BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

K. K. BIRLA GOA CAMPUS

SECOND SEMESTER, 2022-2023

COURSE HANDOUT(Part-II)

Date: 17.01.2023

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

Course No. : **ECE F242 / EEE F242 / INSTR F242**
Course Title : **Control Systems**
Instructor-in-charge: **NARAYAN S MANJAREKAR**
Team of Instructors: Lecture- Narayan S Manjarekar
:Tutorial- Narayan S Manjarekar, Sarang C Dhongdi

Course Description*:* Introduction, modeling of dynamical systems, time-domain analysis, frequency-domain analysis, stability and performance analysis, controller design.

Scope and objective of the Course: The course aims at:

- Understanding the dynamics of a system and modeling it mathematically
- Stability and performance analysis of the system
- Understanding the performance specifications in the time-domain and frequency-domain
- Synthesis of control laws for stability and/or performance.

Text Book:

- Nagrath I. J. and M. Gopal, Control Systems Engineering, New Age International (P) Limited, 5th ed, 2007.

Reference Books:

(i) Kuo, B. C., and Golnaraghi, F., Automatic Control Systems, John Wiley & Sons, 8th ed, 2003.

(ii) Dorf R. C. and Bishop R. H., Modern Control Systems, Pearson Education 12th ed.

Course Plan:

Lecture	Learning objective	Coverage	To be covered from Text book
1-2	Introduction	Notion of control systems	Ch. 1
3-5	Mathematical modeling	Time domain models, linearization, time-invariance, transfer function, pole-zero plot	[T] 2.1-2.3, [R1] 4.7-4.8
6-8	Modeling with block diagrams	Block diagram representation, transfer function from block diagrams	[T] 2.4-2.5,
9-10	Modeling with signal flow graphs (SFG)	SFG representation, Mason's gain formula, SFG from block diagram	[T] 2.6, [R1] 3.2
11-12	Time domain analysis	Steady state analysis, Type of the system	5.1-5.5
13-14	Time domain analysis	Transient analysis of first and second order systems	5.6 -5.9
15-17	Stability of linear time-invariant (LTI) systems	Notion of stability, stability notion in the frequency domain, Routh criterion	6.1-6.6
18-20	Analysis by root locus	Concept root locus, effect of placing additional poles and zeros, root locus analysis	7.1-7.4

21-23	Control synthesis by root locus	Design of controller for given specification	10.1, 10.2, 10.4, Class notes
24-26	Notion of frequency response	Sinusoidal inputs, Bode plot and its analysis, approximate Bode plot	8.1, 8.2, 8.4-8.6
27-29	Frequency response	Polar plot	8.3
30-31	Control design problem –I	Linearization, open loop analysis, control specifications, controller design, closed-loop analysis	Class notes
32	Control design problem –II	Do	Class notes
33	Control design problem –III	Do	Class notes
34-36	Nyquist plot	Obtaining Nyquist plot, stability using Nyquist plot	9.1-9.4
37-38	Effects of feedback	Sensitivity analysis to parameter variations	3.1-3.6
37-38	Controller realization	Actuators, Electronic controllers	4.1-4.6, Class notes
39-40	Practical issues	Saturation, sensor noise, operating point, uncertainties	Class notes

Evaluation scheme:

Evaluation component	Duration	Weightage (%)	Date & Time	Evaluation type
Midsemester Examination	90 min	30	16/03/2023, 11.00 AM - 12.30 PM	CB
Quizzes/Assignments	-	35	To be announced later	CB/OB
Comprehensive Examination	180 min	35	09/05/2023, AN	CB

CB – Closed-book
OB – Text Book and/or handwritten Class Notes (in the hard-copy format) only are permitted. Use of **printed/photocopied** material, **softcopies** and/or **online material** is **not** permitted.)

Tentative schedule for the Quizzes and Assignments will be announced later.

Chamber Consultation Hour: To be announced later.

Make-up policy: Make-up will be granted only on genuine grounds.

Make-up will not be granted for Quizzes and Assignments.

Notices: Notices concerning the course will be displayed on Moodle course web page: https://quantaaws.bits-goa.ac.in

Instructor-in-charge

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