GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY

Faculty of Engineering

Department of Electrical, Electronic and Telecommunication Engineering

BSc Engineering Degree

Semester 4 Examination – September 2021

(Intake 37 – EE/ET/MC)

MICROPROCESSORS, MICRCONTROLLERS AND EMBEDDED SYSTEMS

(ET2223)

Time allowed: 3 hours   23rd September 2021

ADDITIONAL MATERIAL PROVIDED

Nil

INSTRUCTIONS TO CANDIDATES

This paper contains 5 questions on 4 pages.

Answer ALL questions.

This is a closed book examination.

This examination accounts for 80% of the module assessment. A total maximum mark obtainable is 100. The marks assigned for each questions and parts thereof are indicated in brackets.

If you have any doubt as to the interpretation of the wordings of a question, make your own decision, but clearly state it on the script.

Assume any reasonable values for any data not given in or provided with the question paper, clearly make such assumptions made in the script.

All examinations are conducted under the rules and regulations of the KDU.

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Question 01

a. Sketch a suitable block diagram to add, two 3-bit binary numbers. (3 marks)

b. Modify the block diagram in Q1 part (a) to add or subtract, two 3-bit binary numbers. Explain the operation of adder/subtractor circuit. (5 marks)

c. "*A machine language and its associated assembly language are completely machine dependent*". Do you agree with this statement? Discuss. (4 marks)

d. Explain VLSI design abstraction levels. (8 marks)

Question 02

a. Explain the function of the chip selection line in a memory chip with the aid of a suitable diagram. (6 marks)

b. Calculate the number of memory chips required to design 16 k memory, if the memory chip size is 1024 x 4. (4 marks)

c. Compare and contrast the types of Bus-based I/O addressing of microprocessors with their features. (6 marks)

d. Explain the purpose of bus arbitration with examples. (4 marks)

Question 03

a. *"As embedded systems started progressing, they started becoming more and more complex"*. Discuss your ideas on this statement using an example. (6 marks)

b. Embedded systems are reactive and real time. Explain this characteristic of an embedded system using examples. (6 marks)

c. Compare the testing types of embedded systems, based on their platform. (8 marks)

Question 04

a. Explain "system on a chip (SoC)" and list the components which are contained in a typical SoC? (6 marks)

b. Explain the start and stop conditions of I2C communication with the aid of suitable timing diagram. (6 marks)

c. State and explain the main difference between UART and USART protocols. (4 marks)

d. List the ways in which I/Os (Inputs/Outputs) are incorporated into the PLC and give a comparison between them. (4 marks)

Question 05

a. Method of representing and playing music on a computer is sampled sound.

Sound is being sampled using a 16-bit sample resolution and a sample rate of 20 000 Hz.

1 Hz is one sample per second.

    i. Calculate the amount of storage space that will be required to store 30 seconds of recorded sound. Express your answer in kilobytes. (2 marks)

    ii. The highest frequency component in the sound that is being sampled is 14 500 Hz. The sample rate of 20 000 Hz is not high enough to enable a faithful reproduction of the original sound from the sample.

    Explain why this is the case, justifying your response. (3 marks)

b. Briefly explain the process of a sensor, which starting from sensing of a stimulus, with the aid of a block diagram. (5 marks)

c. Below is a C language program which is using PWM to control the brightness of an LED in Arduino.

```
int LED_pin = 11;

void setup() {
    pinMode(LED_pin, OUTPUT);
}

void loop() {

    int dtwait = 1000;
    int V1=20, V2=220, V3=120;

    analogWrite(LED_pin, V1);
    delay(dtwait);

    analogWrite(LED_pin, V2);
    delay(dtwait);

    analogWrite(LED_pin, V3);
    delay(dtwait);
}
```

   i.   Explain the code line by line.   (8 marks)

  ii.   State the reason for defining the pin 11 as LED_pin.   (2 marks)