



**UGANDA INSTITUTE OF INFORMATION AND
COMMUNICATIONS TECHNOLOGY
DAY, EVENING AND WEEKEND PROGRAMMES END OF
YEAR TWO SEMESTER TWO FINAL EXAMS.
ACADEMIC YEAR 2022/2024.**

DEPARTMENT: ICT & ENGINEERING
YEAR OF STUDY: TWO SEMESTER: II
**PROGRAMME: DIPLOMA IN ELECTRICAL AND ELECTRONICS
ENGINEERING (DEEE)**

COURSE: EMBEDDED SYSTEMS
COURSE CODE: EEE2201
DATE: 7/07/2024
TIME: 2.00 PM– 4:45 PM

INSTRUCTIONS:

- i. This paper consists of two (2) sections: **Section A** and **Section B**
- ii. Section A is compulsory and you're supposed to circle the most correct choice.
- iii. Section A has a total of **20 marks**
- iv. Section B contains Four (4) questions each with **10 marks**, except **question 1** which has **20 marks** and **compulsory**.
Attempt ONLY three (3) questions from section B. with question 1 included.

SECTION A:

1. Which of the following is a correct syntax for a **for-loop** in **C**?

- A) ``for (int i = 0; i < 10; i++)``
- B) ``for int i = 0; i < 10; i++``
- C) ``for (int i = 0; i < 10)``
- D) ``for (i = 0, i < 10, i++)``

2. What will be the output of the following code segment?

```
int sum = 0;  
for (int i = 0; i < 5; i++) {  
    sum += i;  
}  
printf("%d", sum);
```

- A) 10
- B) 15
- C) 20
- D) 5

3. Which statement correctly describes the **do-while** loop?

- A) It is executed at least once.
- B) It might not execute at all.
- C) It has no condition.
- D) It executes only if a condition is true initially.

4. Identify the correct output of the following code:

```
int i = 0;  
do {  
    printf("%d ", i);  
    i++;  
} while (i < 3);
```

- A) 0 1 2
- B) 0 1 2 3
- C) 1 2 3
- D) 1 2 3 4

5. What is the output of the following code snippet?

```
int a = 10;  
if (a > 5) {  
    printf("A");  
} else {  
    printf("B");  
}
```

- A) A

- B) B
- C) No output
- D) Compilation error

6. What will be the output if the variable `x` is initialized to 4 in the following code?

```
if (x == 4)  
    printf("Four");  
else if (x > 4)  
    printf("Greater than four");  
else  
    printf("Less than four");
```

- A) Four
- B) Greater than four
- C) Less than four
- D) No output

7. Which of the following pins on the ATmega328P are used for ADC?

- A) PORTB pins
- B) PORTC pins
- C) PORTD pins
- D) None of the above

8. How many bits is the ADC resolution of the ATmega328P?

- A) 8 bits
- B) 10 bits
- C) 12 bits
- D) 16 bits

9. Which register would you configure to set up the ADC on the ATmega328P?

- A) ADCSRA
- B) TCCR0A
- C) PORTB
- D) UCSR0B

10. What is the range of values for the `uint8\_t` data type?

- A) 0 to 255
- B) 128 to 127
- C) 0 to 65535
- D) 32768 to 32767

11. Which of the following data types is 16 bits wide?

- A) `uint16\_t`
- B) `int8\_t`
- C) `uint32\_t`

D) ``int64_t``

12. Which logic gate outputs true only when all inputs are true?

- A) OR
- B) AND
- C) NOT
- D) XOR

13. A multiplexer is used to:

- A) Perform addition
- B) Perform subtraction
- C) Select one input from multiple inputs
- D) Invert the input signal

14. Which of the following sensors provides an analog output?

- A) Push button
- B) Potentiometer
- C) Rotary encoder
- D) Tactile switch

15. How do you declare an array of 10 integers in C?

- A) ``int array;``
- B) ``int array[10];``
- C) ``array int[10];``
- D) ``int[10] array;``

16. The ATmega328p operates at a clock frequency of:

- (a) 1 MHz
- (b) 16 MHz
- (c) 50 MHz
- (d) It varies depending on the program

17. A `uint16_t` data type in C can store an unsigned integer value in the range of:

- (a) 0 to 255
- (b) 0 to 65,535
- (c) 128 to 127
- (d) It depends on the compiler

18. The ATmega328p microcontroller can convert an analog voltage on a pin to a digital value using its:

- (a) Timer/Counter
- (b) UART (Universal Asynchronous Receiver Transmitter)
- (c) ADC (**Analog to Digital Converter**)

(d) SPI (Serial Peripheral Interface)

19. Which of the following pins on the ATmega328P are used for ADC?

A) PORTB pins

B) PORTC pins

C) PORTD pins

D) None of the above

20. Which statement correctly describes the **do-while** loop?

A) It is executed at least once.

B) It might not execute at all.

C) It has no condition.

D) It executes only if a condition is true initially.

SSECTION: B

1.

A.

Uganda is a country that possesses immense potential for economic development in various Sectors. Embedded systems, with their ability to control, automate, and optimize processes, can play a crucial role in driving Uganda forward towards full economic growth, explore how embedded systems can be applied in the various sectors mentioned below to unlock this potential.

- i. Power-systems' industry (generation, distribution, and transmission).
- ii. Security and Home Automation.
- iii. Trade and commerce.
- iv. Renewable Energy sector.
- v. Fishing industry

(10 marks)

B.

- I. **Riham Cola industries Uganda LTD**, happens to be having a three phase **10hp** water pump feeding two mixer units for their beverages business. You are tasked with the responsibility of designing an electronic (**microcontroller based**) star delta starter systems that efficiently and safely starts the pump. Write an Arduino C/C++ code that implements the operation of this star delta starter.

(5 marks)

- II. **Hamis Kiggundu** is a prominent trader in Kampala Uganda who happens to be a landlord, owning **Ham tower** building. It was found out that one of the major problems is that his tenants face while using his building is power Outages mainly caused by Over loading conditions due to tenants consuming more power than they should at any instant, which causes the circuit breakers to trip. Using the knowledge, you have acquired from your embedded systems classes, with the help of a well labeled block diagram describe and explain a possible solution to Mr. Kiggundu's problem.

(5 marks)

2.

A.

Let's assume you are working on an embedded systems project using an **ATmega328p** microcontroller, and you need to **optimize memory usage** while ensuring the correct functionality of your program. The project involves reading sensor data, processing it, and sending the results to a display. The sensor data includes

temperature readings that range from **-50** to **150** degrees Celsius.

You need to count the number of readings taken, which can go up to **65,535**.

You have to store the status of multiple sensors, where each sensor can be either **ON** or **OFF**.

- a. Explain which data types you would use to store the temperature readings, the count of readings, and the sensor status, and justify your choices.

(3 marks)

- b. Write a short snippet of C/C++ code that demonstrates the declaration of these variables using appropriate data types.

(2marks)

B.

You are tasked with developing an Arduino-based temperature monitoring system for a small greenhouse in which two LEDs are connected to pin 13. The system should read temperature data from one sensor, store these readings in an array, and then analyze the data to determine if the temperature is within different ranges.

- a) Define an array to store at least 20 temperature readings from the sensor.
- b) Use a `for` loop to populate the array with temperature data.
- c) Use an `if` statement to check the temperature ranges.

Implement the following LED behavior based on the temperature readings:

- a. Blink the LEDs 15 times with a 500ms interval if the temperature is below 18°C.
- b. Blink the LEDs 15 times with a 300ms interval if the temperature is between 18°C and 25°C.

- c. Blink the LEDs 20 times with a 100ms interval if the temperature is between 25°C and 30°C.
- d. Turn on the LEDs continuously if the temperature exceeds 30°C.

(5marks)

3.

A.

Create a **function** in Arduino IDE called "**loop-Test**" that uses both a **for-loop** and a **while-loop** to toggle an LED connected to **pin 13** on and off. The **for-loop** should toggle the LED on and off **8** times, while the **while-loop** should toggle the LED on and off indefinitely until a button connected to **pin 2** is pressed.

(5marks)

B.

Discuss the basic syntax elements of **C/C++** programming, including data types, variables, operators, control flow statements, and functions. Provide a simple code snippet demonstrating the declaration and initialization of a variable in **C**.

(5marks)

4.

A. How do microcontrollers utilize combinational and sequential logic circuits to perform complex tasks? Provide specific examples of embedded system applications that rely on these circuits.

(5marks)

B.

I. Draw the DIP (Dual In-line Package) pinout diagram of the ATmega328P microcontroller. Ensure that all pins are well-labeled with their respective functions.

(2marks)

II. List and explain at least three major peripherals of the ATmega328P microcontroller. Provide example applications for each peripheral in the normal operation of the microcontroller.

(3marks)

END

.....GOOD LUCK.....

