

Course Title: Cyber-Physical Embedded Systems

A Program Elective Course (UG3 / UG4) for CSE by Dr. Balaji Raman

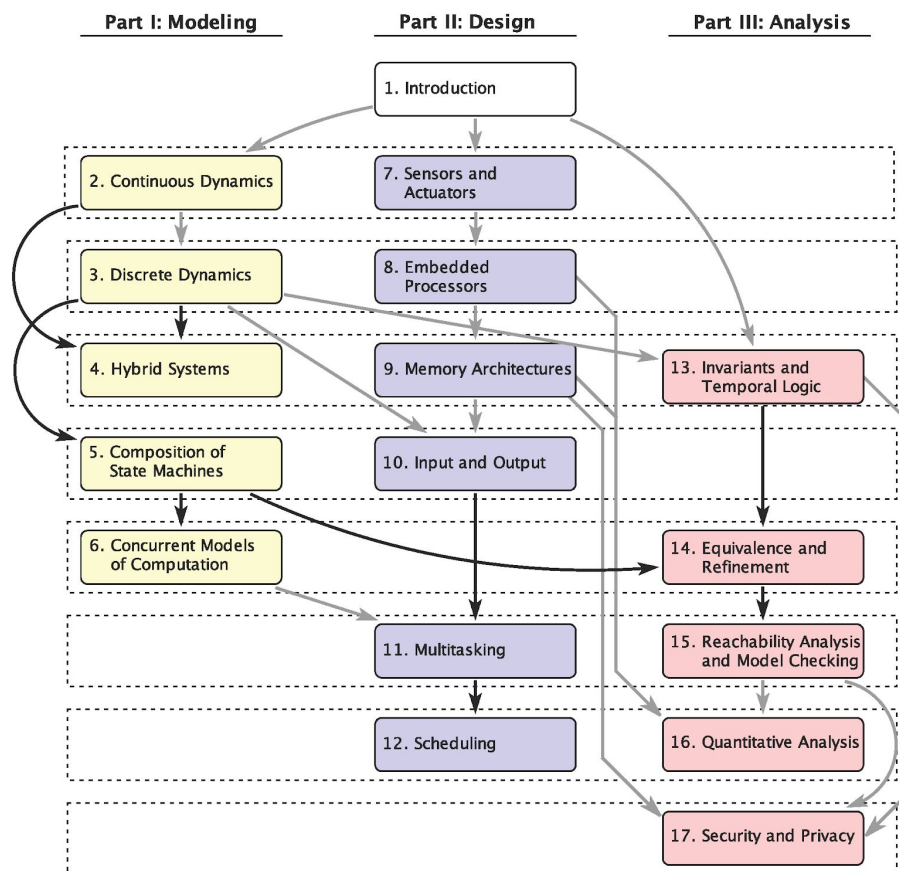
L-T-P-C: 3 - 1 - 0 - 4 (4 credit course; 3 Lectures per Week; 1 Tutorial)

Prerequisite:

Students should have familiarity with computer system organization, computer programming, basic discrete mathematics, algorithms, and signals and systems.

Course Introduction:

This course closely follows the [textbook from Edward Lee and Seshia](#). You can see below the [structure of this book](#) to understand the contents and flow of this course. Students should not misunderstand that this is a hardware-oriented course; this course is part hardware, part software, and part analytical.



Course Outline (Topics):

Part 1: Modeling

- ❑ Modeling Dynamic Behaviors and Control: Continuous Dynamics (Chapter 2),
- ❑ Discrete Dynamics (Chapter 3), and
- ❑ Hybrid Systems (Chapter 4),

Part 2: Design

- ❑ Design and Implementation: Sensors and Actuators (Chapter 7),

- ❑ Embedded Processors (Chapter 8), and
- ❑ Memory Architectures (Chapter 9),

Part 3: Analysis

- ❑ Analysis and Verification: Invariants and Temporal Logic (Chapter 13),
- ❑ Equivalence and Refinement (Chapter 14), and
- ❑ Reachability Analysis and Model Checking (Chapter 15).

Textbooks:

1. Edward A. Lee and Sanjit A. Seshia, *Introduction to Embedded Systems, A Cyber-Physical Systems Approach, Second Edition*, MIT Press, ISBN 978-0-262-53381-2, 2017.

Reference Books:

2. Rajeev Alur, *Principles of Cyber-Physical Systems*, MIT Press, ISBN: 9780262029117, 2015.

Course Work:

Course grades will be based on the following weightage pattern.

- Examinations: 50%
 - Mid Semester Exams (There is no Mid Exam 1, but there is a Mid Exam 2): 15%
 - End Semester Exam: 35%
- Project: 30%
- Quizzes: (Two): 20%

Resources:

- a) Introduction to Embedded Systems (EECS 149/249 A)
By Edward Lee, University of California, Berkeley, USA
Link: <https://ptolemy.berkeley.edu/projects/chess/eecs149/>
<http://chess.eecs.berkeley.edu/eecs149/>
- b) MOOC course on Cyber-Physical Embedded Systems offered in EdX platform
Link: [EECS149.1x](https://www.edx.org/course/eeecs149.1x)

The overall usefulness of the course:

- The Embedded Systems industry is evolving to Cyber-Physical Systems. There are a lot of potentials for software engineers to get hired into these industries (that is, the company that focuses on Cyber-Physical Systems).

Instructor:

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