BITS Pilani - Dubai Campus
Knowledge Village, Dubai
II – Semester 2005-2006

Number of Pages	:	3
Number of Questions	:	14

Course Number	:	CS UC 444
Course Name	:	Real-Time Systems
Nature of Component	:	**Comprehensive Examination**
Weightage	:	40%
Max. Marks	:	40 Marks
Duration	:	180 minutes
Date of Examination	:	24.05.2006

Note: 1) Please follow all the instructions to candidates given on the cover page of the answer book.
2) All parts of the question should be answered consecutively. Each answer should start from a fresh page.

1. Give the 0-address machine, 1-address machine, 2-address machine and 3-address machine coding for the expression given below: $a = (b + c) * d - e$ (3 marks)
2. For a given set of tasks to a processor, and their deadlines & release times are same, under this condition what will be the algorithm used for the assigning the priorities to the tasks in order to schedule tasks for execution? (1 marks)
3. Check whether the task T3 is schedulable are not? Calculate the total utilization, also assign priorities to the tasks and mention on what basis the priorities are assigned. (3 ½ marks)

Task	pi (ms)	ei (ms)	priority	Blocking	Deadline
T1	100	40	?	0	100
T2	150	50	?	0	150
T3	400	70	?	0	270

4. Give the difference between the priority-inheritance and priority-ceiling protocol. (3 marks)
5. Why is it important for a real-time system to have a watchdog timer? Is a timer interrupting routine an appropriate point in the software to reset the watchdog timer, why or why not? (3 marks)
6. Show the Moore Finite State Automata to accept the words "cab", "cob", "cat", "cot" but no others from the alphabet L = { a, b, c, t, o}. (2 marks)

7. Consider a real time weapon control system aboard an aircraft. Discuss (provide a brief explanation) which of the following events would be considered synchronous and which would be considered asynchronous to the software: (2 ½ marks)

   a) A divide-by-zero error.
   b) A built-in-test software failure.
   c) A ten millisecond clock interrupt.
   d) A signal indicating the pilot has pressed the "fire rocket" button.
   e) A signal indicating "low on fuel".

8. Check whether the given set of task is schedulable or not using RMA Schedulability concept? (2 ½ marks)

Task	Priority	Period	Execution Time	Utilization
1	?	100	15	?
2	?	200	50	?
3	?	300	100	?

9. Give the advantages of Programmed IO real-time technique over Memory-Mapped IO. (1 ½ marks)

10. Construct a partial Data Flow Diagram for Air Traffic Control systems, some of the data and functional requirement for monitoring the entry, exit and traversal of planes in an airspace are given below: Planes entering the space are sensed by the **radar** input, the **communication** input identifies planes that leave the space. The current contents of the space are maintained in the data area **Airspace_status.** A log or history of the space is kept in the **Airspace_log** storage. An air traffic controller can request the display of the status of a particular plane through the **operator** input. It's clear that **Get_status** function requires the operator input **plane_id** before it can retrieve the plane's status from **Airspace_status** storage.

(3 marks)

11. Design a Smart Traffic Light System using the important four components, each specified by a finite state automaton: Pedestrian, Sensor_Controller, Car_Traffic_Light, and Pedestrian_Traffic_Light. The detailed definition of the problem is as follows: When a pedestrian approaches the beginning of the pedestrian crosswalk for the traffic intersection, he/she is detected by a sensor_controller. The sensor_controller then sends a signal to the car traffic light to make it turn to red. This car traffic light turns to yellow and then to red, and in turn sends a signal to the pedestrian traffic light to make it turn on the "walk" sign. This walk sign should turn on before the pedestrian starts crossing the intersection.

Another sensor detects when the pedestrian finishes crossing and the sensor_controller sends a signal to the pedestrian traffic light to make it turn to "don't walk". The pedestrian traffic light then turns to don't walk and sends a signal to the car traffic light to make it turn to green. The Pedestrian automaton communicates with the **sensor_controller** automaton with the **new_pedestrian** event to indicate a pedestrian approaches the intersection. The event **crossing** and **end_crossing** indicates the beginning and the end of crossing by the pedestrian. The event of nothing happening is **idle.** The sensor_controller automaton communicates with the Car_Traffic_Light automaton with the **turn_end** event to signal it to turn **red.** Note that Car_Traffic_Light turns **yellow** before turning **red.** The Car_Traffic_Light automaton communicates with the Pedestrian_Traffic_Light automaton with the is **red** event to indicate that cars should have stopped and signal it turn to walk. (7 marks)

12. Mention the Algorithms some under the fixed-Priority Scheduler and Dynamic-Priority Scheduler in a Uni-processor Scheduling? (2 marks)
13. Consider there are three periodic tasks with the following arrival times, computation times, and periods. The periodic tasks parameters are as follows: J_1 (0, 2,5); J_2 (1, 1, 4); and J_3 (2, 2, 20). Check whether the RM scheduler produces a feasible schedule or not; and also check that whether the periodic tasks meets their deadlines are not. (3 marks)
14. 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 τi	Period pi	Deadline Di	Run-Time Ci
$\tau 1$	4	4	1
$\tau 2$	5	5	1.8
$\tau 3$	20	20	1
$\tau 4$	20	20	2

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II - SEMESTER 2006-2007

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

Course Number	:	**CS UC 444**
Course Title	:	**Real-Time Systems (Common Elective for IV Year CS/EEE/EIE)**
Nature of Component	:	**OPEN BOOK**
Date	:	16.04.2006 (Sunday)
Weightage	:	20%
Duration	:	50 mins

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. Construct a DFD for a Billing Application and the parameters for the billing applications are allow: the input ***Transaction_Control*** provides the control data for the start and end of each transaction, denoted by ***start_trans*** and ***end_trans***, respectively. The itemized bill is maintained in the ***Bill*** storage area. At the end, the itemized bill, named ***bill***, is read from ***Bill*** and then output 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)
2. Give a finite state machine (**fsm**) in a state diagram form that distinguishes among the three input objects: ***identifiers, unsigned integers, and other strings.*** The input alphabet or set of events is **I=*{l,d,b,$}***, where ***l*** denotes an alphabetic character, ***d*** is a digit, i.e., ***d*** in ***{0,1,...,9}***, ***b*** is the "blank" or space characters and ***$*** represents any special character, such as @,#,or !. An ***identifier*** is any string of alphabetic characters and digits, starting with an alphabetic character and surrounded by one or more blanks. Your **fsm** should have a separate halt state for each of the three possible input objects. (5 Marks)
3. Design a State Chart for the Ringing 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, and d,*** for user control. The ***Main*** Superstate consist of three substates as ***Normal_display, Chime_alarm_Set and Update*** states, and one non substate of ***Main*** superstate is ***Ring_Alarm*** state. The triggering event (Alarm_On) of alarm ring **Alarm_On** $\rightarrow ct = t_{alarm}$ occurs when the condition $ct = t_{alarm}$ becomes true. ***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 stop after 30

seconds, denoted by ***timeout*** transition and go back to ***Main*** state. In either case, the ***Main*** 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*** 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 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. (5 Marks)

4. Calculate the frame size for the given task set, calculation of the frame size done based on the three frame size constraints. Also calculate the Hyperperiod for given set of tasks. (2 Marks)

T_i	p_i	e_i	D_i
T_1	15	1	14
T_2	20	1	14
T_3	22	3	22

5. Under what condition the construction of a static schedule off-line jobs and state whether the over-run of jobs take place or not in static schedule. (2 Marks)
6. What is the need of slack stealing in a cyclic schedule of the periodic tasks, explain it with a appropriate example. (2 Marks)

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BITS, Pilani – Dubai Campus
Knowledge Village, Dubai
II – Semester 2006

Version - B

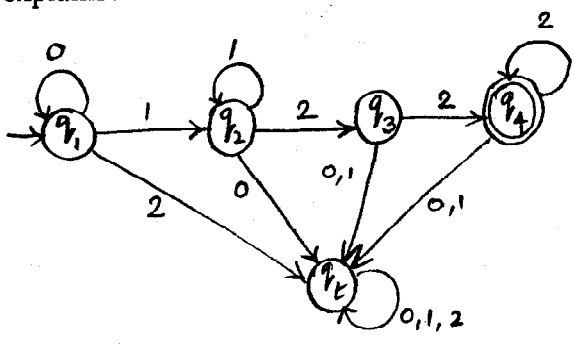
Quiz – I

Course Number & Title : CS UC 444 – Real – Time Systems
Weightage : 10%
Date : 16.03.2006 Duration : 30 mins

1. Watchdog Timer is useful in detecting deadlocks. Incidentally, resetting the timer is sometimes called _____.
2. The _____ algorithm has been used for scheduling real-time traffic in high-speed switched networks.
3. The DMA controller is responsible for assuring that only one device can place data on the bus at any one time, and this role is called _____.
4. A Multiprocessor systems and distributed systems are called dynamic system, because the jobs are _____ to processors.
5. Warnier – Orr Notation is a representation methodology that is similar to structure charts, with several improvements. (True / False)
6. When an aperiodic job is released, it is placed in the queue without the attention of the scheduler. (True / False)
7. Draw a generic One-State Automaton for a regular expression denoting the strings that it accepts is R*.

   Answer:

8. Least-Slack-Time-First algorithm is sometime called as _____ algorithm.
9. A Periodic Task Ti is a 4-tuple (ϕ_i, p_i, e_i, D_i), represents _____.
   a. (period, frames, execution time, deadline)
   b. (period, phase, execution time, absolute deadline)
   c. (phase, period, execution time, relative deadline)
   d. none of the above
10. Brief the following design and what the design explains?



11. ***Structure Charts*** are otherwise called as _____.

12. Petri nets are another type of Mathematical Model used to specify the operations to be performed in a Multiprocessing or Multitasking environment. (True / False)

13. ***Programming Design Language*** differ slightly from ***pseudocode.*** (True / False)

14. The major ***weakness*** that seems to be inherent in *dataflow diagram* is that they make it difficult to depict synchronization in flow. (True / False)

15. Once an overall dataflow diagram has been drawn, further detail within the process blobs is provided. The diagram is then redrawn with the additional detail. This *process* is called _____.

    a) Structure approach b) Finite State Automata c) leveling d) Petri nets

16. One way to implement a scheduler that makes scheduling decision periodically in time-driven approach of scheduling is to use a _____.

17. A / D circuitry converts continuous signals into _____ ones.

    a) Linear, b) nonlinear, c) discrete, d) none of the above

18. _____memory uses a single transistor per bit

    a) EEPROM b) PROM, c) UVROM d) Flash

19. Programmable Logic Arrays are sometimes called _____.

20. What is the algorithm which assigns priorities to jobs according their release time's _____.

    a) EDF b) LST, c) LRT, d) LIFO

BITS, Pilani – Dubai Campus
Knowledge Village, Dubai
Second Semester – 2006

Course Number	:	**CS UC 444 – Real-Time Systems**
Nature of Component:		**Closed Book - Test – I**
Date of Examination	:	26.02.2006 (Sunday) -- 50 mins
Weightage	:	20 %

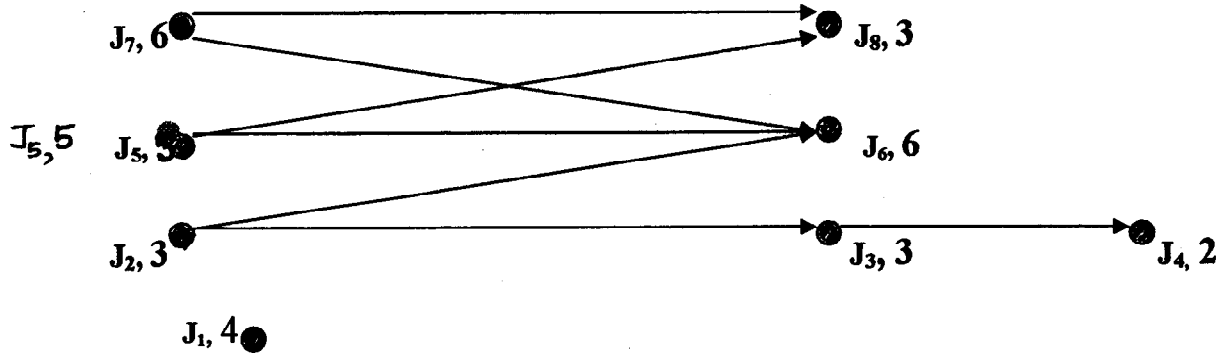
Note: ***All questions are compulsory. Write any assumption made with its requirement. Symbols have usual meaning.***

1. What is major constraint that distinguishes Real-Time System from Non-Real-Time System? (1 mark)
2. Under what condition, we will choose the Latest Release Time Algorithm to produce a feasible schedule.(3 marks)
3. Give the definition and their notation for Relative Deadline and Absolute Deadline. (2 mark)
4. Explain Time-Driven and Event-Driven approach of Real-Time scheduling (2 marks)
5. Discuss (a) whether an embedded system is a Hard or Soft Real-time systems, justify. (3 marks)

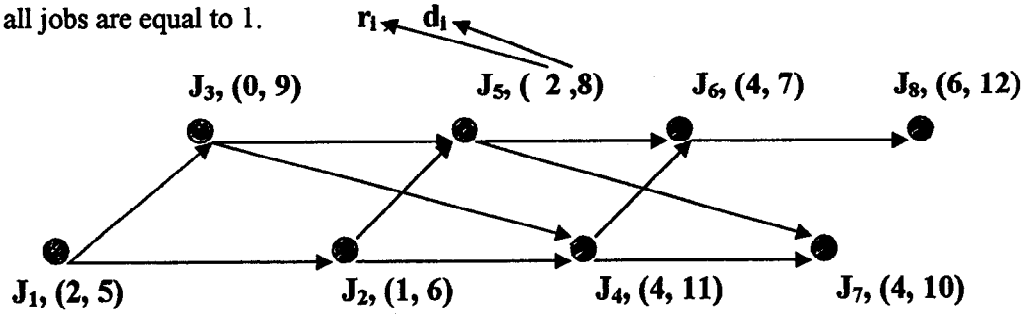
   (b) Whether a Non-Embedded system is Hard or soft Real-Time system. Explain these with an example.
6. A Classical precedence graph with all its edges represent precedence constraints is shown below with their timing constraints, job 5 is released at time 5 and all the other jobs are released at time zero. You have to give the schedule and execute the jobs on two processors based on priority-driven scheduling under the two possible case:

   a) Preemptive and

   b) Non-Preemptive (4 marks)



7. Calculate the effective timing constraints for the precedence graph given below, and also draw the Timing Diagram for the original precedence graph using two processors based on EDF Scheduling Algorithm, and the execution time of all jobs are equal to 1. (5 marks)



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