OLLSCOIL NA hÉIREANN, CORCAIGH
THE NATIONAL UNIVERSITY OF IRELAND, CORK

COLAISTE NA hOLLSCOILE, CORCAIGH
UNIVERSITY COLLEGE, CORK

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Semester 1 - Winter 2017

CS3514: C-Programming for Microcontrollers

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1.5 hours

Attempt all questions.
All Questions Carry Equal Marks.
Total Mark for this Paper is 80.
(For information: Minutes/Mark = 1.125)

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PLEASE ENSURE THAT YOU HAVE THE CORRECT EXAM PAPER

Question 1

a) List the main components of a typical microcontroller. (2 mark)

b) Write code for the Arduino to toggle a LED on and off when a switch is repeatedly pressed. (8 marks)

c) Draw a labelled circuit diagram showing the hardware controlled by the code in (b) above. (5 marks)

d) Explain switch debouncing. Update your code in (b) to include software debouncing. (5 marks)

Question 2

a) What is an ADC? What is the input to, and the output from, an ADC ? (4 marks)

b) Using a 100K ohm fixed resistor and a 100K ohm potentiometer, draw the circuit diagram of a voltage divider. Connect the voltage divider to an ADC and write code to turn on 3 LEDs in sequence as the potentiometer is turned. (10 marks)

c) Write code to write the output from the ADC in (b) above to the Serial Monitor of the Arduino. (6 marks)

Question 3

a) Provide C declarations for each of the following:
   i. The variable ppf which is a pointer to a pointer to a float.
   ii. A 10 element array of pointers to floats called pfar.
   iii. A 10 element array of floats, called far, initialized to the values: 0.0, 1.1, 2.2, 3.3, 4.4, 5.5, 6.6, 7.7, 8.8, 9.9, respectively.
   iv. A float variable called f. (6 marks)

b) Write a C for-loop to have each element of pfar point to the corresponding element of far. That is, pfar[0] should point to far[0], etc. (4 marks)

c) Explain what each of the following statements:
   i. ppf = pfar+3;
   ii. f = **ppf+2;
   After (i) and (ii), above, are executed, what is the value in f? (3 marks)

d) Using appropriate bitwise operators, write code to set the 4^{th} bit in a character, C, to 0, while leaving the other bits unchanged. (4 marks)

e) Using appropriate bitwise operators, write code to toggle the 5^{th} bit in a character, C, while leaving the other bits unchanged. (3 marks)

Question 4

a) What is a hardware interrupt? (2 mark)

b) What are the steps involved in setting up a hardware interrupt on the Arduino? (3 marks)

c) Use the Arduino attachInterrupt() function to call function foo() on the falling edge of the external interrupt 0. (2 marks)

d) How fast will a 16-bit counter overflow when clocked at 16MHz? (5 marks)

e) What is the purpose of each of the following:
   1. Timer PreScaling
   2. Clear Timer on Compare Match mode (CTC mode)?

   How can these concepts be used together to generate accurate timer interrupts? (8 marks)