BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
FIRST SEMESTER 2021-2022
Course Handout (Part II)

Date: 20/08/2021

In addition to part-I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No. **: EEE F422**
Course Title **: Modern Control Systems**
Instructor-in-charge **: Pratyush Chakraborty**

1. Scope & Objective of the Course:

Control theory is an indispensable subject used for improving performances of various systems present around us. Most of these systems are complex in nature. This course mainly focuses on modern control techniques that were developed historically after classical control theory. The topics are state variable methods, digital control, nonlinear dynamical systems and control, and optimal control.

2. Textbook: (**T**) I.J. Nagrath and M. Gopal, Control Systems Engineering, New Age International (P) Ltd, 5th ed, 2007.

3. Reference Book:

(**R1**) M. Gopal, Modern Control System Theory, New Age International (P) Ltd, 3rd ed.

(**R2**) Linear Systems, Thomas Kailath, Prentice Hall

4. Course Plan:

Lect. No.	Topics to be covered	Learning objectives	Chapter in the Textbook
1-2	Introduction	General overview of the course, History of Control Theory, Review of Classical Control	1.1,1.3
3-6	State Variable Method for linear time-varying systems	Understanding the concept of state, converting an ordinary differential equation into different state realizations	12.1-12.3
7-8	Similarity Transform	Understanding the connection across different state realizations, diagonalization, Jordan form	12.5
9-11	Time Response	Understanding state transition matrix, solving state equation in various methods	12.6
12-14	Observability and Controllability	Understanding the concept of controllable and observable system	12.7
15-17	Pole Placement Design and State Observers	Understanding state feedback, pole placement method and development of state observers	12.8-12.9
18-19	Introduction to Digital Control System	Understanding basics of digital control system, spectrum analysis of sampling process, signal reconstruction	11.1-11.3
20-21	Difference equations	Understanding Z and inverse Z transform	11.4-11.7
22-23	Z transform analysis of sampled data control system	Analysis of sample and hold circuits	11.8
24-25	The z and s domain relationship,	Investigation of stability using various methods	11.9

	stability analysis		
26-27	State Variable Analysis of Digital Control System	Understanding state variable methods in digital control	Class notes, 12.4
28-34	Optimal Control	Understanding Optimal Control, Dynamic Programming, Pontryagin's Maximum Principle	14
35-36	Nonlinear systems	Understanding behavior of nonlinear systems and common physical nonlinearities	15.1, 15.2
37-40	Phase Plane Method, Limit Cycles, Describing functions, Lyapunov's criterion	Investigation of stability of nonlinear systems by various methods	15.3-15.9, 13.1-13.4
41-42	Introduction to Intelligent Control	Understanding the concept of Stochastic Optimal Control, Markov Decision Process, Introduction to Reinforcement Learning	Class notes

5. Evaluation Scheme:

Component	Duration	Weightage	Marks	Date & Time	Nature of Component
Midsem	90 min	30%	60	19/10/2021 1.30 - 3.00PM	Open Book
Comprehensive exam	120 hours	35%	70	15/12 AN	Open Book
Quizzes (Best 1 out of 2)	40 min	15%	30	To be decided	Open Book
Seminar	20 min	10%	20	To be decided	Open Book
Assignments	-	10%	20	To be decided	Open Book

6. Chamber Consultation Hours: To be announced in the class.

7. Notices: All notices will be displayed on CMS only.

8. **Make-up Policy:** Make-up shall be given only to genuine cases. No make-up for quizzes and assignments.

9. Academic Honesty and Integrity Policy:
Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Dr. Pratyush Chakraborty

(Instructor In-Charge, EEE F422)