DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN

COURSE OUTLINE			
Course Title	CONTROL SYSTEM – I		[V semester ICE, A section]
Course Code	ICPC21	No. of Credits	4
Department	INSTRUMENTATION AND CONTROL ENGINEERING	Faculty	DHANALAKSHMI K.
Pre-requisites Course Code	NIL		
Course Coordinator(s)	NIL		
Faculty's E-mail	dhanlak@nitt.edu	Telephone No.	9443858456
Course Type	Core course		

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 LEARNING OBJECTIVES

To introduce and teach the iterative nature of most designs in order to achieve working (controlled) systems.

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.

COURSE OUTCOMES (CO)

On completion of this course, the students will be able to

1. generate mathematical models of dynamic control systems by applying differential equations.
2. analyze and characterize the behaviour of a control system in terms of different system and performance parameters.
3. compute and assess system stability.
4. evaluate and analyze system performance using frequency and transient response analysis.
5. 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.
6. critically analyze and outline the dynamic response of closed loop systems.

Course Outcomes	Aligned Programme Outcomes (PO)
1. generate mathematical models of dynamic control systems by applying differential equations.	1, 3, 4, 5, 6
2. analyze and characterize the behaviour of a control system in terms of different system and performance parameters.	1, 3, 4, 5, 6
3. compute and assess system stability.	1, 3, 4, 5, 6
4. evaluate and analyze system performance using frequency and transient response analysis.	1, 3, 4, 5, 6
5. 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, 3, 4, 5, 6
6. critically analyze and outline the dynamic response of closed loop systems.	1, 3, 4, 5, 6

COURSE TEACHING AND LEARNING ACTIVITIES

S. No.	Week	Topic	Mode of Delivery
1 - 8	1, 2	Introduction and overview of control system.	Chalk and Talk
9 - 18	3, 4	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
19 - 24	4, 5, 6	Feedback Control System Characteristics, and Performance Specifications on transients and steady-state, Stability of Linear Feedback Systems – Routh-Hurwitz criterion.	Chalk and Talk Exercises
25 – 32	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

33 – 42	9, 10	Frequency Response Methods, Nyquist's Stability Criterion, Bode Plots, Performance Specifications in Frequency-Domain, Stability Margins.	Chalk and Talk Exercises
43 – 50	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	Portions Week/Date	Duration of the test/exam	% Weightage
1.	Assessment 1	Units 1 and 2	1 hour	20
2.	Assessment 2	Units 3 and 4	1 hour	20
3.	Assessment 3	Units 5	1 hour	10
4.	Compensatory Assessment	All 5 units	1.5 hours	20
5.	Assessment 4	All 5 units	3 hours	50

ESSENTIAL READINGS :

Students can learn the course from any standard book or opensource material.

Few books from the syllabus are:

1. Dorf, R.C., & Bishop, R.H., Modern Control Systems, 13th edition, Prentice Hall, 2016.
2. Franklin, G.F., David Powell, J., & Emami-Naeini, A., Feedback Control of Dynamic Systems, 7th edition, Prentice Hall, 2014.
3. Nise, N.S., Control Systems Engineering, 7th edition, Wiley, 2015.
4. Katsuhiko Ogata, Modern Control Engineering, PHI Learning Private Ltd, 5th Edition, 2010.

COURSE EXIT SURVEY

1. Feedback will be collected from each student, through questionnaire- one at the mid of the semester and the other during the last week of the academic semester.
2. Feedback will be obtained during the class committee meetings also.

COURSE POLICY

Attendance requirement: **75 % attendance is mandatory** to be eligible to appear for each assessment.

If the attendance of a student falls short at the end of the semester, he/she will acquire a 'V' grade (REDO).

Every student is required to appear each assessment and is expected to obtain minimum one third of the mark in each assessment to be safely eligible to pass the course.

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.

If this is not adhered to, request of any kind will not be accepted for a student to be permitted to appear for the Compensatory assessment.
Any student who misses any or both of the first 2 assessments will get an opportunity to compensate for only 20 % weightage.
Compensatory assessment will be conducted 1 week prior to Assessment 4 (the end semester examination).

Grading policy– Relative grading based on normalized curve or z-score will be followed. (Rule B 12 b)

Withdrawal from the end semester examination– A student may for any valid reason, on production of valid proof/certificate and with the approval of the HoD be permitted to withdraw from appearing for the end semester examination (assessment 4), only if the application is made before the commencement of the examination. The student can then, appear for the Re assessment.

Re assessment– The Re assessment will be conducted during the vacation OR in the first week of the next semester.
The students eligible to appear for the Re assessment are:

1. Students who were absent (only with proper official permission) for Assessment 4 OR withdrawn from the Assessment 4
   weightage will be 50 % (internal marks will remain the same)
2. Students who failed in the subject AND who were absent (without permission) for Assessment 4
   weightage will be 100 %

Students who fail in the Re Assessment have to register for the Formative Assessment.

ADDITIONAL COURSE INFORMATION

The student can step into the faculty member's office for consultation whenever she is available.

Queries may also be emailed to the faculty directly at dhanlak@nitt.edu

FOR SENATE'S CONSIDERATION

Course Faculty

Date: 11 July 2018

CC - Chairperson

HoD 20/8/18