EMBEDDED SYSTEMS
(AEIE 5201)

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) Embedded systems are
(a) general purpose (b) special purpose
(c) both (a) and (b) (d) none of these.

(ii) Which of the following is an example of a 'small scale embedded system'?
(a) Simple calculator (b) Cell phone
(c) Computer (d) Washing machine.

(iii) Which of the following is (are) an intended purpose(s) of embedded systems?
(a) Data collection (b) Data processing
(c) Data communication (d) All of these.

(iv) ATmega328 belongs to which AVR family?
(a) Tiny AVR (b) Mega AVR
(c) Xmega AVR (d) Application specific AVR .

(v) The internal EEPROM size in an ATmega328 microprocessor is
(a) 1KB (b) 2KB (c) 32KB (d) 1MB

(vi) RTOS is an abbreviation for
(a) Robust Time Operating System (b) Robust Thread Operating System
(c) Real Time Operating System (d) Real Thread Operating System.

(vii) Which programming language is typically used in Arduino code?
(a) C/C++ (b) Java
(c) Python (d) Assembly.

(viii) Number of lines used In SPI data communication protocol is
(a) 2 (b) 3 (c) 4 (d) 5.

(ix) Which of the following is an example for RTOS?
(a) Windows 10 (b) Windows XP
(c) Windows 2000 (d) QNX.

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

Fill in the blanks with the correct word

(xi) In RISC processors, the number of instructions is _____.

(xii) In CISC processors, the number of instructions is _____.

(xiii) ATmega328 is a _____ bit microcontroller.

(xiv) In ATmega328 microcontroller the size of internal Flash Memory is _____.

(xv) _____ programming language is typically used in Raspberry pi.

Group - B

2. (a) What are the primary elements of an embedded system? *[(CO1)(Remember/LOCQ)]*
(b) Briefly discuss the process of improving the energy efficiency of a processor. *[(CO2)(Understand/LOCQ)]*
(c) With one suitable diagram explain the working of LUT in FPGA. *[(CO1)(Remember/LOCQ)]*

2 + 6 + 4 = 12

3. (a) Describe briefly the differences between the RISC and CISC architectures. *[(CO2)(Remember/LOCQ)]*
(b) Classify the embedded system based on generation. *[(CO1)(Remember/LOCQ)]*
(c) The NRE cost to manufacture a product is Rs.5,50,000/- and per unit cost is Rs.2000/-. Let, the product life is 500 weeks and the product is launched in the market by a delay of 5 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. *[(CO1)(Analyze/IOCQ)]*

4 + 4 + (2 + 2) = 12

Group - C

4. (a) Write down the main features of the ATmega328p-pu microcontroller. *[(CO1)(Remember/LOCQ)]*
(b) Draw the Status Register of ATmega328p-pu microcontroller and discuss the function of V, H and I flag bits. *[(CO1)(Remember/LOCQ)]*
(c) Write an assembly level program to write '23' in EEPROM memory location 0050_H of ATmega328p-pu microcontroller. *[(CO1)(Apply/IOCQ)]*

4 + (1 + 3) + 4 = 12

5. (a) Design a circuit to connect one temperature sensor (LM35) to ATmega328p-pu microcontroller. *[(CO4)(Design/HOCQ)]*
(b) Write a program for the above circuit to read data from temperature sensor. *[(CO4)(Apply/IOCQ)]*

(c) Write the features of SPI data communication protocol. *[(CO6)(Remember/LOCQ)]*

3 + 5 + 4 = 12

Group - D

6. (a) What is Kernel space? List the differences between Monolithic kernel and Microkernel. *[(CO4)(Remember/LOCQ)]*

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

(c) Explain the structure of TCB. *[(CO4)(Remember/LOCQ)]*

(1 + 3) + 4 + 4 = 12

7. (a) Write a Python code to blink a LED for 50 times. *[(CO5)(Apply/IOCQ)]*

(b) Design a circuit to interface one temperature sensor (LM35) to Raspberry Pi board using MCP3002 ADC. *[(CO4)(Design/HOCQ)]*

(c) Write Python code for the above circuit to read data from temperature sensor and display it. *[(CO5)(Apply/IOCQ)]*

4 + 3 + 5 = 12

Group - E

8. (a) Design a circuit to interface one LM35 temperature sensor and one LED to Arduino Uno board. *[(CO4)(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. *[(CO4)(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. *[(CO4)(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. *[(CO4)(Apply/IOCQ)]*

(b) Create an Arduino Uno program to blink one LED. *[(CO1) (Apply/IOCQ)]*

4 + 6 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	47.91	37.50	14.59

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.*