Birla Institute of Technology and Science, Pilani, Rajasthan
BITS G553 Real Time Systems
First Semester 2017-18
Comprehensive Examination (Regular)
Closed book (PART-A)

Max. Marks 25   07-12-2017   **Suggested Time: 75 Min**

Note: Please answer all the parts of a question in one place.
2. Justify your answer wherever needed. Else marks will not be given.
3. Answer the questions concisely- to the point.

Q1. a) Mention any four key differences between a Real-Time Operating System (RTOS) and a general purpose Operating System (GPOS).   [2]

b) Mention any three features of a GPOS or the memory of a general-purpose computing system that may not be preferred in an RTOS or RT computing system. Also mention the reason for the same.   [3]

c) Why should pend and post operations of a semaphore/mutex be atomic?   [1]

d) What is the advantage of a semaphore in terms of implementation? Which disadvantage of semaphore does a mutex remove?   [2]

Q2. What are the necessary and sufficient conditions for deadlock to occur between jobs/processes?   [2]

Q3. a) Which drawback of black-box testing does white-box testing mitigate?   [1]

b) How does Built-in Test Software enhance fault tolerance? What is its disadvantage? What care must be exercised while using it?   [2]

Q4. What is the difference between interoperability and portability? How can we ensure that a software is i) interoperable and ii) portable?   [2]

Q5. a) What is a SoC? How does it accelerate the design process of a system?   [1.5]

b) What is an FPGA? What is its purpose?   [1.5]

c) What is the difference between a DRAM and SRAM? What are their typical applications?   [2]

Q6. a) How does demand paging mitigate external fragmentation?   [1]
b) What is the reason for external fragmentation to occur?   [1]

Q7. Jobs J1, J2 and J3 must all occur for J4 to occur. J4 or J5 or J6 (one of them) must precede J7. Input data is tested in J7 and if certain condition is true, J8 and J9 occur in sequence. If the condition tested in J7 is false, J10 and J9 occur in sequence. J11 executes as long as J9 provides the required data. Represent the above jobs using a task graph.   [3]

Max. Marks:45   07-12-2017   **Suggested Time: 105 Min**
Note: Please answer all the parts of a question in one place.
2. Justify your answer wherever needed. Else marks will not be given.

Q1. Four periodic task T_i (P_i, e_i, D_i)={ (14,2,10) ,(20,4,20), (10,4,9), (100,7,11)} are scheduled

using DMA. They have a resource requirement for resources X,Y and Z as follows

T1 [X;0.5] T2[X;3[Y;1]] T4[Z;4[X;1][Y;1]]. The resource access is controlled using basic

priority ceiling protocol. T4 self-suspends itself for 2 units of time. Determine whether

the system is schedulable.   [15]

Q2. A car navigation system is equipped with a sensor, which continuously maps the obstacles within its periphery in NORMAL mode. If it finds an obstacle dangerously close to the car, it switches to RECOVERY mode. In the NORMAL mode, the user can query the system about the distance from nearest obstacles using DISTAT button. The display screen of the car displays the distance for 5 seconds and goes back to its usual display mode. The display screen displays the current engine temperature, axle rotation (rpm), etc. in the usual display mode. There are sensors which monitor the engine health i.e. its temperature, axle rotation (rpm),etc. If the temperature is beyond certain threshold, the driver is warned by display of a warning message for 5 seconds. If the driver does not respond or take appropriate action, the car goes to RECOVERY mode. If he takes necessary action within 5 seconds, it goes back to displaying usual messages. The obstacle monitoring and engine health-monitoring sub-systems work simultaneously. (Ignore the dependency for the Screen display that they share). In RECOVERY mode, the car decelerates at a set speed. At any point of time user can switch to MANUAL mode where both obstacle monitoring and engine health-monitoring sub-systems are turned off. By default, the car works in the NORMAL mode in which obstacle monitoring and engine health-monitoring sub-systems are turned ON. Represent this system using a state-chart. Define events/ signals clearly.   [10]

Q3. What is the maximum value of e_i so that the system T1(5,2.5,7) T2(6,e_i) T3(4,0.5,3) and T4(10,1) is schedulable using RMA?   [7]

Q4. a)Consider four fixed priority periodic tasks T1 (3,0.5), T2(10,1) and T3(15,1). There is a periodic server Ts (6,1) which is scheduled with the periodic tasks rate monotonically. Is this system schedulable if Ts is a sporadic Server? What are the response times of the aperiodic jobs A1 (4,2) and A2 (5,1)?
b) If Ts is a deferrable server, comment about its schedulability without performing the simulation.   [8+5=13 marks]