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) The resolution of the ADC in a Raspberry Pi is _____?
(a) 8 bit (b) 10 bit
(c) 32 bit (d) Raspberry Pi doesn't have an ADC.

(ii) The data will not go from the port registers to the pin unless
(a) DDR register of that port is set to 0
(b) PORT register of that port is set to 1
(c) DDR register of that port is set to 1
(d) PORT register of that port is set to 0.

(iii) import sys
print sys.argv[0]
run as: python test.py hello
What will be the output of the above Python program?
(a) hello (b) test.py
(c) the code won't run (d) none of the above.

(iv) What is the maximum number of master-slave devices that can be hooked up using UART is?
(a) 127 master-slave pairs (b) 255 master-slave pairs
(c) 8 master-slave pairs (d) 1 master-slave pair.

(v) What will be the input command to avrdude for checking programmer (usbasp) processor (ATmega328p) connection?
(a) avrdude –p m328p –c usbasp
(b) avrdude –B m328p –c usbasp
(c) avrdude –c m328p –p usbasp
(d) avrdude.

(vi) In AVR, which register is responsible for enabling ADC operation?
(a) ADMUX (b) PIN
(c) ADCSRA (d) all of the mentioned.

(vii) For following command
PORTB = 0x00;
PORTB = (1<<7);
the binary contents of PORTB is:
(a) 0b10000000 (b) 0b10000000
(c) 0b00001000 (d) 0b00010000.

(viii) Identify which of the following describes as a non real-time systems.
(a) an on-line banking (b) a self-driving car
(c) a library book reservation system (d) a desktop computer.

(ix) The Atmega328p in a genuine Arduino UNO runs at the speed of
(a) 20MHz (b) 16MHz
(c) 16GHz (d) 11MHz.

(x) What does "ls –l" bash command do?
(a) Displays list of files in the directory
(b) Deletes the directory
(c) Creates a new directory
(d) Deletes all files in the directory.

Group – B

2. (a) State in brief a few points of difference between an application specific computer and an embedded system. Give two examples from your life where embedded systems are used.

(b) What do you understand by lithography process in manufacturing processors? Briefly state the current industrial lithography standard in processor fabrication.

(3 + 3) + (3 + 3) = 12

3. (a) Can the flight computer of an airline be termed as an embedded system? Justify your answer.

(b) Why is power consumption one of the most important constraints in embedded system design? How are conventional computer systems not susceptible to such constraints?

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

Group – C

4. (a) Consider an LED connected to pin 19 (PB5) of an AVR Atmega328p. Write a code to accept commands over UART at 9600 baud to turn the LED on or off. Draw necessary circuit diagram.

   (b) Explain the working of an i^2c bus with a suitable functional block diagram. State a few points of differences between the SPI and i^2c bus.

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

5. (a) Explain the bits of ADC Control and Status Register A (ADCSRA) of the Atmega 328p. What is the function of ADPS [2:0] bits in the ADCSRA register?

   (b) Which bit in the ADCSRA register can be used to check ADC conversion status? Write a simple code for using the ADC of ATmega328p to represent the light intensity falling on an LDR by using eight LEDs connected to port D of the microcontroller.

(4 + 2) + (2 + 4) = 12

Group – D

6. (a) What do you understand by micro kernel in an operating system? How is monolithic kernel different from micro kernel?

   (b) Write a python code to accept command line inputs using the SYS module, assume Linux as operation environment.

(3 + 3) + 6 = 12

7. (a) What do you understand by Real Time operating systems (RTOS)? State some advantages and disadvantages a RTOS has over conventional operating systems.

   (b) What is job queue in an operating system? Explain with diagram showing CPU switch from process to process.

(3 + 3) + (3 + 3) = 12

Group – E

8. (a) Write an Arduino UNO application code to sweep the position of a servo motor from 0 to 180 degree and back. Draw necessary circuit diagram.

   (b) Write a python code to incoming read serial data from the hardware UART of a Raspberry Pi and print it on the console.

(4 + 2) + 6 = 12

9. (a) Write an Arduino UNO application code to check for current ambient temperature using a LM35 temperature sensor, and glow a red LED connected to pin 13 if the temperature goes above 32 degree celsius. Draw necessary circuit diagram.

   (b) Write short note on any two:
   (i) Task queue in operating systems
   (ii) Applications of IoT using Arduino UNO
   (iii) Multithreaded CPUs.

(4 + 2) + (3 × 2) = 12