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KERTAS SOALAN INI MENGANDUNGI ENAM (6) MUKA SURAT

Instruction: Answer **ALL** questions.

Q1 (a) The reader-writer 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**.

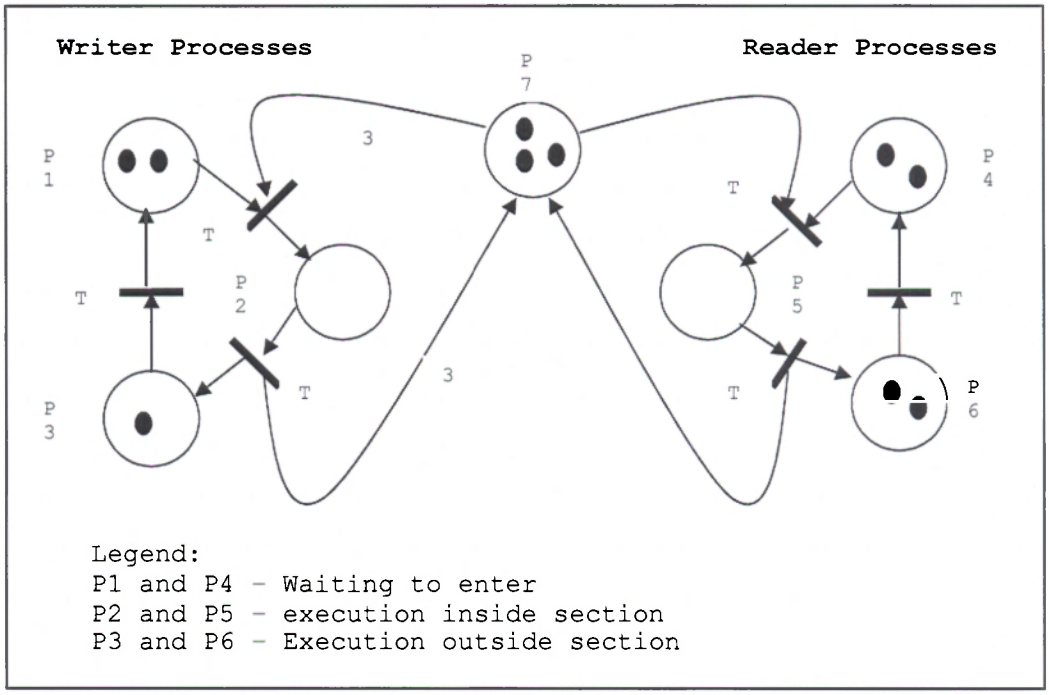

FIGURE Q1: Reader-writer problem modeled with Petri Net.

(a) Explain the firing process in:

(i) Transition TA.

(3 marks)

(ii) Transition TB.

(3 marks)

(iii) Transition TC.

(3 marks)

(b) Based on **FIGURE Q1**, draw a Petri net for the situation where there are at most **THREE (3)** simultaneous reader processes inside the critical section, but also allow **TWO (2)** writer processes in the critical section at the same time but still do not allow reader and writer to be in the section at the same time. (Hint: The place in the middle of **FIGURE Q1** can be viewed as a "semaphore". In this example you should use two "semaphores").

(10 marks)

Q2 (a) Consider a 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 Rate Monotonic Scheduling (RMS) 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 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) Consider the **THREE (3)** processes below. Assume that P1 has the highest priority followed by P2 and P3.

```
P1:: begin…lock(S1); lock(S3); unlock(S3); unlock(S1); end;
P2:: begin…lock(S3); lock(S2); unlock(S2); unlock(S3); end;
P3:: begin…lock(S2); lock(S1); unlock(S1); unlock(S2); end;
```

(i) Draw the priority ceiling protocol to prevent deadlock on P1, P2 and P3 execution.

(6 marks)

(ii) Compute the Worst Case Blocking Time for process P1, P2 and P3.

(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 (R_n).

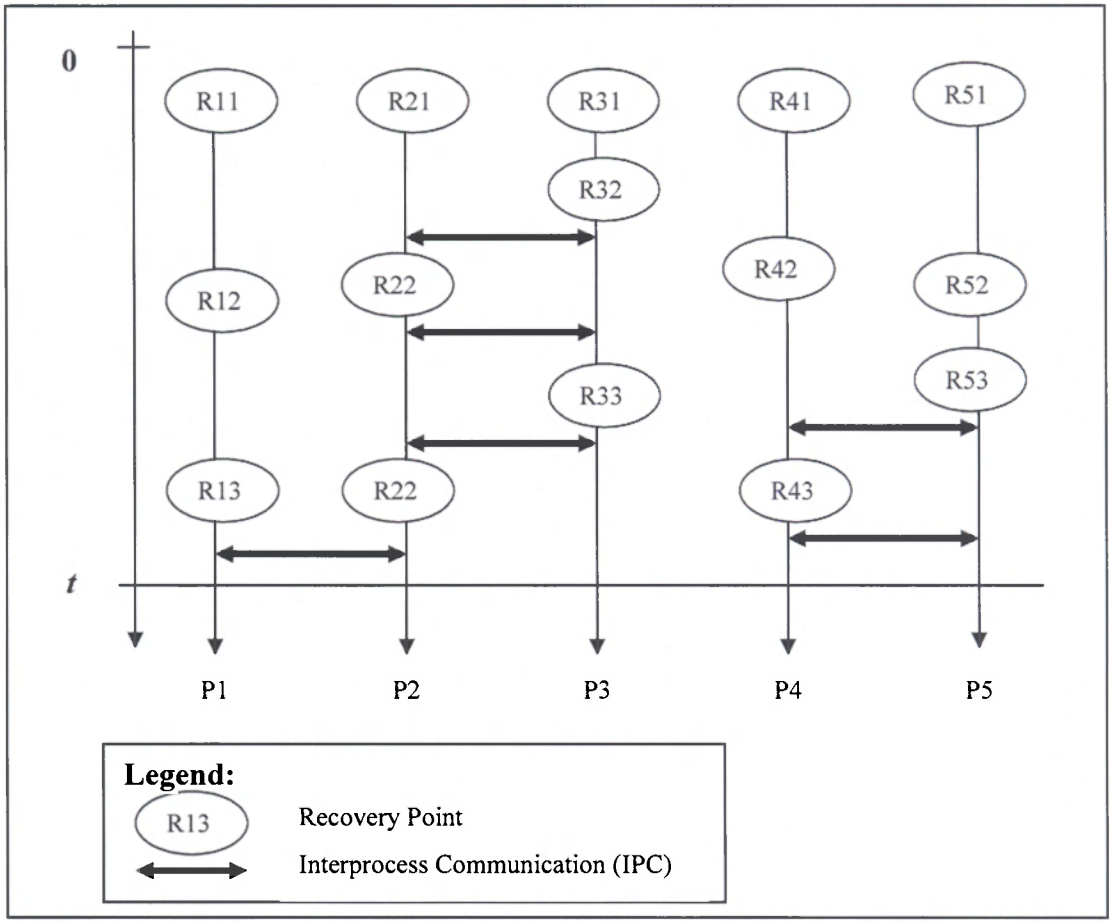

Figure Q4

(a) By using Backward 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 with Domino effect.

(1 mark)

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

(5 marks)

(d) Justify **THREE (3)** models in handling errors in Real Time System.

(9 marks)