DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I

Name of the programme Specialization	**B.Tech.** **Instrumentation and Control Engineering**		
Course Title	**Control Systems – 1**		
Course Code	**ICPC 16**	No. of Credits	**4**
Course Type	**Core course**		
Pre-requisite(s)	NIL		
Session	**January 2022**	Section	**B**
Name of Faculty	**Dr. Dhanalakshmi K.**	Department	**ICE**
Official Email	**dhanlak@nitt.edu**	Telephone No.	**9443858456**

Syllabus https://www.nitt.edu/home/academics/departments/ice/programmes/btech/curriculum/For%20students%20admitted%20in%202020-21%20and%202021-22.pdf

Review of Systems, Mathematical Models – Differential Equations, Linear Approximations and Transfer Functions, Block Diagrams and Signal Flow Graphs.

Feedback Control System Characteristics, and Performance Specifications on transients and steady state, Stability of Linear Feedback Systems – Routh-Hurwitz criterion.

The Root Locus Method, Feedback Control System Analysis & Performance Specifications in Time Domain, Design of Lead, Lag, and PID Controller using Root Locus.

Frequency Response Methods, Nyquist's Stability Criterion, Bode Plots, Performance Specifications in Frequency-Domain, Stability Margins. Design of Lead, Lag and PID controller in Frequency Domain.

Course Objectives

1. To introduce the concept of feedback control system.
2. To impart knowledge in mathematical modeling of physical systems.
3. To impart knowledge in characteristics and performance of feedback control system.
4. To teach a variety of classical methods and techniques for analysis and design of control systems.

Mapping of COs with Pos

Course Outcomes: On completion of this course, the students will be able to	Programme Outcomes (PO)
1. Generate mathematical models of dynamic control system by applying differential equations.	1, 2, 5, 10, 12
2. Analyze and characterize the behavior of a control system in terms of different system, performance parameters and assess system stability.	1, 2, 5, 10, 12
3. Evaluate and analyses system performance using frequency and transient response analysis.	1, 2, 5, 10, 12
4. Design and simulate control systems (linear feedback control systems, PID controller, and multivariable control systems), using control software, to achieve required stability, performance and robustness.	1, 2, 5, 10, 12

COURSE PLAN – PART II

Course Overview

It is the first course on Control Theory and Control System Design; in understanding of concepts and fundamentals of system dynamics and control. This course focuses on the modelling, analysis and design of systems control. Emphasis will be on linear, time-invariant, single-input single-output continuous time systems. A strong background in Laplace transformation and differential equations is highly recommended. Suitable computer software package will extensively assist in the analysis and design of control systems.

Course Teaching and Learning Activities

Classes	Week/Contact Hours	Topic	Mode of Delivery
1 - 6	**1**	Introduction and overview of control system.	Chalk and Talk
7 - 12	**2, 3**	Review of Systems, Mathematical Models – Differential Equations, Linear Approximations, Principles behind mathematical modelling of electrical and mechanical systems. Transfer Functions, Block Diagrams and Signal Flow Graphs, Mason's Gain Rule.	Chalk and Talk Exercises
13 - 19	**4, 5**	Feedback Control System Characteristics, and Performance Specifications on transients and steady-state, Stability of Linear Feedback Systems – Routh-Hurwitz criterion.	Chalk and Talk Exercises
20 – 25	**6, 7, 8**	The Root Locus Method, Feedback Control System Analysis & Performance Specifications in Time-Domain, Design of Lead, Lag, and PID Controllers using Root Locus.	Chalk and Talk Exercises Demonstration
26 – 32	**9, 10**	Frequency Response Methods, Nyquist's Stability Criterion, Bode Plots, Performance Specifications in Frequency-Domain, Stability Margins.	Chalk and Talk Exercises
33 – 40	**11, 12, 13**	Design of Lag and PID controllers in Frequency Domain, Design of Lag-Lead Controllers using time-domain and frequency-domain methods.	Chalk and Talk Exercises Demonstration

Course Assessment Methods

S.No.	Mode of Assessment	Date	Duration	% Weightage
1.	Assessment 1	Units 1 and 2	1 hour	20
2.	Assessment 2	Units 3 and 4	1 hour	20
3.	Assessment 3	All 5 Units	Take home	10
	Compensatory Assessment	First 4 units	1 hour	20
4.	Assessment 4	All 5 units	3 hours	50

- Assessments will be scheduled in line with the institute calendar
- Students can access their answer scripts of all the assessments.

Reference Books: Few of them are available online for download

1. Dorf, R.C., Bishop, R.H., "Modern Control Systems," Prentice Hall, 13th Edition, 2016.
2. Franklin, G.F., David Powell, J., Emami-Naeini, A., "Feedback Control of Dynamic Systems," Prentice Hall, 8th Edition, 2018.
3. Nise, N.S., "Control Systems Engineering," Wiley, 7th Edition,2018.
4. Golnaraghi, B.C. Kuo., "Automatic Control Systems," 10th Edition, McGraw-Hill Education, 2018.
5. Nagrath, M. Gopal, Control Systems Engineering, 6th Edition, New Age International Publishers, 2017.
6. Katsuhiko Ogata, Modern Control Engineering, PHI Learning Private Ltd, 5th Edition,2017

Course Exit Survey

Feedback from the students during the class committee meetings
Feedback before End-term examination through a questionnaire, for consideration in future.

Course Policy (based on Institute Rules & Regulations)

Attendance requirement: **75 % attendance is mandatory** to be eligible to appear for the end semester examination.
If the attendance of a student falls short at the end of the semester, he/she will acquire a 'V' grade (REDO).

Prior permission should be obtained from the faculty member or at least kept informed (only in case of emergency) **through email**, if a student would be unable to appear for any assessment.
Compensation Assessment (20 % weightage):
This is not an improvement test for everyone.
Is allowed to take by a student who has missed Assessment 1 or Assessment 2, with prior approval.
Will be conducted 1 week prior to Assessment 4 (the end semester examination).

Grading policy A student is declared pass based on the rule B.15.2, page 8 of the rules and regulations. Relative grading based on normalized curve will be followed. Grading is done for those students declared passed based on the class average – average and above shall get S, A, and B grades, and below average shall get C, D, and E.

Academic dishonesty and plagiarism

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

The above policy against academic dishonesty shall be applicable for all the programmes.

Course Faculty	Chairperson, CC	HoD
(Dr. Dhanalakshmi K.)	(Dr. K. Srinivasan)	(Dr. K. Dhanalakshmi)