

Kadi Sarva Vishvavidyalaya, Gandhinagar
Bachelor of Engineering (Electrical Engineering Syllabus)

CONTROL SYSTEMS
B.E. SEM-IV SUBJECT CODE: EE-402

A. Course Objective:

The educational objectives of this course are

1. To understand the basics of open loop and closed loop feedback systems
2. To find gain of various systems
3. To plot Root Locus, Bode Plot, Nyquist Plot and to find stability as well error in response

B. Teaching / Examination Scheme

SUBJECT		Teaching Scheme				Total Credit	Examination Scheme					Total Marks
		L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
		Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
EE-402	CONTROL SYSTEMS	4	0	2	6	5	3	70	30	20	30	150

C. Detailed Syllabus

1. Introduction: Various Control Systems, Difference Between Closed Loop And Open Loop Control Systems,
2. Block Diagram Representation and Signal Flow Graphs: Basic definitions, advantages and disadvantages of block diagram, block diagram reduction rules, important definitions related to SFG, comparison of block diagram and SFG methods, Mason's gain Formula for SFG, Formation of SFG from equations and electrical networks.
3. Mathematical Modelling: Transfer Function, its properties, advantages and disadvantages, poles and zeros of Transfer Function, Mechanical system modeling, Analogous systems, gear trains.
4. Time Response Analysis: Transient and steady state response, stability and sensitivity, various test signals, steady state error, First and Second order system analysis, Damping Ratio, Time Domain Specifications.
5. Stability Analysis: Routh's Stability Criterion, Advantages and disadvantages, Hurwitz's criterion.
6. Root Locus Analysis: Introduction, rules for root locus plot, Root locus using MATLAB.
7. Frequency Domain Analysis: Bode Plot, Nyquist Plot, Bode and Nyquist plots using MATLAB
8. State Space Representation: State variables, state model, state diagram representation
9. Control Actions and Control System Components: Proportional, integral, PD, PI and PID controllers, servo potentiometers, servo motors, techo generator, stepper motor and synchros.

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D. Lesson Planning

SR No.	Lectures (Hours)	Weight age in % in Exam	Topic
1	02	05	Control System Introduction: Various Control Systems, Difference Between Closed Loop And Open Loop Control Systems,
2	02	15	Block Diagram Representation and Signal Flow Graphs: Basic definitions, advantages and disadvantages of block diagram,
	02		Block diagram reduction rules, Examples based on block diagram reduction techniques
	02		Important definitions related to SFG, comparison of block diagram and SFG methods,
	02		Mason's gain Formula for SFG, Formation of SFG from equations and electrical networks.
3	01	10	Mathematical Modelling: Transfer Function: Properties, Advantages & Disadvantages, Poles and zeros of Transfer Function
	02		Mechanical system modeling,
	02		Analogous systems, gear trains.
4	06	15	Time Response Analysis: Transient and steady state response, stability and sensitivity various test signals, steady state error,
	06		First and Second order system analysis, Damping Ratio, Time Domain Specifications
5	03	10	Stability Analysis: Routh's Stability Criterion, Advantages and disadvantages, Hurwitz's criterion.

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6	06	10	Root Locus: Intoduction , General Rules for Constructing Root Loci, Root Locus plots with MATLAB.
7	04	15	Frequency Domain Analysis: Bode Plot
	04		Nyquist plot
	02		Bode and Nyquist plots using MATLAB
8	04	10	State space analysis: State variables, state model
	04		State variables, state model
9	03	10	Control Actions and Control System Components: Proportional, integral, PD, PI and PID controllers, servo potentiometers,
	03		Servo motors, tacho generator, stepper motor and synchros.

E. INSTRUCTIONAL METHOD AND PEDAGOGY

1. At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
2. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc.
3. Attendance is compulsory in lectures, practical's and Tutorial which carries 05 Marks.
4. At regular intervals assignments is given. In all, a student should submit all assignments of 05 marks each.
5. Classroom participation and involvement in solving the problems in Tutorial rooms carries 05 Marks.
6. Viva Voce will be conducted at the end of the semester of 05 Marks.
7. One internal exam of 30 marks is conducted as a part of mid semester evaluation.
8. Experiments shall be performed in the laboratory related to course contents.
9. The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures.

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F. Suggested List of Experiments:

Sr. No.	Name of the Experiments
1.	To study Open Loop and Closed Loop Control systems.
2.	To study feedback control system
3.	To study different applications of control system
4.	To study response of Type “0” Control system.
5.	To study response of Type “1” Control system.
6.	To study response of Type 2”” Control system.
7.	To study Test Signal Generator.
8.	To verify potentiometer as Error Detector
9.	To verify the characteristic of DC position servo mechanism
10.	To verify the characteristics of Synchro Transmitter
11.	To study and plot Root Locus of using MATLAB.
12.	To study and draw Bode Plot using MATLAB.
13.	To study and draw Nyquist Plot using MATLAB.

G. Students Learning Outcomes

On successful completion of the course

1. The student can be acquired the basic knowledge of electric circuits, electrical fundamentals, thus being prepared to pursue any area of engineering spectrum in depth as desired.
2. The students will be able to effectively employ electrical systems and lead the exploration of new applications and techniques for their use.
3. Linear Circuit Analysis by De Carlo/Lin 2nd Edition, Oxford University Press Indian Edition

H. Recommended Study Materials:

TEXT BOOK:

Modern Control System Theory – by Dr. M. Gopal, New Age International Publishers, 2nd edition, 1996.

REFERENCE BOOKS:

1. Design of Feedback Control Systems by Stefani, Shahian, Savant, Hostetter, Oxford University Press
2. Control Systems by AshfaqHussain, HaroonAshfaq, DhanparRai& Co.
3. Modern Control Engineering By Katsuhiko Ogata, 4th Edition, Prentice Hall of India
4. Feedback Control Systems by Dr. S.D. Bhide, R.A. Barapate, S. Satyanarayan, Tech-Max Publication, Pune
5. Web Materials: <http://www.wikipedia.org>