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) An embedded system must have
(a) Hard disc (b) Output device
(c) Processor and Memory (d) Communication device.

(ii) Which of the following is an example of an embedded system that uses SPP as its system core?
(a) DSO (b) Smart watch
(c) Digital camera (d) Mobile phone.

(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 SRAM is
(a) 1 Kbyte (b) 2 Kbyte (c) 32 Kbyte (d) 64 Kbyte.

(v) In ATmega328 microcontroller the number of channel in internal ADC is
(a) 5 (b) 6 (c) 7 (d) 8.

(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 = [157, 'MTECH', 'AEIE', 100]
(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) The python code to create a time delay of 10 sec is
(a) time.delay(10) (b) time.delay(10s)
(c) time.sleep(10) (d) time.sleep(10s).

Group- B

2. (a) Briefly discuss the components of an embedded system using a suitable block diagram. *[(CO1)(Remember/LOCQ)]*
(b) Briefly discuss the embedded systems based on complexity and performance requirements. *[(CO1)(Understand/LOCQ)]*
(c) Write down the key features of ASIP. *[(CO1)(Understand/LOCQ)]*

(3 + 2) + 4 + 3 = 12

3. (a) What are the differences between RISC and CISC processors? Give an example for each. *[(CO1)(Remember/LOCQ)]*
(b) Explain the operation of a LUT in an FPGA using a suitable example. *[(CO1)(Understand/LOCQ)]*
(c) The NRE cost to manufacture a product is Rs. 2,50,000/- and per unit cost is Rs. 1500/-. Let, the product life is 100 weeks and the product is launched in the market by a delay of 6 weeks.
(i) What is the actual per unit cost to manufacture 2000 units of the embedded system?
(ii) Calculate the percentage revenue loss due to delayed product launch. *[(CO1)(Analyse/IOCQ)]*

(4 + 1) + 3 + (2 + 2) = 12

Group - C

4. (a) Draw and discuss the status register of ATmega328p-pu Microcontroller. *[(CO1)(Remember/LOCQ)]*
(b) Discuss the SRAM memory organization in ATmega328p-pu Microcontroller. *[(CO1)(Remember/LOCQ)]*
(c) Explain the function of ADCSRA register in ATmega328p-pu Microcontroller. *[(CO1)(Remember/LOCQ)]*

(1 + 3) + 4 + 4 = 12

5. (a) Design a circuit to interface one stepper motor to ATmega328p-pu Microcontroller. Write a program to rotate the stepper motor. *[(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 'P' 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 38400 baud and store it in a CSV file.

[(CO5)(Solve/IOCQ)]

(3 + 3) + 6 = 12

7. (a) Design a circuit to interface one LED and one push button switch to Raspberry Pi board. *[(CO4)(Design/HOCQ)]*

(b) Write Python code for the above circuit to turn ON the LED when the switch is closed and OFF when the switch is open. *[(CO5)(Solve/IOCQ)]*

(c) Write a Python code to blink a LED for 10 times. *[(CO5)(Solve/IOCQ)]*

3 + 5 + 4 = 12

Group - E

8. (a) Design a circuit to interface one LDR and one LED to Arduino Uno board. Write program that turns OFF the LED if the light intensity exceeds a predefined threshold and turns it ON otherwise. *[(CO4)(Design/HOCQ)]*

(b) Create an Arduino Uno program that blinks one LED. *[(CO4)(Solve/IOCQ)]*

(4 + 6) + 2 = 12

9. (a) Design a circuit to interface one LM35 temperature sensor and one LED to Arduino Uno board. Write a program that checks the current ambient temperature and turns on the LED when the temperature exceeds 35°C; otherwise, the LED is turned off. *[(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

Cognition Level	*LOCQ*	*IOCQ*	*HOCQ*
Percentage distribution	*41.67*	*34.37*	*23.96*

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*