UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011

COURSE NAME	: REAL TIME SYSTEM
COURSE CODE	: BIT 3333
PROGRAMME	: BACHELOR OF INFORMATION TECHNOLOGY
EXAMINATION DATE	: APRIL / MAY 2011
DURATION	: 3 HOURS
INSTRUCTION	: ANSWER **ALL** QUESTIONS.

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

Q1 (a) Given the following scenario:

A vending machine allows a customer to purchase two types of reload cards. The first one costs RM10 and the second one costs RM20. The vending machine accepts only RM5 and RM10 notes. Initially, the vending machine's note compartment is empty (zero credit). The vending cannot hold more than RM20. The vending machine allows customers to perform three main operations. Firstly, the customer can insert a note into the vending machine whose value is added to any available credit. Secondly, the vending machine can dispense a reload card to the customer if he has the right credit (RM10 <= credit <= RM20). Finally, the vending machine dispenses any available change to the customer after a transaction is completed.

Draw a Petri net.

(6 marks)

(b) The readers-writers problem shows that writer processes have exclusive access to the critical section and that there may be at maximum three simultaneous reader processes can be modeled using the generalized Petri net shown in **Figure Q1(b)**.

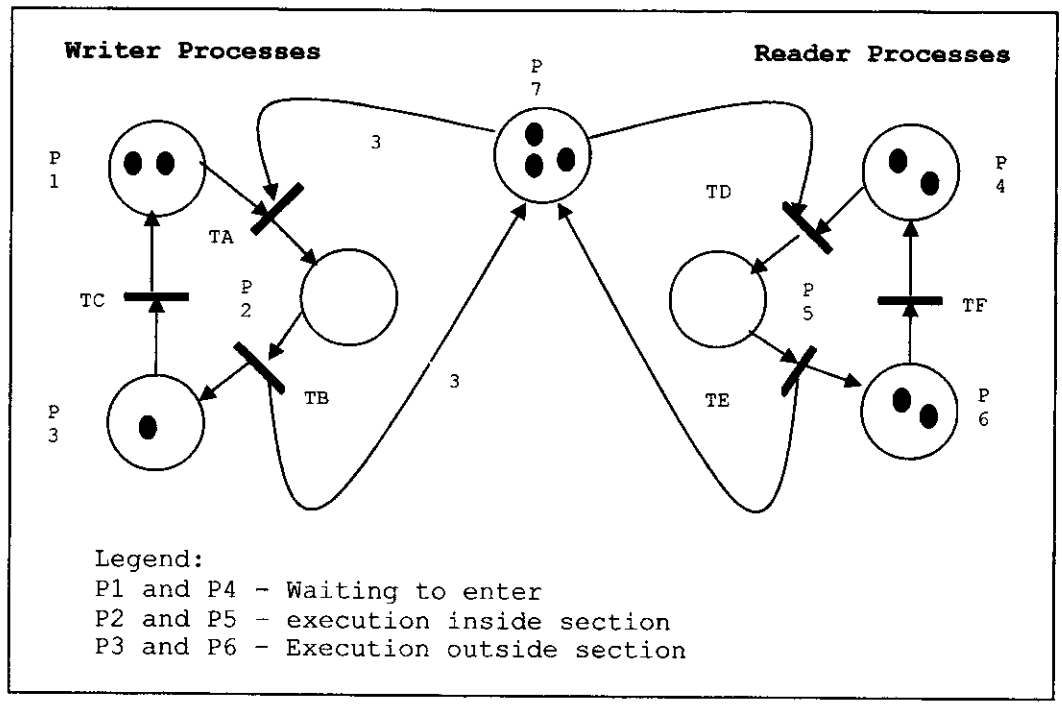

Figure Q1(b)

Explain the firing process in:

(i) Transition TA.

(ii) Transition TB.

(iii) Transition TC.

(9 marks)

(c) Based on **Figure Q1(b)**, draw a Petri net for the following situation:

(i) **THREE (3)** simultaneous reader processes inside the critical section.
(ii) **TWO (2)** writer processes in the critical section at the same time but still do not allow readers and writers to be in the section at the same time.

(Hint: The place in the middle of **Figure Q1(b)** can be viewed as a "semaphore". In this example you should use two "semaphores").

(5 marks)

Q2 (a) Consider the set of tasks in **Table 1**, where T denotes the task period, D denotes the deadline and C denotes the execution time of the task. Assign a priority to each task according to the Deadline Monotonic Scheduling (DMS) principle.

Table 1: The task set.

Task Name	T (period)	D (Deadline)	C (execution time)
A	3	3	1
B	5	5	2
C	2	2	0.5

(i) Calculate the process utilization for task A, B and C.

(3 marks)

(ii) Compute the Worst Case Execution Time for task A, B and C.

(10 marks)

(iii) Draw the execution schedule (Gantt chart) for the task A, B and C by assuming that all tasks are released simultaneously.

(6 marks)

(b) Explain **SIX (6)** failures that might happen in Real Time System.

(6 marks)

(c) Define **TWO (2)** approaches to improve reliability of the system.

(2 marks)

(d) Based on **Q2(c)**, explain in detail **ONE (1)** of the approach.

(4 marks)

Q3 Henry Hacker has implemented a real-time application with three critical common resources R1, R2 and R3 protected by mutual exclusion semaphores which can be accessed by three different processes P1, P2 and P3. The critical sections in the three processes are accessed through the following statements as shown in **Figure Q3**:

```
P1                          P2                          P3
Wait(R1);                   Wait(R2);                   Wait(R3);
Wait(R2);                   Wait(R3);                   Wait(R1);
// Using R1 and R2          // Using R2 and R3          //Using R1 and R3
Signal(R2);                 Signal(R3);                 Signal(R1);
Signal(R1);                 Signal(R2);                 Signal(R3);
```

Figure Q3

(a) Explain what is the problem with solution in **Figure Q3**?

(4 marks)

(b) Suggest an implementation by rewriting P3 to avoid the problem in **Q3(a)**.

(5 marks)

(c) Clarify **FOUR (4)** strategies that can be used to prevent issues in mutual exclusion.

(8 marks)

Q4 **Figure Q4** shows **FIVE (5)** processes (P1, P2, P3, P4 and P5) that run simultaneously with recovery point (Rn).

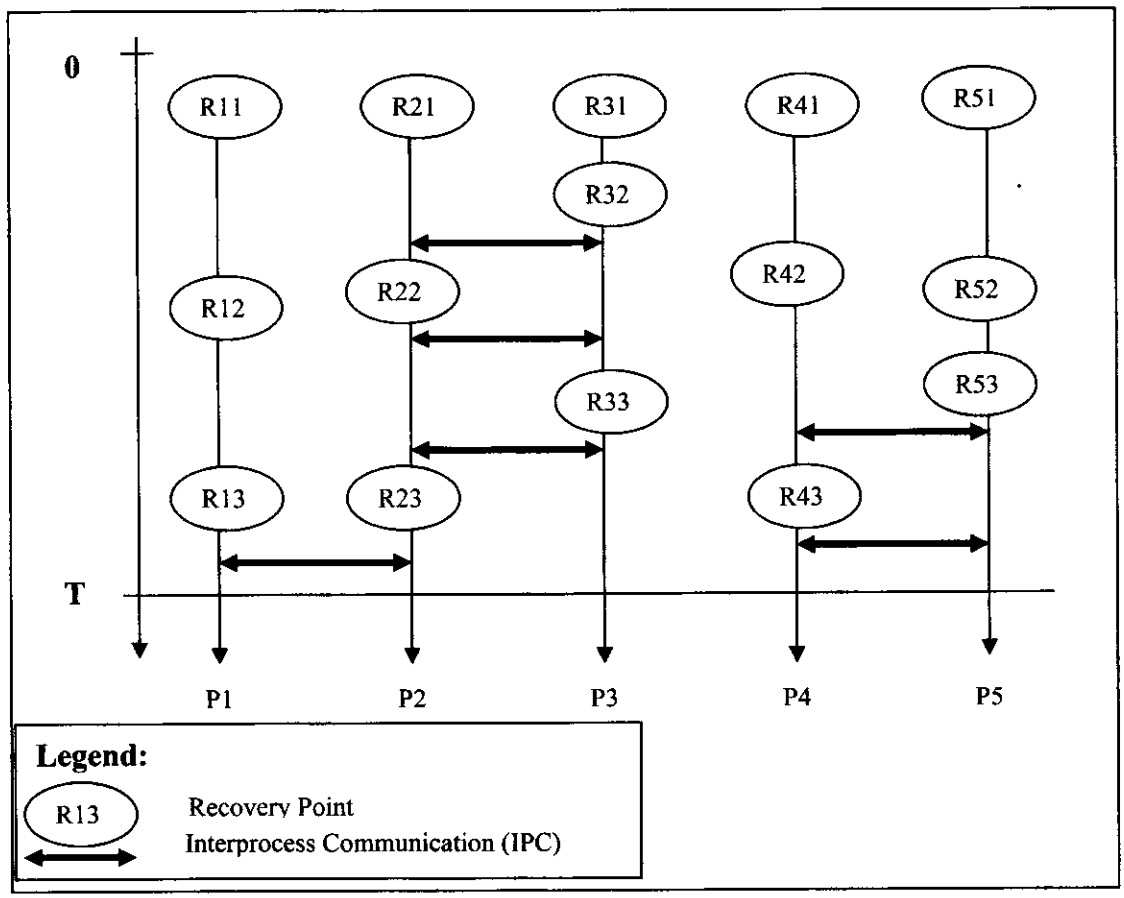

Figure Q4

(a) By using Forward Error Recovery concept, explain what happen if error occurs at:
(i) Process P1 at T time.
(ii) Process P2 at T time.
(iii) Process P3 at T time.
(iv) Process P4 at T time.
(v) Process P5 at T time.

(20 marks)

(b) State process(es) with Domino effect.

(2 marks)

(c) Explain how recovery block can be used to prevent errors in Real Time System.

(5 marks)

(d) Justify **TWO (2)** models that can handle errors in Real Time System.

(6 marks)