

Birla Institute of Technology & Science, Pilani
First Semester 2022-2023
Comprehensive Examination

BITS G553-REAL TIME SYSTEMS Closed Book

Weightage: 35% Duration : 3 Hours Date of Exam :19 Dec 2022

Closed Book max Marks: 30 Suggested Time 45 minutes

Note:

1. All parts of a question should be answered consecutively.
 2. Each answer should start from a fresh page.
 3. All the symbols have their usual meaning unless specified.
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Q1. Which resource allocation protocol algorithm is 'Greedy Algorithm'? Why is it called so? [2]

Q2. Explain the terms mutual exclusion and critical section in resource access? [2]

Q3. Which scheduling approach is most common in Real-Time Operating Systems? Though Round-Robin approach is not suitable for it is used sometimes? Why? [2]

Q4. Compare Mutexes and binary semaphores. [2]

Q5. What are the advantages and disadvantages of using Task Control Block for task management? [2]

Q6. What do you mean by bandwidth preserving algorithms? When they are used? [2]

Q7. What are the various ways a job is blocked by another job in resource access control protocols? Explain with the help of resource graphs. [6]

Q8. Why and when job slicing is done in clock-driven scheduling? [2]

Q9. Why are resource access control protocols required for resources? [2]

Q10. Compare time-relative buffering and ring buffer. [2]

Q11. How is an overlay different from the concept of swapping? What advantage does overlay provide compared to swapping? [2]

Q12. What are the advantages and disadvantages of foreground/background systems [2]

Q13. Which features among the following does an operating system and micro kernel have? [2]

- I) Thread management II) File and Disk support III) Task scheduling IV) User Interface
V) Inter process communication and synchronization

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Weightage: 35% Duration : 3 Hours Date of Exam : 19 Dec 2022

Open Book max Marks: 40 Suggested Time: 2hr 15 minutes

Q1. A system of three tasks $T1(5, 1)$; $T2(6,1.5)$, $T3(10,1)$, $T4(15,2)$ are scheduled using RMA with a sporadic server $Ts(8,1)$. If the sporadic jobs $S_i(r_i, e_i, d_i) = S_1(4, 1, 11)$; $S_2(5, 2, 19)$; $S_3(6, 1.5, 15)$ arrive. Which of the sporadic jobs can be accepted? (Show relevant calculations, partial schedules and specify the reasons for the decision made).

[10M]

Q2. Four periodic task $T_i(P_i, e_i, D_i) = \{(20,3,20), (25,3,21), (14,4,9), (80,7,11)\}$ are scheduled using RMA. They have a resource requirement for resources A, B, C and D as follows

$T1 [A;2[B;1]]$ $T2[C;2[A;1]]$, $T3[D;2]$ $T4[A;5[B;3[C;2[D;1]]]$. The resource access is controlled using basic priority ceiling protocol. $T2$ has a non-preemptible section of 1.0 time units and the context switching time is 0.12 units for all the tasks.

- a) Calculate the maximum blocking times of each of the task due resource contention only.
- b) What is the blocking time because of other factors for each of the task?
- c) Determine whether the system is schedulable without performing an actual simulation.

[12M]

Q3. Provide a Petri Net for a Chocolate Vending Machine. A Choco bar is dispensed only after inserting a proper coin. There is no provision for giving change back. However if a wrong coin is inserted, the coin is returned showing an error sign. The machine shows the error sign for 5 seconds and returns to normal functioning. There is no scope of inserting a coin during these 5 seconds of sending the error signal. Also include the request for refilling after 50 Choco bars are serviced. Write all places and transitions clearly whatever you assume. Give firing table also.

[12M]

Q4. A cyclic scheduler is used to schedule a set of three periodic tasks $T1 = (15, 2)$; $T2 = (10, 2)$ and $T3 = (30, 3)$.

- (a) Find hyperperiod and possible frame size(s) Satisfying all the required constraints.
- (b) Choosing largest frame size, draw a Network Flow Graph for one hyperperiod. **[6M]**