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| **CT-405** | **:** | **Control Systems** | **First Semester** |
| **Text Book** | **:** | Modern Control Systems (12th Edition) | |
| **Period** | | by Richard C. Dorf | |
| | **:** | **45** periods for 15 weeks (3 periods/week) (Lecture + Lab) | |

**Course Description**

Introduction to automatic control systems; mathematical models of physical systems; block diagrams and signal flow graphs; transient and steady state responses.

**Course Objectives**

- To teach the fundamental concepts of Control systems and mathematical modeling of the system
- to provide basic linear systems background with emphasis on deriving mathematical models for linear time invariant electrical, mechanical and electromechanical systems, and relating the output behavior to these models.
- To study the concept of time response and frequency response of the system
- To teach the basics of stability analysis of the system

**References**


1. Modern Control Systems (12th Edition) by Richard C. Dorf & Robert H. Bishop
2. Design of Feedback Control Systems (4th Edition), 2002 by Raymond T. Stefani, Bahram Shahian, late Clement J. Savant, and late Gene H. Hostetter Oxford Press
3. Modern Control Engineering, 2001 by Katsuhiko Ogata Prentice-Hall
4. Modern Control System Theory, 2001 by M.Gopal Wiley Eastern Ltd.
5. Introduction to Control Theory (2nd Ed) by J. Doyle, B. Francis, and A. Tannenbaum


## Assessment Plan for the Course

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|---|---|
| Paper Exam: | 60% |
| Attendance: | 10% |
| Test/ Quiz: | 10% |
| Lab: | 10% |
| Lab Assessment: | 10% |

## Tentative Lecture Plan

| No. | Chapter | Page | Period | Detail Lecture Plan |
|---|---|---|---|---|
| | **Chapter 7 The Root Locus Methods** | 443-552 | **16** | All Examples and Exercises |
| 1. | 7.1 Introduction | 443-444 | 2 | |
| 2. | 7.2 The Root Locus Concept | 444-448 | 2 | |
| 3. | 7.3 The Root Locus Procedure | 449-462 | 3 | |
| 4. | 7.4 Parameter Design by the Root Locus Method | 462-472 | 2 | |
| 5. | 7.5 Sensitivity and The Root Locus | 473-480 | 2 | |
| 6. | 7.7 Negative Gain Root Locus | 492-496 | 2 | |
| 7. | 7.8 Design Example | 496-510 | 2 | |
| 8. | 7.10 Sequential Design Example | 516-518 | 1 | |
| | **Chapter 8 The Frequency Response Methods** | 553-633 | **10** | All Bode Exercises |
| 10. | 8.1 Introduction | 553-556 | 1 | |
| 11. | 8.2 Frequency Response Methods | 556-577 | 4 | |
| 12. | 8.3 Frequency Response Measurements | 577-579 | 1 | |
| 13. | 8.4 Performance Specifications in the Frequency Domain | 579-582 | 1 | |
| 14. | 8.5 Log Magnitude and Phase Diagrams | 582-583 | 2 | |
| 15. | 8.6 Design Example | 583-595 | | |
| 16. | 8.8 Sequential Design Example<br>8.9 Summary | 602-607 | 1 | |
| | **Chapter 9 Stability in the Frequency Domain** | 634-742 | **7** | All Bode Exercises |
| 18. | 9.4 Relative Stability and the Nyquist Criterion (Gain Margin and Phase Margin) | 653-660 | 2 | |
| 19. | 9.6 System Bandwidth<br>9.7 The Stability of Control Systems with Time Delay | 668-674 | 2 | |
| 20. | 9.9 PID Controllers in the Frequency Domain | 691-692 | 1 | |
| 21. | 9.11 Sequential Design Examples | 700-703 | 1 | |
| 22. | 9.12 Summary<br>(Bode Diagram Root Locus) | 703-711 | 1 | |
| | **Chapter 10 The Design of Feedback Control Systems** | 743-833 | **10** | All Examples & Exercises |
| 24. | 10.1 Introduction<br>10.2 Approaches to System Design | 743-751 | 2 | |

| No. | Chapter | Page | Period | Detail Lecture Plan |
|---|---|---|---|---|
| | 10.3 Cascade Compensation Network | | | |
| 25. | 10.4 Phase-Lead Design Using the Bode Diagram | 751-757 | 4 | |
| 26. | 10.5 Phase-Lead Design Using the Root Locus | 757-764 | | |
| 27. | 10.7 Phase-Lag Design Using the Root Locus | 767-771 | 4 | |
| 28. | 10.8 Phase-Lag Design Using the Bode Diagram | 772-776 | | |
| 30. | Revision for All Chapters | | **2** | |