BITS Pilani, Dubai Campus
Dubai International Academic City, Dubai

II Semester 2010 - 11

Course	:	**CS C444 Real-Time Systems**
Year	:	**IV Year CS (Elective)**
Component	:	**Comprehensive Examination (Closed Book)**
Date	:	**01-06-2011 (Wednesday)**
Duration	:	**180 mins**
Marks & Weightage	:	**40 Marks (40%)**

Note: Answer all the questions and draw the design neatly considering all possible parameters.

1. Draw the DFD for the Partial Air Traffic Control System. The design will have the following function: "Get_Status" it is clear that this function requires the input " plane_id" before it can retrieve the plane's status from the Airspace_status store. The status of the plane like plane_id, time, position from the process Status_Insert which is receives the required inputs from the Radar Device; similarly, the Airspace_log data store, stores inputs like plane_id, time position from the process called "Log_Insert" which is also connected to the Radar device; The inputs that are collected from the radar are Plane_is and Position; All the information are stored in the data store " Airspace_Status" and the "Airspace_Log". There are other processes like "Status_delete" and "Log_delete" are using the input "Plane_id" from the Communication module. The processed data " Plane_id" from the "Status_delete" process is stored in the Airspace_Statusa and the processed data like " Plane_id and time" from the "Log_delete" process is stored into the data stoe " Airspace_Log". Finally the "Get_status" process will give the details of the plane_id and Status and it can be displayed and can be printed out.(6 Marks)
2. Draw the Finite State Machine for a simple controller for the train crossing gate. Input events are train_entering and train_leaving signals; the output events are open_gate, and close_gate. The state variable count keeps tracks of the number of trains in the crossing_area, like train_entering will be couinted by incrementing the count variable and the train_leaving will be decremented by 1 in the count variable. The states that you can only use in your FSM design are No_trains and one_or_more_trains. (4 Marks)
3. For the Petri Net firing table given below draw the petri net design showing before firing and after firing for each sequence of transitions. (5 Marks)

	P1	P2	P3	P4
M0	1	1	2	0
M1	0	0	3	1
M2	0	0	2	2
M3	0	0	1	3
M4	0	0	0	4

4. In 1997, NASA's Mars Pathfinder Space Mission's Sojourner Rover Vehicle, which was used to explore the surface of mars. In this case the MIL-Std-1553B information bus manager was synchronized with mutexes. Accordingly a meteorological data-gathering task that was of lower priority and low frequency blocked a communication task that was of higher priority and higher frequency. This infrequent scenario caused the system to rest.

   Assume that you are the Real-Time System analyst and you were asked to rectify the problem from the ground station. What will be your actions to overcome the problem faced by the Mars pathfinder? Mention them. (5 Marks)

5. Consider 3 periodic tasks with the following arrival times (s), computation times (c), and periods(p) (which are equal to their respective relative deadlines):

   J1: s1=0 c1=2 p1=d1=5,

   J2: s2=1 c2=1 p2=d2=4 and

   J3: s3=2 c3=2 p3=d3=20

   All the jobs are scheduled on a uni-processor and preemptions are allowed wherever needed. Check whether RM schedule meets all jobs deadlines and also check it gives a feasible scheduling. (5 Marks)

6. Calculate the following: response time a_0, total utilization and check whether the Task T3 is schedulable are not. (6 Marks)

Task	p_i (ms)	e_i (ms)	priority	blocking	Deadline
T1	100	40	?	0	100
T2	150	50	?	0	150
T3	400	70	?	0	270

7. Under what condition, we will choose the Latest Release Time Algorithm to produce a feasible schedule? (2 Marks)
8. When a job is said to be preemptable or non-preemptable. Explain? (3 Marks)
9. Check whether the application given below is *harmonic or not* and calculate the total utilization. (2 Marks)

Task	Runtime e_i	Period p_i	Utilization	Priority
T1	3	9	?	?
T2	6	18	?	?
T3	8	36	?	?

10. What do you mean by Online and Offline Scheduling? Give one example. (2 Marks)

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II - SEMESTER 2010-11

Course Number	:	**CS C444**
Course Title	:	**Real-Time Systems (Elective for IV Year CS)**
Nature of Component	:	**OPEN BOOK**
Date	:	**10.04.2011 (Sunday)**
Weightage	:	**20%**
Duration	:	**50 min**

No. of Pages	:	**2**
No. of Questions:		**6**

Note: *1. Answer all questions. All parts of the question should be answered consecutively. Each answer should start from a fresh page.*
2. Please follow all the instructions to candidates given on the cover page of the answer book.
*3. **Text Books, Reference Books and Lecture notes are allowed.***

1. What do you mean by Job slicing and when does it happen? For the following set of tasks *T1* = (4, 1), *T2* = (5, 2, 7), *T3* = (20, 5) Based on the frame size constraints (1) and (3) check the frame size derived are equal or not? (2 Marks)
2. Construct a efficient DFD for a Billing Application, similar to one at a supermarket check-out stand, for each customer transaction, a running itemized bill is computed and the parameters for the billing applications are as follows: the input ***Transaction_Control*** provides the control data for the start and end of each transaction, denoted by ***start_trans*** and ***end_trans***, respectively. At the end, the itemized bill, named bill, is read from Bill and then ouput by the print_Bill function. The ***Compute_Cost*** function computes the total cost of an item and sends the result to ***Update_Bill*** which then updates the ***Bill*** data. (4 Marks)
3. Find the Hyper period and frame size using the three frame size constraints for the given set of task as shown below: (3 marks)

Task	Period	Deadline	Run-Time
τi	pi	Di	Ci
τ1	4	4	1
τ2	5	5	1.8
τ3	20	20	1
τ4	20	20	2

4. Design a State Chart for the Ringing and lighting the watch alarm application described below: consider a simple digital watch with time, date, hourly chime, and alarm clock functions, and 4 buttons, ***a, b, c, & d,*** for user control. The watch alarm has two super states, one is clock and another is Light, the **clock** super state consists of two sub-super states as ***Main*** and **Ring_alarm**. The **Main** sub-superstate consist of three sub-states as

Normal_display, Chime_alarm_Set and Update states, The transition between Main and the ring_alarm states takes place when the triggering event (Alarm_On) of alarm ring **Alarm_On** $\rightarrow ct = t_{alarm}$ occurs when the condition $ct = t_{alarm}$ becomes true. The notation ***ct*** denotes current time and t_{alarm} is the time to which the alarm clock is set. Pressing any button (the ***any_button***) will cause the alarm to stop ringing; otherwise, the ringing will continue and stop after 30 seconds, denoted by ***timeout*** transition and go back to ***Main*** state. In either case, the ***Main*** sub-superstate is reentered at the same point where it was interrupted by the alarm (***H*** entry); that is, at the default entry of one of the three states of ***Main***. In the ***Main*** sub-superstate the transition are given as below: the start state is of ***Normal_Display*** state, transition takes from ***Normal_Display*** state to ***Chime_Alarm_Set*** when the ***b*** button is pressed, and to ***Update*** state when the ***c*** button is pressed. The Digital watch can come back to ***Normal_Display*** state from ***Chime_Alarm_Set*** when the ***d*** button is pressed and also from ***Update*** state when the ***d*** button is pressed, and also when ***a*** button is pressed the transition takes place from ***Update*** state to ***Normal_Display*** state. Show the concurrency and event broadcasting between the two super states of the statechart. The Light super state, which specifies that the light can be turned on or off with the *d* button and *d'* is the event associated with letting go of the button. The depress button event *d* is broadcast to both the Light and the clock super states. This the principal way that the machines interact and communicate directly. (6 Marks)

5. What do you mean by minor cycle and major cycle time in case of a cyclic executive program? (2 Marks)

6. Give Petri Net's design for a Model communication protocol between TWO processes. The design should consider the parameters like send message, send acknowledge, wait acknowledge, receive acknowledge, buffer between the two process in order to avoid loss of information during communication, process 1 and process 2 and justify your design in order to implement it in the real world of application. (3 Marks)

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BITS Pilani, Dubai Campus
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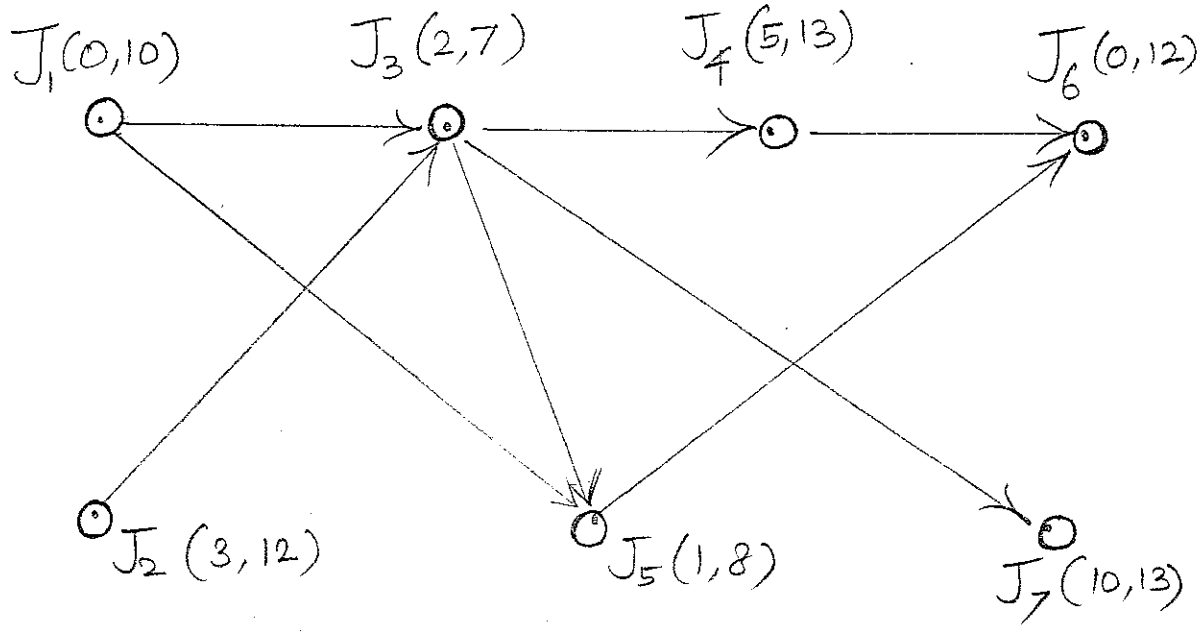
II Semester 2010-11

Course	:	CS C444 Real-Time System (IV CS Year Elective)
Component	:	Test 1 (Closed Book)
Date	:	20-02-2011, Sunday
Duration	:	50 mins
Weightage	:	20% (20Marks)
No. of Pages	:	2 Pages

Note:- Answer all the questions.
Write your answers neat and legible and avoid over writing.

1. Consider the following periodic tasks: T_1 (4, 7), T_2 (4,8) and T_3 (6, 20).
   What is the (3 Marks)
   (a) Hyperperiod.
   (b) Utilization of each task.
   (c) Total Utilization of tasks.
2. Consider the jobs J_1, .. , J_4, each released at time zero and with execution time 1. The mutual dependences are J1 → J_3, J2 → J_4. Draw the schedule of the jobs using TWO processors. (2 Marks)
3. Consider ONE processor, perform preemptive priority scheduling and the following jobs (execution time : 1) and (3 Marks)



(a) Compute the effective release time and deadlines for each job.
(b) Schedule the jobs using 2 Processor using the event driven scheduling (e_i : 1).

4. Is the following task set EDF – Schedulable? Note that the deadlines are not equal to their respective periods. (3 Marks)

Task	e_i	d_i	P_i
T_1	1	5	5
T_2	2	4	10
T_3	3	10	15

5. Schedule on ONE processor the non-preemptive independent jobs. $J_i = (r_i, e_i, d_i)$.

   J1 = (0, 4, 11) , J2 = (2, 5, 8), J3 = (4, 3, 15) Is the LRT scheduling is feasible? Justify your answer. (2Marks)

6. What distinguishes RT systems and non-RT systems? (2 Marks)

7. Classify the following set of real-time application based on their deadlines and justify your answer with proper and valid information in two to three lines. (4 Marks)

   (a) Autopilot
   (b) Nuclear reactor core temperature control.
   (c) Word processor
   (d) Household furnace thermostat

8. What do you mean by Dynamic and Static Scheduling of Multiprocessor system?

   (1 Marks)

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II Semester 2010-11

Course : CS C444 Real-Time Systems Date: 25-4-2011
Year : IV Year CS (Elective) Max. Marks: 10 Marks

Name : _____ **Id. No.:** _____

1. If there are n periodic tasks and they have to be scheduled in a processor and the schedulable is tested based on RMA 1 method. What is equation that represents the RMA 1 Schedulable?
2 Marks

Ans:

2. Check whether the given set of tasks has harmonic periods or not? And also check their utilization, total utilization & check whether all the jobs meet their deadlines.

Task	runtime	period	utilization	priority
T1	7	13	?	?
T2	10	26	?	?
T3	12	50	?	?

2 Marks

3. What are the advantages of prioritizing based on shorter periods? 2 Marks

4. Why the following set of tasks are not schedulable as per RMA1 method? What did you suggest to make these tasks schedulable? 2 Marks

Task	runtime	period	utilization	priority
T1	60	150	?	?
T2	60	220	?	?
T3	120	430	?	?

5. If the T1 has runtime (6 ms), period(15 ms); T2 has runtime(4ms) and period (20 ms); and T3 has run time (5 ms), period (30 ms). The rate of frequency for T1= 66, T2=50 and T3= 34; if loss is 19% per MHz. Check whether the tasks are schedulable using RMA1 method or not? 2 Marks

BITS PILANI, DUBAI CAMPUS,
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QUIZ - I
II Semester 2010-11 (4th Years CS - Elective)

Date: 14-03-2011 (Monday) Course: CS UC 444 – Real-Time Systems Time: 2:15pm to 2.35pm

Name: _____ Id. No. : _____

1. A real-time database contains data objects, called _____ that represent real-world objects.
2. The _____ of a job is the instant of time by which its execution is required to be completed.
3. On-line Transaction systems have _____ deadline and is a _____ real-time system.
4. The release times of jobs are not known until the event triggering them occurs. These jobs are called _____ or _____ because they are released at _____ of time.
5. The execution time of a job J_i is the range _____, where _____ and _____ are the minimum execution time and maximum execution time of J_i.
6. A task is _____ if the jobs in it have either soft deadlines or no deadlines.
7. The _____ algorithm has been used for scheduling real-time traffic in high speed switched networks.
   a) EDF b) LRT c) weighted round-robin d) none of the above.
8. One way to implement a scheduler that makes scheduling decision periodically in time-driven approach of scheduling is to use a _____.
   a) fixed time slice b) hardware timer c) both d) none of the above.
9. What is the other name for the priority-driven approach: _____.
   a) First-In-First-Out, b) time slice approach, c) event-driven, d) none of the above.
10. What is the algorithm which assigns priorities to jobs according their release time's _____. a) EDF b) LST, c) LRT, d) LIFO.
11. _____memory uses a single transistor per bit.
    a) EEPROM b) PROM, c) UVROM d) Flash.
12. In Programmed I / O method , an _____ instruction will transfer data from a specified I/O device into a specified CPU register. a) PUSH, b) POP, c) LOAD, d) IN.
13. Programmable Logic Arrays are sometimes called _____.
14. The *enable priority interrupt* is used to enable interrupts for processing by the _____.
    a) CPU, b) memory-mapped IO, c) programmed IO, d) none of the above.
15. The DMA controller is responsible for assuring that only one device can place data on the bus at any time, this process is called _____.
16. A / D circuitry converts continuous signals into _____ ones.
    a) linear, b) nonlinear, c) discrete, d) none of the above.