Sri Lanka Institute of Information Technology

B.Sc. Honours Degree in Information Technology
Specialized in Computer Systems & Network Engineering

Final Examination
Year 2, Semester 2 (2019)

IE2070 – Embedded Systems

Duration: 3 Hours

October, 2019

Instructions to Candidates:

- This paper has 5 questions. Answer all questions.
- Write answers in the booklet given.
- Total marks for the paper is 50.
- This paper contains 3 pages including the cover page.
- Electronic devices capable of storing and retrieving text, including calculators and mobile phones are not allowed.
- Students are allowed to bring the ATMega328P instruction set (Printed).

Question 1 (Timers)   10 Marks

1. Explain why the width of the Timer could be vital in choosing for an application.

   2 Marks

2. Using diagrams illustrate the differences between CTC mode and Normal mode

   2 Marks

3. Explain the roles of the TOV flag and OCF flag in the Timer 0 module of ATMega328P microcontroller.

   2 Marks

4. Demonstrate using a graph as to how a duty cycle varying waveform can be produced using the Timer 0 module.

   2 Marks

5. Choose an appropriate pre-scalar to generate a timer interrupt of 10ms using the CTC mode. (XTAL=8MHz)

   2 Marks

Question 2 (CPU Architecture & Assembly)   10 Marks

1. What is the role of the Program Counter in the ATMega328P microcontroller?

   2 Marks

2. Explain why the width of the Timer could be vital in choosing for an application.

   1 Marks

3. What is the result of this code and where is it stored in?
   LDI R21, 0x15
   ADD R21, 0x24   **2 Marks**

4. State whether the line of code given below is valid and justify your answer.
   LDI R1, 0x00

   2 Marks

5. Write a simple code to load values 0x30 and 0x78 into locations $104 and $108

   3 Marks

Question 3 (Interrupts & ADC)   10 Marks

1. Give an example of a practical scenario that involves the use of external interrupts and suggest why it could be advantageous to use interrupts over polling for your application.

   2 Marks

2. Describe the role of an interrupt vector during the occurrence of an interrupt.

   2 Marks

3. Explain the difference between low level and falling edge triggered interrupts in the context of external interrupts

   2 Marks

4. What are the parameters that you would consider when choosing an ADC for a practical application?   **2 Marks**

5. Using a diagram demonstrate the three stages in Analog to Digital conversion.

2 Marks

Question 4 (Serial communication)   10 Marks

1. Compare and contrast parallel and serial communication with two advantages of each method.

2 Marks

2. Give a key difference between synchronous and asynchronous serial communication.

1 Mark

3. Draw a block diagram of the UART module including the configuration registers and the shift registers.

2 Marks

4. Would you recommend a low baud-rate or a high baud-rate in a noisy channel? Justify your answer.

1 Mark

5. Calculate the UBRR register value for a baud-rate of 9600 given that the XTAL frequency is 8MHz.

2 Marks

6. Give reasons as to why parity bit and stop bits maybe required in serial communication.

2 Marks

Question 5 (Design)   10 Marks

1. Consider an application where you have three windows which need to be monitored for their status (open/close). The purpose of the application is to indicate the user the status as to whether each window is open or closed.

   i) Propose a method to build an embedded system based on ATMega328P to solve the problem stated. (Hint: Mention any sensors/actuators you may use)

   3 Marks

   ii) Draw a circuit diagram for your proposed solution.

   3 Marks

   iii) Give a Pseudo-code/ Flowchart that demonstrates your software approach to solve the problem.

   4 Marks

- **END OF PAPER** -