



Beijing-Dublin International College



SEMESTER 1 FINAL EXAMINATION - (2021/2022)

School of Electrical and Electronic Engineering

EEEN3002J Microcontrollers

Professor John T. Sheridan
Dr. Avishek Nag*

Time Allowed: 120 minutes

Instructions for Candidates:

Answer ALL questions. The distribution of marks in the right margin shown as a percentage gives an approximate indication of the relative importance of each part of the question. Show **all details** in answer book, **not** on exam paper

BJUT Student ID:_____ **UCD Student ID:**_____

I have read and clearly understand the Examination Rules of both Beijing University of Technology and University College Dublin. I am aware of the Punishment for Violating the Rules of Beijing University of Technology and/or University College Dublin. I hereby promise to abide by the relevant rules and regulations by not giving or receiving any help during the exam. If caught violating the rules, I accept the punishment thereof.

Honesty Pledge:_____ **(Signature)**

Instructions for Invigilators

Non-programmable calculators are permitted.

No rough-work paper is to be provided for candidates.

Paper notes and books allowed, no other electronic devices allowed.

Question 1:

- a. Find the delay generated by timer 0 in the following code. Do not include the overhead due to instructions.

```
CLR P2.3
MOV TMOD, #02H
HERE: MOV TH0, #0B8H
SETB P2.3
SETB TR0
AGAIN: JNB TF0, AGAIN
CLR TR0
CLR TF0
CLR P2.3
```

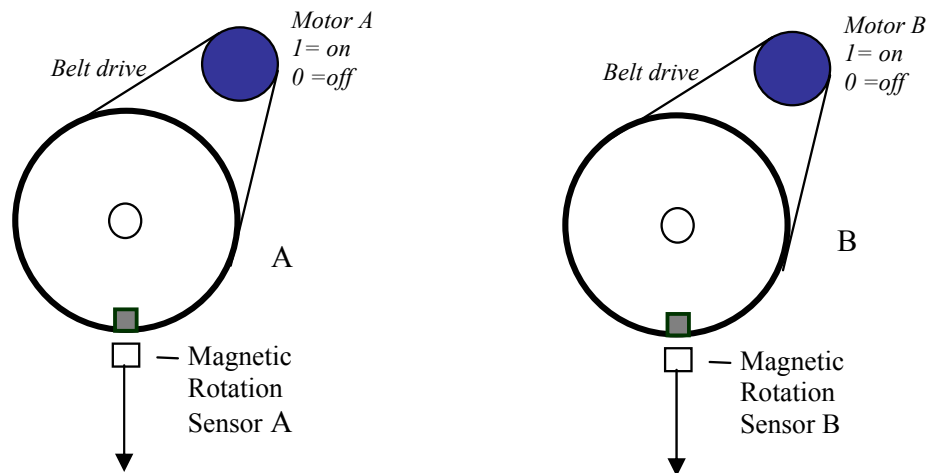
(10%)

- b. Write a program that finds the number of 1s in a given byte. (10%)
- c. Ten blocks of 16-bit numbers are stored from memory location 5000H to 5009H. Which output of the 74LS138 decoder chip will access these memory locations if address lines A12, A13, A14, and A15 are connected to pins A, B, C, and $\overline{G2A}$ respectively and $\overline{G2B}$ is grounded? Write an assembly language code to find how many even numbers are there among the ten 16-bit numbers. Register R2 should display the number of even numbers. (10%)
- d. Write a subroutine which checks the content of 20H. If it is a positive number, the subroutine find its two's complement and store it in same location and returns. (10%)
- e. Explain the steps of receiving and transmitting data from serial port both with and without interrupts. (10%)

Question 2:

As part of a industrial automation system two wheels are driven by two separate motors, motor A and motor B. The rotation sensors give a logic low level as the wheel magnet passes the sensor. Each motor can be turned on and off by providing a logic signal as indicated in the diagram. An 8051 is to be used to control these motors where a motor can be turned on and allowed run for N rotations and then turned off. The sensor signals will cause timer/counter interrupts.

- a. Let us say you decide to use the timer 0 to count the number of rotations for motor A and timer 1 to count the number of rotations for motor B. What will be the values loaded in TMOD, TH0, TL0, TH1, and TL1? Justify your answers properly. (15%)
- b. What will be the value loaded in the IE register? Justify your answer. (5%)
- c. Assuming that motor A is connected to P1.6 and motor B is connected to P1.7, write down the entire assembly language code. Your code must be clearly showing the following:



- Starting addresses of the main program, the interrupt service routine for timer 0 and the interrupt service routine of timer1.
- The complete instructions of the main program, the complete instructions of the interrupt service routine for timer 0 and the interrupt service routine of timer1.
- Appropriate comments for each line of the code.

(30%)