Tribhuvan University

Institute of Science and Technology

Bachelor of Computer Science and Information Technology

Detailed-Syllabus: Real Time Systems (CSC-354)

Sixth Semester

Lesson Plan:

S.N.	Chapters	Descriptions	Time Hrs.	Hours
1.	Unit 1. Introduction	Digital control - example	0.5	3
		High level controls – examples of control hierarchy, guidance and control, real time commands and control	1	
		Signal processing – radar system	0.5	
		Real time applications – issues and examples	1	
2.	Unit 2. Hard versus Soft real time systems	Jobs and processors, release time, deadlines and timing constraints, hard and soft timing constraints	1.5	4
		Common definitions, hard timing constraints and temporal quality of service guarantees	0.5	
		Hard real time systems	1	
		Soft real timing systems	1	
3.	Unit 3. Reference model of real time systems	Processors and resources, temporal parameters of real time workload	1	4
		Periodic task model	1	
		Precedence constraints and data dependency, other dependency	1.5	
		Functional parameters-figure of usefulness function, resource parameters-concepts only, scheduling hierarchy-concepts only	0.5	
4.	Unit 4. Approaches to real time scheduling	Clock driven approach, weighted round Robin approach, priority driven approach, dynamic versus static systems	1.5	4
		Effective release time-example, optimality of EDF & LST algorithms-theorem (with proof)/corollary (without proof) and example, Non-optimality of EDF & LST algorithms-theorem/corollary (without proof) and example	2	
		Challenging in validating timing constraints in priority driven systems-anomalous behavior of priority driven systems with example only, office versus online scheduling-concepts only	0.5	
5.	Unit 5. Clock driven scheduling	Notations and assumptions. Static, time driven scheduler, general structure of cyclic schedules	2.5	5
		Cyclic executives-concept only (without algorithm), improving the average response time of aperiodic jobs-slack stealing with an example, scheduling sporadic jobs-acceptance test, EDF scheduling of accepted	1.5	

		jobs with an example (without algorithm)		
		Practical considerations- concepts only, algorithm for constructing static schedules- network flow graph only, pros and cons of clock driven scheduling-concepts only	1	
6.	Unit 6. Priority driven scheduling of periodic tasks	Static assumptions, fixed priority versus dynamic priority algorithms – (without relative merits)	2	6
		Maximum schedule utilization-theorem (without proof), example of infeasible EDF schedules, optimality of RM & DM algorithms- only (without proof)	1	
		Scheduling test for fixed priority tasks with short response times-critical instants, theorem (without proof) and example, schedulability test for fixed priority tasks with arbitrary response times-busy intervals, general scheduling test (general time demand analysis method- statements only)	1.5	
		Sufficient schedulability conditions for RM & DM algorithms- theorem only (without proof), practical factors- concepts only	1.5	
7.	Unit 7. Scheduling aperiodic and sporadic jobs in priority driven systems	Assumptions and approaches- objectives, correctness and optimality only, deferrable servers- operations of deferrable servers only, sporadic servers- sporadic server in fixed priority systems only	3	6
		[Constant utilization, total bandwidth and weighted fair queuing servers]- concepts, theorems/corollary (without proof) only	1	
		Slack stealing in deadline driven systems- example of deadline stealer, slack stealing in sixed priority systems-optimality criterion and design consideration with an example, [scheduling of sporadic jobs- real time performance for jobs with soft timing constraints, two level scheme for integrated scheduling]- basic concepts only	2	
8.	Unit 8. Resources and resource access control	Assumptions on resources and their usage, effects of resources contention and resource access control	1	5
		Non-preemptive critical sections, basic priority inheritance protocol-definition of basic priority inheritance protocol	1	
		Basic priority ceiling protocol- definition of basic priority ceiling protocol, stack based, priority ceiling (ceiling priority) protocol- motivation and definition of stack sharing priority ceiling protocol	1	
		Use of priority ceiling protocol in dynamic priority systems- implementation of priority	1	

		ceiling protocol in dynamic priority systems. Preemption ceiling protocol- preemption levels of jobs and periodic tasks, definitions of protocols and duration of blocking (motivation and assumptions only)		
		Controlling access to multiple unit resources- priority (preemption) ceiling of multiple unit resources, controlling concurrent accesses to data objects- convex ceiling protocol(motivation and assumptions only)	1	
9.	Unit 9. Multiprocessor scheduling. Resource access control and synchronization	Model of multiprocessor and distributed systems	1.5	5
		Task assignment- task assignment based on execution time requirements (simple bin packing formulation only), multiprocessor priority ceiling protocol- blocking time due to resource contention	1.5	
		Elements of scheduling algorithms for end-end periodic tasks- interprocessor synchronization protocols (greedy synchronization protocol only), end-to-end tasks in heterogeneous systems- corollary (without proof)	1.5	
		Predictability validation of dynamic multiprocessor systems	0.5	
10.	Unit 10. Real time communication	Model of real time communication	1	6
		Priority based service disciplines for switched networks- weighted fair queuing discipline	1	
		Weighted round Robin service disciplines- greedy WRR discipline	1	
		Medium access control protocol of broadcast networks- medium access protocols in CAN and IEEE 802.5 token ring	1	
		Internet and resource reservation protocols- issues in resource reservation	0.5	
		Real time protocols	1	
		Communication in multi computer systems- wormhole networks	0.5	
			Total	45

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Semester: Sixth

Course: Real Time Systems

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Model Question

Full Marks: 80 **Pass Marks: 32**

Long Answer Questions

Attempt any two questions. [2x12=24]

1. What do you understand by Priority driven algorithms? State and prove the optimal Earliest Deadline First (EDF) Theorem.
2. What do you understand by slack stealing in dead line driven systems? Explain the operation of a slack stealing with a suitable example.
3. What is multiprocessor priority ceiling protocol? Describe it with the help of suitable diagrams.

Short answer questions

Attempt any eight questions. [8x7=56]

1. Define wormhole networks used for communication in multiprocessor systems. Describe routing and transmission mechanism in a wormhole networks.
2. Describe the terms tracking and gating used in a radar signal processing system.
3. Differentiate between hard real time systems and soft real time systems. Give three examples of each.
4. Define temporal parameter of real time workload? Explain different types of temporal parameters of a job.
5. How does the system handle frame overruns in a clock-driven scheduling? Explain.
6. What do you understand by 'Busy Intervals' in fixed priority tasks with arbitrary response times? Explain.
7. What are the objectives and levels of two level schemes for integrated scheduling?
8. Explain 'Priority Inversion' caused by resource contention, with suitable example.
9. Describe a real-time communication model with the help of suitable diagram.
10. Write sort notes on
    a. Identical versus heterogeneous processors
    b. Fixed priority versus dynamic priority algorithms