



UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2010 SESSION

SUBJECT CODE : FSB 33403
SUBJECT TITLE : EMBEDDED SYSTEM
LEVEL : BACHELOR
TIME / DURATION : 12.30pm – 3.30pm
(3 HOURS)
DATE : 05 MAY 2010

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
 2. This question paper is printed on both sides of the paper.
 3. Please write your answers on the answer booklet provided.
 4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
 5. This questions paper consists of TWO (2) sections. Section A and B. Answer ALL questions in section A. For section B, answer TWO (2) questions only.
 6. Answer ALL questions in English.
-

THERE ARE 7 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

Define 'Embedded Systems'.

(3 marks)

Question 2

Discuss the following aspects of Embedded Systems dependability

(a) Reliability

(2 marks)

(b) Maintainability

(2 marks)

(c) Availability

(2 marks)

(d) Safety

(2 marks)

(e) Security

(2 marks)

Question 3

With an aid of an example describe an industrial application area of embedded systems.

(3 marks)

Question 4

What kind of software architecture is being used in the following example? Briefly explain.

```
void interrupt devA() { handleInputDevA(); }
void interrupt devB() { readyB = 1; }
void main() {
    for (;;) {
        if (readyB) {
            handleInputDevB();
            readyB = 0;
        }
        if (pollInputDevC())
            handleInputDevC()
    }
}
```

(10 marks)

Question 5

List and explain two types of computer architectures.

(6 marks)

Question 6

Differentiate between the following techniques of processor communication with the external world.

(a) Interrupt Driven I/O

(4 marks)

(b) Direct Memory Access

(4 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer only TWO questions.

Please use the answer booklet provided.

Question 7

- (a) A real-time embedded system has a preemptive priority based scheduler. There are five tasks, *one data buffer, one 8-bit digital I/O port, and two serial ports involved*. The five tasks are:

Task 1:

1. Initialize digital I/O port for input
2. Read digital input
3. Count rising edges on each input

Task 2:

1. Read Data from serial port 1
2. Check CRC byte for errors in serial data
3. If data buffer is empty
{write data payload to buffer}

Task 3:

1. Initialize digital I/O port to output
2. Write data to digital outputs
3. Toggle bit 0 of digital I/O port on and off (i.e. make a brief pulse on bit 0).

Task 4:

1. If data buffer is full
{take data from buffer}
2. Write data to serial port 2

Task 5:

1. Count no. of bytes in data buffer
2. Display byte count on LCD

Answer the following questions.

- i. Which resource or resources are shared by these tasks?
(5 marks)
 - ii. Which task contains critical sections for which resources?
(5 marks)
 - iii. Identify the specific lines of pseudocode above which is critical section.
(5 marks)
 - iv. Using mutex semaphore, address the critical section problem in this case. Give specific details.
(5 marks)
- (b) By using state diagram, explain binary semaphore and discuss its usage in synchronizing two tasks.
(10 marks)

Question 8

(a) Sketch and explain any two typical interfacing method of expanding of a microcontroller based system I/O's (input and output) by interfacing two microcontrollers together.

(10 marks)

(b) Sketch and label the state diagram of 'Task States' in RTOS (*Real-Time Operating Systems*).

(10 marks)

(c) Figure 1 shows an insulin pump data flow. A system is used by diabetics to simulate the function of the pancreas which manufactures insulin, an essential hormone that metabolizes blood glucose. The systems measures blood glucose (sugar) using a micro-sensor and computes the insulin dose required to metabolize the glucose.

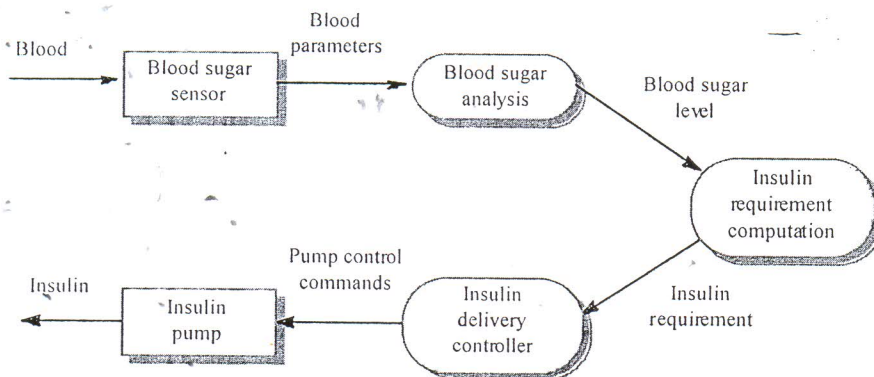


Figure 1: Insulin pump data flow

i. What type of software architecture might you use for such a system?

(2 marks)

ii. Justify your answer in (c)(i).

(8 marks)

Question 9

- (a) Briefly explain the following phase of models in the embedded systems development process.
- i. Requirements (2 Marks)
 - ii. Architecture (2 Marks)
 - iii. Coding (2 Marks)
 - iv. Testing (2 Marks)
 - v. Maintenance (2 Marks)
- (b) You are currently working for a company that is working on a new Embedded Systems project. You are an Embedded Systems engineer hired to write the embedded software to configure and test the hardware (i.e., set up and configure the new embedded controller). The software must be shipped together with the hardware, otherwise the hardware is useless. Unfortunately, the hardware is constantly being changed and will not be finalized until a few weeks before shipping. What process model would you use? Justify your answers by briefly explaining not only your choice but also why you rejected another choice. (10 marks)

- (c) Referring to the following algorithm and flow chart in Figure 2, sketch the FSD (*Finite State Diagram*) to capture and specify the system dynamics of a furnace system.

This algorithm describes the operation of the furnace:

1. Read exterior temperature.
2. Read interior temperature.
3. If interior temperature is not equal to exterior temperature, go to step 1.
4. Read interior temperature.
5. If interior temperature is greater than or equal to desired temperature, turn off voltage to coil.
6. If current temperature is less than desired temperature, turn on voltage to coil.
7. If time is less than cure time, go to step 4.
8. Turn off voltage to coil.

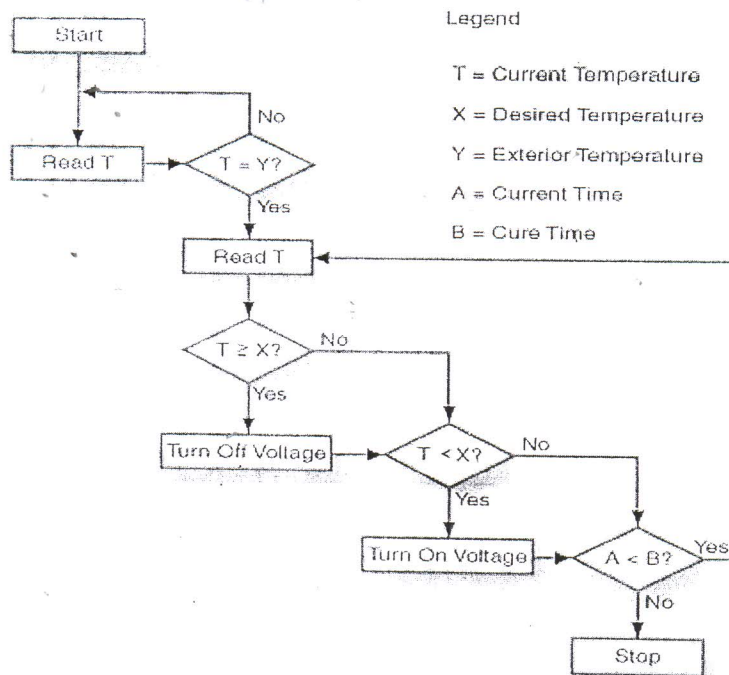


Figure 2: System flow chart

(10 marks)

END OF QUESTION