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

   (b) What is thread? 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 control the position of a servo motor using an analog potentiometer connected to first ADC pin (A0). Draw necessary circuit diagram.

   (b) State a few points of difference between a Raspberry Pi and an Arduino UNO. Write a python code to blink a LED with user defined delay connected to GPIO7.

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

9. (a) Consider a DC motor connected to pin 9 of an Arduino through a power transistor. Write an Arduino code to control the speed of the motor using PWM reading values off a potentiometer connected to pin A0. Draw necessary circuit diagram.

   (b) Write short notes on any two of the following:
   (i) Embedded system design with Arduino
   (ii) Task queue in OS
   (iii) Multithreaded CPUs.

(5 + 1) + (3 × 2) = 12

EMBEDDED SYSTEMS
(AEIE 5204)

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 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.

   (ii) What does if __name__=='__main__': do in a Python code?
   (a) Tells the interpreter current code has main in it
   (b) It does nothing
   (c) Finds out the main method, executes it first
   (d) None of the above.

   (iii) What is the maximum number of slave devices that can be hooked up to an SPI bus?
   (a) 127
   (b) 255
   (c) 8
   (d) Depends on the no. of slave select lines.

   (iv) 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 .

(v) The BCM2835 of Raspberry Pi is a processor of
(a) 8 bit (b) 10 bit
(c) 32 bit (d) 64 bit.

(vi)
```
>>> s = 'Hello World'
>>> print s[1:5]
```
Which of the following output is seen at console for the above Python code?
(a) Hell
(b) Hello World
(c) Hello
(d) TypeError: string slicing not allowed.

(vii) In AVR, which registers are responsible for I/O operation?
(a) PORT (b) PIN
(c) DDR (d) all these

(viii) Identify which of the following describes best "hard" real-time systems.
(a) An on-line banking
(b) A self-driving car
(c) A library book reservation system
(d) A temperature controller in an AC

(ix) For following command
```
PORTB = 0x00;
PORTB = (1<<4);
```
the binary contents of PORTB is
(a) 0b00000000 (b) 0b10000000
(c) 0b00001000 (d) 0b00010000.

(x) What does "rm -rf tasks" Linux command do?
(a) Displays list of files in the "tasks" directory
(b) Deletes the directory named "tasks"
(c) Creates a new directory named "tasks"
(d) Deletes all files in the "task" directory.

Group – B

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

(b) What do you understand by special purpose processors? Briefly describe the steps involved in IC fabrication.

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

3. (a) Can the temperature controller inside a car's air conditioning unit 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?

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

Group – C

4. (a) What do you understand by the dual role of the PORTx registers in Atmega 328p? Write a simple code to read the state of a switch connected to pin 13 (PD7) and use it to turn ON or OFF an LED connected to pin 18 (PB4) of an Atmega 328p, running at 16MHz clock. Draw necessary circuit diagram.

(b) Explain the working of a SPI bus with a suitable functional block diagram. State a few points of differences between the SPI bus and UART.

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

5. (a) How to connect a LM75 digital temperature sensor to an AVR Atmega 328p over the i^2c bus? Draw necessary wiring diagram and write a code to print ambient temperature values onto the serial console via UART.

(b) Write a simple code using the ADC of Atmega 328p to represent the light intensity falling on an LDR by using eight LEDs connected to port D of the microcontroller. Draw suitable wiring diagram.

(5 + 2) + (3 + 2) = 12

Group - D

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

(b) Write a python code to print the contains of a folder using the OS module, assume Linux as operation environment.

(3 + 3) + 6 = 12