**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**

**FIRST SEMESTER 2022-2023**

**Course Handout (Part II)**

Date: 29/08/2022

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 : Alivelu Manga Parimi**

**1. Scope & Objective of the Course:**

Feedback automatic control systems are indispensible in industrial processes, scientific instruments and even commercial, social and management situations. Most of these systems are non linear in nature. Analysis and design of these non linear systems is very important task that an engineer has to carry out. This course mainly focuses on various advanced control techniques.

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

**3. Reference Book:**

M. Gopal, Modern Control System Theory, New Age International (P) Ltd, 2nd ed.

**4. Course Plan:**

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| --- | --- | --- | --- |
| **Lect. No.** | Topics to be covered | **Learning object(s)** | **Chapter in the Text Book** |
|  | Introduction | General overview of the course |  |
| 2. | State variable analysis; | Understanding of concept of state, state variable and state model | 12.1,12.2 |
| 3-6. | State model for LTC system | Determination of state model for LTC systems, state variable and linear discrete time systems | 12.3,12.4 |
| 7. | Diagonalization | To understand the transformation of state model into a canonical form | 12.5 |
| 8-9. | State equation, transition matrix | To solve state eqs and computation of transition matrix | 12.6 |
| 10-11. | Controllability and observability | To understand the concept of controllable and observable system | 12.7 |
| 12. | Pole placement | Understanding the effects of pole placement and pole zero cancellation | 12.8 |
| 13-15. | Digital Control System; Spectrum analysis of sampling process ; signal reconstruction | Understanding of basics of digital control system | 11.1,11.2,11.3 |
| 16-18. | Difference equations; Z Transform; Inverse Z Transform | Determination of Z, inverse Z transform and DE | 11.4,11.5,11.7 |
| 19-20. | Z transform analysis of sampled data control system | Analysis of sampler and hold circuits | 11.6,11.8 |
| 21-23 | z and s domain relationship, stability analysis | Investigation of stability using various methods | 11.9-11.10 |
| 24. | Compensation Techniques | Application of compensation techniques for Sampled data control systems. | 11.11 |
| 25-26. | Closed loop frequency response, Constant M and N circles | Investigation of closed loop system stability using their closed loop frequency plots. | 9.5,9.6 |
| 27-29. | Liapunov’s stability analysis | Understanding of Liapunov’s method of stability analysis and its applications | 13.1-13.4 |
| 30. | Nonlinear systems; common physical nonlinearities | Understanding of behavior of non linear systems | 15.1, 15.2 |
| 31. | Phase Plane Method, singular points | Basic understanding Phase Plane Method, singular points | 15.3,15.4 |
| 32. | Stability of nonlinear systems, Limit Cycles | Investigation of stability of non linear systems | 15.5 |
| 33-34. | Phase Plane Trajectories | Construction of phase plane trajectories and its application to stability analysis | 15.6 |
| 35-37. | Describing functions; | Derivations of describing functions and its application to stability analysis | 15.7-15.9 |
| 38. | Adaptive control | Basics of Adaptive control | 16.2, class notes |
| 39-42. | Application of Modern Control Techniques | Intelligent Control using ANN, Fuzzy, Genetic Algorithm in various fields | Class notes |

**5. Evaluation Scheme:**

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| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage** | **Date & Time** | **Nature of Component** |
| Midsem | 90 min | 90M, 30% | 02/11 9.00 - 10.30AM | 30% CB |
| Comprehensive exam | 180 mnts | 120 M  40% | 22/12 FN | 40% CB |
| Quizzes | 30 min | 30M, 10% | To be decided | 10% CB |
| Assignment |  | 45M, 15% |  | 15% OB |
| Interaction in class | During class | 15M, 5% |  | 5%OB |

**6. Chamber Consultation Hours:** to be announced in the class.

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

**8. 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.

**(Instructor In-Charge, EEE F422)**