SYSTEMS
(AEIE 5201)

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)   Embedded systems are designed to
         (a) Measure the state of a device   (b) Change the state of a device
         (c) Regulate a physical variable   (d) All of these.

   (ii) Which of the following is an example of Application Specific Instruction Set Processor (ASIP)?
         (a) Intel i5   (b) 8086 Microprocessor
         (c) Adreno 610   (d) ATmega328 microcontroller.

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

   (iv) In ATmega328 microcontroller the size of internal Flash Memory is
         (a) 1 Kbyte   (b) 2 Kbyte   (c) 32 Kbyte   (d) 64 Kbyte.

   (v)   In ATmega328 microcontroller the resolution of internal ADC is
         (a) 8   (b) 10   (c) 12   (d) 16.

   (vi) In the I2C protocol, the maximum number of nodes that can be connected is
         (a) 64   (b) 100   (c) 128   (d) 256.

   (vii) What data type is the object below?
         L = [8, 22, 'AEIE', 7]
         (a) Dictionary   (b) Tuple   (c) List   (d) Array.

   (viii) Which of the following Python function converts a string to float?
         (a) int(x [,base])   (b) long(x [,base])
         (c) float(x)   (d) str(x).

    (ix)   In Arduino Uno board the number of digital Input Output pin is
             (a) 10   (b) 12   (c) 14   (d) 16.

    (x)   In Arduino Uno board the number of analog Input pin is
             (a) 2   (b) 4   (c) 6   (d) 8.

Group- B

2.   (a)   What is an embedded system?   [(CO1)(Remember/LOCQ)]
       (b)   State in brief a few points of difference between a conventional computer and an embedded system.   [(CO1)(Understand/LOCQ)]
       (c)   What are the main components of FPGA? With one suitable diagram explain the working of LUT in FPGA.   [(CO1)(Analyze/IOCQ)]
                                                      2 + 3 + (1 + 6) = 12

3.   (a)   What are the differences between Von-Neumann and Harvard Architectures?
                                                       [(CO2)(Remember/LOCQ)]
       (b)   Explain the role of Digital Signal Processor and Graphics Processor in embedded system design.   [(CO2)(Understand/LOCQ)]
       (c)   The NRE cost to manufacture a product is Rs. 3,00,000/- and per unit cost is Rs.1000/-. Let the product life is 102 weeks and the product is launched in the market by a delay of 4 week.
           i) What is actual per unit cost to manufacture 1500 units of the embedded system?
           ii) Calculate the percentage revenue loss due to delayed product launch.
                                                   [(CO2)(Analyse/IOCQ)]
                                            4 + (2 + 2) + (2 + 2) = 12

Group - C

4.   (a)   Write down the main features of the ATmega328p-pu microcontroller.
                                                       [(CO1)(Remember/LOCQ)]
       (b)   Draw and discuss the Status Register of ATmega328p-pu microcontroller.
                                                      [(CO1)(Remember/LOCQ)]
       (c)   Write short notes on (any one):
           i) Data direction register
           ii) Port data register.   [(CO1)(Remember/LOCQ)]
                                                   4 + (1 + 3) + 4 = 12

5.   (a)   Design a circuit to interface one switch and one LED to ATmega328p-pu microcontroller. Write a program that turns OFF the LED if the switch is closed and turns it ON otherwise.   [(CO4)(Solve/IOCQ)]
       (b)   Write an AVR program to initialize the SPI for master, mode 0, with clock frequency $f_{osc}/64$ and then transmit 'E' via SPI repeatedly.
                                                      [(CO6)(Solve/IOCQ)]
                                                   (3 + 4) + 5 = 12

Group - D

6. (a) What do you understand by an operating system's monolithic kernel? State what role does the __init__ method in a python class play?
    [(CO3)(Understand/LOCQ)]
    (b) Write a python program for a Raspberry Pi to read incoming sensor data from serial port '/dev/ttyACM0' at 115200 baud and store it in a CSV file.
    [(CO2)(Solve/IOCQ)]
    (3 + 3) + 6 = 12

7. (a) Write a Python code to blink an LED once every second connected to the GPIO6 pin of Raspberry Pi.   [(CO5)(Solve/IOCQ)]
    (b) Create a block diagram to connect one LM35 temperature sensor to a Raspberry Pi board via an MCP3002 ADC. Write a Python programme to read the temperature and display it.   [(CO2)(Design/HOCQ)]
    4 + (3 + 5) = 12

Group - E

8. (a) Design a circuit to interface one LM35 temperature sensor to pin 23 and one LED to pin 2 of ATmega328p. Write an AVR application code to check the current ambient temperature and turn ON a LED if the temperature goes above 50°C .   [(CO4)(Design/HOCQ)]
    (b) What is the purpose of the analog input pins on the Arduino Uno board?
    [(CO1)(Understand/LOCQ)]
    (4 + 6) + 2 = 12

9. (a) Design a circuit to interface one stepper motor and one DIP switch to Arduino Uno board. Write a program to rotate the stepper motor in clockwise direction when the switch is closed, else rotate it in anticlockwise direction.
    [(CO4)(Design/HOCQ)]
    (b) Create an Arduino Uno program that blinks one LED.   [(CO4)(Solve/IOCQ)]
    (4 + 6) + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	34.37	36.46	29.17

Course Outcome (CO):

After the completion of the course students will be able to
1. Gain the knowledge in the area of embedded development of AVR microcontroller
2. Justify the selection criteria for ARM based single board computers for needs in industrial application
3. Demonstrate the working knowledge of programming Linux based used in industry application

4. Design embedded system required in industrial applications
5. Write program for embedded systems using Python
6. Learn techniques to develop applications using SPI/I2C bus

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