CONTROL SYSTEMS [As per Choice Based Credit System (CBCS) scheme] SEMESTER – IV (EC/TC)			
Subject Code	15EC43	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50(10 Hours per Module)	Exam Hours	03
CREDITS – 04			

Course objectives: This course will enable students to:

- Understand the basic features, configurations and application of control systems.
- Understand various terminologies and definitions for the control systems.
- Learn how to find a mathematical model of electrical, mechanical and electro-mechanical systems.
- Know how to find time response from the transfer function.
- Find the transfer function via Masons' rule.
- Analyze the stability of a system from the transfer function.

Modules	RBT Level
Module -1	
Introduction to Control Systems: Types of Control Systems, Effect of Feedback Systems, Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Analogous Systems. Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs.	L1, L2, L3
Module -2	
Time Response of feedback control systems: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers (excluding design).	L1, L2, L3
Module -3	
Stability analysis: Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis: more on the Routh stability criterion, Introduction to Root-Locus Techniques, The root locus concepts, Construction of root loci.	L1, L2, L3
Module -4	

Frequency domain analysis and stability: Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function. Introduction to Polar Plots, (Inverse Polar Plots excluded) Mathematical preliminaries, Nyquist Stability criterion, (Systems with transportation lag excluded) Introduction to lead, lag and lead-lag compensating networks (excluding design).	L1, L2, L3
Module -5	
Introduction to Digital Control System: Introduction, Spectrum Analysis of Sampling process, Signal reconstruction, Difference equations. Introduction to State variable analysis: Introduction, Concept of State, State variables & State model, State model for Linear Continuous & Discrete time systems, Diaganolisation.	L1, L2, L3

Course Outcomes: At the end of the course, the students will be able to

- Develop the mathematical model of mechanical and electrical systems
- Develop transfer function for a given control system using block diagram reduction techniques and signal flow graph method
- Determine the time domain specifications for first and second order systems
- Determine the stability of a system in the time domain using Routh-Hurwitz criterion and Root-locus technique.
- Determine the stability of a system in the frequency domain using Nyquist and bode plots
- Develop a control system model in continuous and discrete time using state variable techniques

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of Three sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

J.Nagarath and M.Gopal, " Control Systems Engineering", New Age International (P) Limited, Publishers, Fifth edition-2005, ISBN: 81-224-2008-7.

Reference Books:

1. "Modern Control Engineering," K.Ogata, Pearson Education Asia/PHI, 4th Edition, 2002. ISBN 978-81-203-4010-7.
2. "Automatic Control Systems", Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8th Edition, 2008.
3. "Feedback and Control System," Joseph J Distefano III et al., Schaum's Outlines, TMH, 2nd Edition 2007.

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