ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE
FACULTY OF ENGINEERING
DEPARTMENT OF COMPUTER ENGINEERING

FIRST SEMESTER EXAMINATION, 2019/2020 ACADEMIC SESSION

COURSE TITLE: EMBEDDED SYSTEM DESIGN

COURSE CODE: ECE 513

EXAMINATION DATE: FEBRUARY 2020

COURSE LECTURER: PROF A. O. OLUWATOPE

HOD's SIGNATURE

TIME ALLOWED: 3 HOURS

INSTRUCTIONS:

1. ANSWER <u>FOUR QUESTIONS ONLY</u>, **QUESTION ONE IS COMPULSORY.**
2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM.
3. YOU ARE **NOT** ALLOWED TO BORROW ANY WRITING MATERIALS DURING THE EXAMINATION.

QUESTION #1

a. What is an embedded computer system? [1 mark]
b. Discuss the characteristics of embedded computing applications [4 marks]
c. Mention the advantages of microprocessor over custom logics and FPGAs in the design of digital systems [1 mark]
d. What is a cyber-physical system? [1 mark]
e. What are the challenges in embedded computing systems design? [2 marks]
f. Describe the different layers of abstraction in the design process of an embedded computing system [4 marks]
g. List two major goals to be considered in design of the embedded system [2 marks]

QUESTION #2

a. The Board of Trustees of Elizade University, Ilara-Mokin has appointed you as the consulting embedded system engineer to design the main gate control system for a light train system to be built on the campus. Therefore, provide the followings:
   i. Requirement analysis [4 marks]
   ii. Specification [4 marks]
   iii. Architectural design [4 marks]
   iv. Hardware and software components [3 marks]

QUESTION #3

a) Describe the ARM processor from the following perspectives:
   i. Processor organization [3 marks]
   ii. Memory model. [3 marks]
b) Describe the PIC16F family microcontroller from the following perspectives
   i. Processor organization [2 marks]
   ii. Address space. [2 marks]
   iii. Data space [2 marks]
   iv. Addressing mode [2 marks]
   v. Program counter [1 mark]

QUESTION #4

a) Describe the system organisation of PIC 16F882 microcontroller [3 marks]
b) Describe the software platform components of an embedded system [2 marks]
c) Design a n embedded computing system to switch on the light bulb in a room as long as there is darkness in the room and otherwise switch off.
   (i.) Show your hardware circuit (Use Arduino Uno as the controller) [5 marks]
   (ii.) Write out the C sketch to drive the microcontroller [5 marks]

QUESTION #5

a) Draw a state machine or diagram to describe the behavior of a simple car seat belt controller.

The controller's job is to turn on a buzzer if a person sits in a seat and does not fasten the seat belt within a fixed amount of time. This system has three inputs and one output. The inputs are a sensor for the seat to know when a person has sat down, a seat belt sensor that tells when the belt is fastened, and a timer that goes off when the required time interval has elapsed. The output is the buzzer.   [10 marks]

b) Draw the Data Flow Graph for the following basic expressions in C [5 marks]

$$w = 5 + b;$$
$$x = 5 - c;$$
$$y = 5 + d;$$
$$x = 5 + c;$$
$$z = 5 + e;$$

QUESTION #6

a) Draw the Control Data Flow Graph for the program contruct given below: [5 marks]

```
for (i = 0; i < N; i++) {
loop_body();
}
is equivalent to
i = 0;
while (i < N) {
loop_body();
i++;
}
```

b) Design a microcontroller based a light bulb intensity controller. Use an Arduino Uno as the controller.

   i.   Show the hardware circuit and   [5 marks]

   ii.   Write out the C Sketch to drive the microcontroller   [5 marks]