# Control Theory B - Course Syllabus

**Course Number:** EE271B

**Course Title:** Control Theory B

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| **Academic Semester:** | Summer | **Academic Year:** | 2015/ 2016 |
| **Semester Start Date:** | June 6, 2016 | **Semester End date:** | August 4, 2016 |

**Class Schedule:** Mondays, Thursdays from 2 PM to 5 PM

**Instructor(s) Name(s):** Abubakr Muhammad
**Email:** abubakr.muhammad@gmail.com

**Teaching assistant name:** TBA
**Email:**

**Office Hours:** Mon 10am-11am, Tuesdays 2pm-3pm

## COURSE DESCRIPTION AS PER AS PROGRAM GUIDE

First and Second Terms. (Same as ME 221A and ME 221B)
Prerequisites: Linear Algebra (AMCS 151), Differential Equations (AMCS 131), Signals and Systems (EE151 & EE152). Content: Core material in linear systems and optimal control.

- Topics in 271A: review of vector spaces, systems of linear equations, internal stability, controllability, observability, Lyapunov equations, input-output stability, linear matrix inequalities, stabilization, and state observers.
- Topics in 271B: review of finite-dimensional optimization, calculus of variations, maximum principle, Hamilton-Jacobi-Bellman equation, linear quadratic regulator and optimal deterministic filtering.

## COMPREHENSIVE COURSE DESCRIPTION

The course prepares students to do independent work at the frontiers of systems theory and control engineering. The course builds further on standard linear systems theory to explore issues related to optimization, estimation and adaptation. Students will learn to formulate and appreciate fundamental limitations in control, filtering and estimation..

Topics include review of linear control systems, static constrained optimization, calculus of variations, dynamic optimization, Bellman’s principle of optimality, Maximum principle, two-point boundary value problems and Riccati equations, linear quadratic regulater (LQR), learning and adaptation in controllers, policy- and value-iteration.

## LEARNING OUTCOMES

The students should be able to:

- Understand fundamental limits of control & estimation
- Use advanced mathematical techniques to formulate and solve control problems
- Appreciate issues of robustness, optimality, architecture and uncertainty in control problems
- Identify practical challenges in posing control problems

## REQUIRED KNOWLEDGE / PREREQUISITES

*Courses*: EE271A or equivalnet or by permission of instructor
*Topics*: linear algebra, differential equations, signals and systems.

## METHOD OF EVALUATION

| Assessment Module | Number | Weightage |
|---|---|---|
| Mid-term Exam | 1 | 25% |
| Homework | 4 | 24% |
| Term Paper | 1 | 21% |
| Final Exam | 1 | 30% |

## REFERENCE TEXTS

The course will be taught from a combination of textbooks and course notes. The following books and course notes will be used as reference.

- Dynamic Optimization by Arthur Bryson. Addison Wesley. 1999.
- Optimization Based Control. Course notes by Richard Murray. 2010.
- Notes on Optimal Control and Linear Quadratic Problems by Bassam Bameih. 2001.

## COURSE POLICIES

All homework assignments, and exams are required. Students who do not show up for a an exam should expect a grade of zero on that exam. If you dispute your grade on any homework, quiz, or exam, you may request a re-grade (from the TA for the homeworks and quizzes or from the instructor for the exams) only within 48 hours of receiving the graded exam. Incomplete (I) grade for the course will only be given under extraordinary circumstances such as sickness, and these extraordinary circumstances must be verifiable. The assignment of an (I) requires first an approval of the dean and then a written agreement between the instructor and student specifying the time and manner in which the student will complete the course requirements.

## NOTE

The instructor reserves the right to make changes to this syllabus as necessary.