

# Lecture 0: Course Overview

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Embedded Real-Time Systems

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## Teacher

- Seyed-Hosein Attarzadeh-Niaki
  - PhD in Electronic and Computer Systems (KTH, 2014)
- Research interests
  - System-Level Modeling and Design of Intelligent Embedded and Cyber-Physical Systems
  - Design-Space Exploration Problems
- Contact
  - Course-related: Courseware
  - Other stuff: [h\\_attarzadeh@sbu.ac.ir](mailto:h_attarzadeh@sbu.ac.ir)

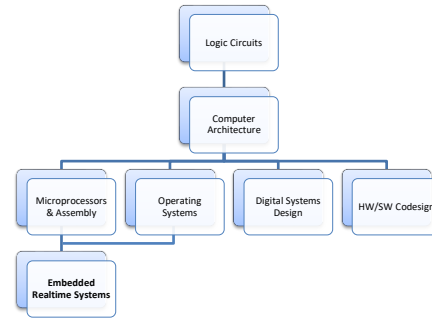


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# Positioning

- Programming Languages
  - C
- Operating Systems
  - Processes and threads
  - Scheduling
- Computer Architecture
  - Computer Organization
  - Instruction set
  - Memory hierarchy
- Microprocessors
  - Memory and IO peripherals
  - System programming and Assembly



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# Course Requirements

- Pass the exams
- Complete the exercises in time
  - Analytical
  - Computer-based
  - Usually one week after they are announced
- Perform and present the course project
- **Active** participation in lectures and tutorials
  - Quizzes and online questions
  - Tutorial attendance

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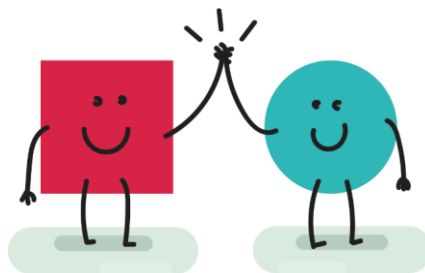
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## Exams and Grading

- The mid-term exam
  - Exact time will be announced
  - Topics: modeling, design
  - $\approx 5$  points
- The final exam
  - Topics: all the topics
  - $\approx 7$  points
- Exercises
  - $\approx 6$  points (0 or 1 for each exercise)
- Course Project
  - 2 points (with possible bonus points)
- Active participation
  - $\pm 2$  points

## Group Work

- Many activities in this course are performed in a group
  - Two students
  - Exercises and the course project
- You also present your work as a team;
  - but may be evaluated individually
- Pick a friend with whom you are comfortable to collaborate



However, you should still be able to do everything individually.

# Course Material

No single book covers all the material in this topic

- Lee, Edward Ashford, and Sanjit Arunkumar Seshia. *Introduction to embedded systems: A cyber-physical systems approach*. Second Edition, MIT Press, 2017. (V2.2) [Main book](#)
- Marwedel, Peter. *Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things*. Vol. 4. Springer, 2021.
- Wolf, Marilyn. *Computers as Components: Principles of Embedded Computing System Design*. Vol 4. Elsevier, 2016.

Practical sources

- Pan, Tianhong, and Yi Zhu. *Designing Embedded Systems with Arduino*. Springer, 2018.
- Mathworks documentations



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# Covered Topics

## Introduction to embedded real-time systems

- Properties of embedded realtime systems
- Embedded software design

## Model-based design

- Sequential models of computation (MoCs) and FSMs
- Concurrent MoCs: synchronous and asynchronous composition
- Modeling physical dynamics

## Embedded platforms and system design

- Embedded processors and memories
- IO ports and devices
- Sensors and actuators
- A/D and D/A converters

## Real-time OS and software

- Realtime scheduling

## Implementation and mapping to target platform

- Code generation
- Optimization

## Complimentary topics

- Quality
- Safety
- Security

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## How Do We Conduct The Course?

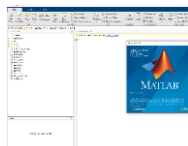
- It is a senior undergraduate-level course
- Main concepts are discussed in the lectures
  - Not the boring details
- Students read the specified material to understand the remaining details
- Exercises and project will (hopefully) help to deepen your understanding of the subject

Read the material, do not  
record/listen to lecturer's voice!

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## Tools Used in the Course



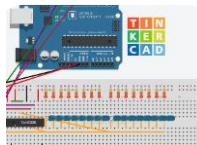
MATLAB



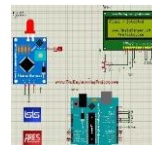
Simulink



Platform IO



TINKERCAD



Proteus

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