

EECS 507: Introduction to Embedded Systems Research  
Midterm Exam  
11 March 2021

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You have until 60 minutes for the exam, and a 20 minutes grace period to upload it to Gradescope (or, if special arrangements were made, to email it to me). If you email, you should not consider it submitted until you receive confirmation from me. It must be to me by 2:50pm.

Open book. Open notes. Open internet. No communicating with anybody except the teacher about the exam. This remains true even after you have submitted the exam. I'll tell you when it is O.K. to discuss.

If you can print and scan/photograph, do that and upload to Gradescope instead of using the forms. If you cannot print and scan/photograph, then use the forms to the degree possible and submit the exam to me via both Gradescope and email. Only those using forms need also email.

There are answer length limits to control exam duration. For the sake of fairness, if you exceed the length limits, I will evaluate only the portion of the answer within the length limit.

Skim all the questions before starting so you can budget your time. They have different difficulties, but each is worth similar credit; that's intentional.

Printed name

Sign below to acknowledge the Engineering Honor Code: "I have neither given nor received aid on this examination, nor have I concealed a violation of the Honor Code."

Signature

- 12 1. What is the primary disadvantage of static scheduling that on-line scheduling overcomes? Use two or fewer sentences.
- 12 2. Indicate two distinct reasons the particular assignment of tasks to PEs during embedded system design/synthesis may influence adherence to system-level deadlines. Use two sentences in total.
- 12 3. Has the general graph coloring problem been proven to require exponential worst-case time in terms of problem instance size? Yes    No
- 12 4. What is the main challenge customer discovery interviews are structured to overcome? Use two or fewer sentences.
- 12 5. Give the Pareto-rank of each of the following solutions, given that price, power consumption, and delay are all costs.

Solution	Price (\$)	Power (mW)	Delay (ms)	Pareto-rank
1	20	50	500	
2	10	70	100	
3	14	20	50	
4	300	150	20	

- 14 6. Consider the following table, which indicates the power management state dependent power consumptions of components in an embedded system.

Component	Power consumption (mW)		
	Active	Standby	Sleep
CPU	500	200	10
Wireless	900	800	0
Gimbal	1200	n.a.	0
Ion accelerators	2000	1500	0

The components have the following activity distributions.

Component	Active	Standby	Sleep
CPU	5%	85%	10%
Wireless	3%	5%	92%
Gimbal	1%	0%	99%
Ion accelerators	1%	1%	98%

Check the design change that would extend battery lifespan more?

Enable the CPU to spend 5% more time in Sleep mode by reducing its time in Standby mode.

Reduce the CPU's active power consumption by 20%.

Show your work to make partial credit possible.

- 12 7. If you were designing an energy scavenging necklace capable of recording video during interesting events, what are the two most important questions that need to be answered to determine whether energy scavenging is feasible?

- 14 8. Given the assumptions in Liu's and Layland's paper, determine minimum processor speed, in MIPS, to allow all deadlines to be satisfied for a task set containing two tasks with periods 2 ms and 3 ms. At 1 MIPS, the execution time of each task is equal to its period. This is a particular question about this specific task set, not a question about a bound for arbitrary task sets.

MIPS:

Show your work.