School of Engineering
Dept. of Electrical and Electronics Engineering
COURSE PLAN
Academic Year 2026-27 ODD SEMESTER

School/Department of Students	**School of Engineering/ Department of Electrical and Electronics Engineering**
Name of the Program(s) of Students	**B. Tech - EEE**
PRC Approval Ref. No.	**PU/AC-24.9/EEE19 /EEE /2024-2028**
Semester/Year	**V/III**
Course Code & Name	**EEE2510-Control Systems Engineering**
Credit Structure (L-T-P-C)	**3-1-0-4**
Contact Hours	**3 Lecture +1 Tutorial period per week**
Course In-Charge (IC)	**Dr Saravanakumar Gurusamy**
Course Instructor(s)	**Dr Saravanakumar Gurusamy**
Course URL	**https://presidencyuniversity.linways.com**

1. COURSE PRE-REQUISITES:

Signals and Systems

2. COURSE DESCRIPTION:

The purpose of this course is to explore the importance of control system engineering and to develop the basic abilities of modelling and analysing the control system. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematical and computing. The course develops the critical thinking and analytical skills. The course also enhances the programming and simulation abilities through assignments

3. COURSE OBJECTIVES:

The objective of the course is to familiarize the learners with the concepts of Control Systems Engineering and attain **Skill Development** through **Problem Solving** methodologies.

4. COURSE OUTCOMES:

TABLE 1: COURSE OUTCOMES

CO Number	Statement of CO	Blooms Cognitive Level
	On successful completion of the course the students shall be able to	

CO1	Derive transfer function model of basic electrical and mechanical systems.	Apply
CO2	Solve for transfer function model of control systems using block diagram reduction and signal flow graphs by Mason's Gain Formula.	Apply
CO3	Analyze the time response characteristics of first and second-order systems for standard test inputs and analyze the effect of P, PI, and	Analyse
CO4	Analyze the stability and performance of control systems using time-domain and frequency domain approaches	Analyse
CO5	Select appropriate lead, lag, and lead-lag compensators to achieve desired system performance specifications	Apply
CO6	Determine state-space models and system properties for linear and non-linear dynamic systems.	Apply

5. MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

5.1 PROGRAM OUTCOMES

On successful completion of the Program, the students will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

TABLE 2a: CO-PO Mapping												
CO. No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	-	-	-	-	-	-	-	-	
CO2	H	M	L	-	M	-	-	-	-	-	-	
CO3	H	M	L	-	M	-	-	-	L	L	-	L
CO4	H	M	L	-	M	-	-	-	L	L	-	L
CO5	H	M	L	-	M	-	-	-		-	-	
CO6	H	M	L	-	M	-	-	-	-	-	-	

5.2 PROGRAM SPECIFIC OUTCOMES

On successful completion of the Program, the students will be able to:

PSO1	Solve complex engineering problems in Power System, Analog and Digital electronics, electrical machines, renewable energy system, Embedded System and Electric vehicles, and Industrial Automation using state-of-the-art techniques.
PSO2	Use modern engineering hardware and software tools in electrical and electronics engineering to adapt in multi-disciplinary area and engage in life-long learning.
PSO3	Provide engineering solutions considering sustainability, societal and environmental implications with professional ethics.

TABLE 2b: CO-PSO Mapping			
CO Number	**PSO1**	**PSO2**	**PSO3**
CO1	H	-	-
CO2	H	M	-
CO3	H	M	-

CO4	H	M	-
CO5	H	M	-
CO6	H	L	-

6. COURSE CONTENT:

Module Number	Module Name	Number of Sessions
1	**System Components and their representation** Introduction to control systems, mathematical models of physical systems-differential equations of physical systems, Mechanical systems, Electrical systems, Block diagrams and signal flow graphs.	9L+3T
2	**Time Response Analysis** Unit step response of first and second order system, time response specifications, time response specifications of second order systems, steady state errors and error constants, P, PI and PID controllers	9L+3T
3	**Stability Analysis** Concept of stability, Routh stability criterion, Root locus concept-rules for sketching root locus, Introduction, Frequency domain specifications -Bode diagrams, Stability Analysis from Bode Plots, Concept of relative stability. Introduction to Nyquist stability criteria. Compensation Techniques, Lead, Lag, lead-lag compensating networks	15L+5T
4	**State space Analysis** Concept of State, State variables & State model, Concepts of controllability and observability, Introduction to Nonlinear systems	12L+4T

REFERENCE MATERIALS:

Text Books:

T1. I. J. Nagrath and M. Gopal, Control Systems Engineering, 7th ed., New Delhi, India: New Age International Publishers, 2024.

Reference Books:

R1. K. Ogata, Modern Control Engineering, 5th ed. Upper Saddle River, NJ, USA: Pearson, 2010.

R2. C. Kuo and F. Golnaraghi, Automatic Control Systems, 10th Ed. New York, NY, USA: McGraw-Hill Education, 2017.

R3. H. Saeed, Automatic Control Systems with MATLAB Programs, 8th ed. New Delhi, India: S. K. Kataria & Sons, 2014.

Online Resources

1. Maruta, I. Toys for Control Education (toy4edu). GitHub Pages.
2. Interactive Learning Modules Project. Universidad de Almería.
3. Douglas, B. Brian Douglas — YouTube Channel.
4. Gurusamy, S. Linear Control System . GitHub pages
5. Lecture Notes 1 — Principles of Automatic Control. MIT OpenCourseWare.
6. Ramakrishna P, NPTEL – Control Engineering nptel.ac.in/courses/108106098

7. DETAILED SCHEDULE OF INSTRUCTION

TABLE 3: LESSON PLAN				
Session Number	**Topic**	**Sub-Topic**	**CO Number**	**Reference**
1.	Program Integration & Course Integration	Overview of the Course, Scopes and Opportunities of Control System Engineering	CO1	T1
Module 1				
2.	Course Integration Module 1 Introduction	Introduction, Open and closed loop control systems, Classifications, Feedback concept	CO1	T1
3.	Mathematical models of physical systems	Differential equations of physical systems- Electrical systems (Demo of Simulation models in MATLAB)	CO1	T1
4.	Mathematical models of physical systems	Differential equations of physical systems- Electrical systems (Demo of Simulation models in MATLAB)	CO1	T1
5.	Mathematical models of physical systems	Differential equations of physical systems- Mechanical Systems- Numerical Problems (Demo of Simulation models in MATLAB)	CO1	T1
6.	Mathematical models of physical systems	Differential equations of physical systems- Mechanical Systems- Numerical problems	CO1	T1
7.	Block diagrams	Block diagram (BD) Reduction Rules	CO2	T1
8.	Block diagrams	Numerical problems with BD reduction	CO2	T1
9.	Block diagrams [Flipped Classroom]	Numerical problems on BD reduction	CO2	T1
10.	Block diagrams [Flipped Classroom]	Numerical problems on BD reduction	CO2	T1
11.	Signal Flow Graphs	Transfer function using Mason's Gain Formulae	CO2	T1
12.	Signal Flow Graphs	Solving problems on Signal flow graph	CO2	T1
Module 2				
13.	Course Integration Module 2	Time response analysis	CO3	T1
14.	Unit step response of First order system	Time response specifications of First order system	CO3	T1

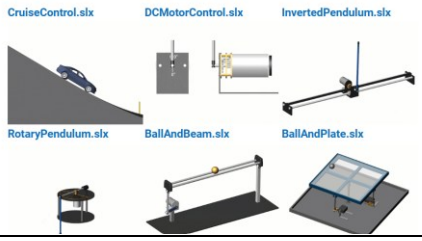
15.	Unit step response of second order system	Time response specifications of Second order system	CO3	T1
16.	Time response specifications	Numerical Problems	CO3	T1
17.	Time response specifications	Numerical Problems	CO3	T1
18.	Time response and Pole – Zero locations	Effect of addition of pole zero in the LHP	CO3	T1
19.	Time response specifications	steady state errors and error constants.	CO3	T1
20.	Time response specifications	steady state errors and error constants.	CO3	T1
21.	steady state errors and error constants.	Numerical Problems	CO3	T1
22.	steady state errors and error constants.	Numerical Problems	CO3	T1
23.	P, PI and PID controllers	Concept of P, I and D, Block diagram of PID controller	CO3	T1
24.	P, PI and PID controllers	Effect P, PI, and PID on system response and Applications	CO3	T1
25.	Midterm Exam Question Paper and Scheme of Evaluation – Discussion			
Module 3				
26.	Course integration of Module 3	Stability Analysis (Technology based Learning)	CO4	T1
27.	Stability Analysis	Concept of stability, Routh stability criterion, Technology Enable Learning (TEL)	CO4	T1
28.	Stability Analysis	Concept of stability, Routh stability criterion,	CO4	T1
29.	Routh stability criterion	Relative stability	CO4	T1
30.	Routh stability criterion	Numerical problems	CO4	T1
31.	Root locus [Jigsaw Method]	Root locus concept and rules	CO4	T1
32.	Root locus [Jigsaw Method]	Sketching root locus in graph	CO4	T1
33.	Root locus [Jigsaw Method]	Numerical Problems	CO4	T1
34.	Frequency domain specifications	Frequency domain specifications, Sketching Bode plot in Graph	CO4	T1
35.	Bode plots [Jigsaw Method]	Sketching Bode plot in Graph	CO4	T1
36.	Bode plots [Jigsaw Method]	Stability Analysis from Bode Plot.	CO4	T1
37.	Bode plots [Jigsaw Method]	Numerical Problems	CO4	T1

38.	Bode plots [Jigsaw Method]	Numerical Problems	CO4	T1
39.	Introduction to Nyquist stability criteria	Nyquist stability criteria	CO4	T1
40.	Nyquist stability criteria	Nyquist stability criteria	CO4	T1
41.	Nyquist stability criteria	Nyquist stability criteria	CO4	T1
42.	Compensation Techniques	Compensation Techniques. [MATLAB Simulation]	CO5	T1
43.	Compensation techniques	Lag Compensation [MATLAB Simulation]	CO5	T1
44.	Compensation techniques	Lead Compensation [MATLAB Simulation]	CO5	T1
45.	Compensation techniques	Lag – Lead Compensation [MATLAB Simulation]	CO5	T1
Module 4				
46.	State Space Analysis	Concept of State, State variables & State model	CO6	T1
47.	State Space model	Concept of State, State variables & State model	CO6	T1
48.	State Space model	State Space to transfer function model conversion	CO6	T1
49.	State Space model	State diagram and solution of state equation	CO6	T1
50.	State Space model	Numerical Problem	CO6	T1
51.	State Space model	Numerical Problem	CO6	T1
52.	State Space model	Concepts of controllability and observability	CO6	T1
53.	State Space model	Concepts of controllability and observability	CO6	T1
54.	State Space model	Numerical Problem	CO6	T1
55.	State Space model (Problem based learning method)	Numerical Problem	CO6	T1
56.	State Space model	Numerical Problem	CO6	T1
57.	Introduction to Nonlinear systems	Introduction and types of nonlinearities	CO6	T1
58.	Introduction to Nonlinear systems	Characteristics of nonlinear systems	CO6	T1
59.	Revision	Module 1	CO1	T1
60.	Revision	Module 2	CO3	T1
61.	Revision	Module 3	CO5	T1
62.	Revision	Module 4	CO6	T1

The main pedagogical methods in the course are as follows:

- Lecture mode.
- Power Point Presentation.
- Problem-based learning methods.

- Simulation based learning methods
- Flipped Class Room
- Jig Saw Method

TABLE 4: SPECIAL DELIVERY METHOD			
S. No	**Session Number**	**Subtopic (as per lesson plan)**	**Pedagogical Method**
1.	3 - 5	Mathematical Modelling (Demo of Simulation models in MATLAB)	
2.	27	Stability Analysis	Technology Enable Learning (TEL), MATLAB Simulation
3.	34	Frequency domain specifications	Technology based learning, MATLAB Simulation
4.	31 - 38	Root Locus and Bode Plot	Jigsaw Method (Peer Learning)
5.	42 - 45	Compensation Methods	MATLAB Simulation

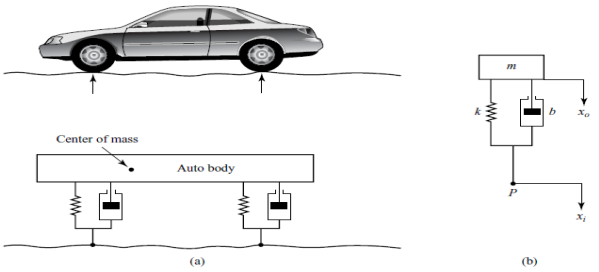
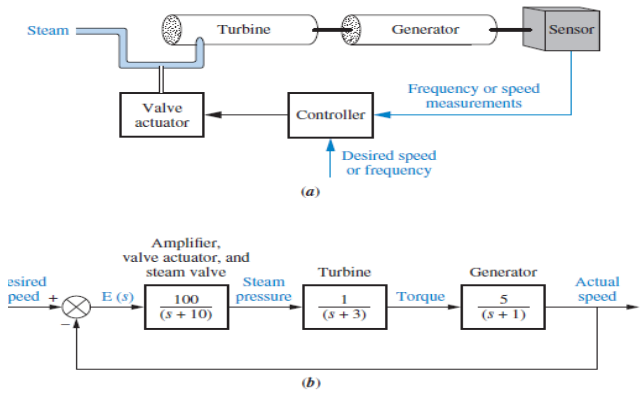
8. ASSESSMENT SCHEDULE

TABLE 5: ASSESSMENT SCHEDULE						
Sl. No	**Assessment Type**	**Coverage**	**CO Number(s)**	**Duration in Minutes**	**Marks**	**Weightage**
1.	CA1	Module-1	CO1	**60**	15	7.5%
2.	Midterm Exam	Module-1&2	CO1 & CO2, CO3	90	50	25%
3.	CA2	Module- 3	CO4	60	15	7.5%
4.	CA3 – Group Mini Project (Complex Simulation/ Simple prototype to demonstrate closed loop control concept)	Module-1,2, 3, 4	CO1, CO2, CO3 & CO4	400	20	10%
5.	End Term Examination	Module-1,2,3 4	CO1, CO2, CO3, CO4, CO5 & CO6	180	100	50%

9. COURSE CLEARANCE CRITERIA:

This is in accordance with the Academic Regulations of the University and the Program Regulations and Curriculum of the respective programs.

10. SAMPLE QUESTIONS:

TABLE 6: SAMPLE QUESTIONS				
Sl. No	**Question**	**Marks**	**CO Number**	**Blooms Cognitive Level**
1	Figure shows a schematic diagram of an automobile suspension system. As the car moves along the road, the vertical displacements at the tires act as the motion of excitation to the automobile suspension system. A very simplified version of the suspension system is shown in figure b. Assuming that the motion Xi at point P is the input to the system and the vertical motion Xo of the body is the output, evaluate the transfer function Xo(S)/Xi(S) of the system. (Consider the motion of the body only in a vertical direction.) Displacement Xo is measured from the equilibrium position in the absence of input Xi. 	10M	CO1	**Apply**
2	Speed controls find wide applications throughout industry and at home Figure.1 (a) shows an application of output frequency control of electrical power from a turbine and generator pair. By regulating the speed, the control system ensures that the generated frequency remains within tolerance. Deviations from the desired speed are sensed, and a steam valve is changed to compensate for the speed error. The system block diagram is shown in Figure.1 (b). Apply the suitable method to find the stability of the given system 	10	CO3	**Apply**

11. MAPPING WITH SUSTAINABLE DEVELOPMENT GOALS (SDGs):

TABLE 7: SDG MAPPING			
S. No	**Topic**	**SDG Number**	**Justification**
1	Mathematical Modelling of Electrical and Mechanical Systems	**SDG 9: Industry, Innovation and Infrastructure**	Mathematical modeling forms the foundation for designing and analyzing engineering systems, enabling innovation and resilient industrial infrastructure.
2	Block Diagrams and Signal Flow Graphs	**SDG 9: Industry, Innovation and Infrastructure**	System representation techniques facilitate the development of complex industrial control systems and support technological advancement.
3	Time Response Analysis and Controller Design (P, PI, PID)	**SDG 9: Industry, Innovation and Infrastructure**	Controller design improves the performance, productivity, and reliability of automated industrial processes.
4	Stability Analysis of Control Systems	**SDG 9: Industry, Innovation and Infrastructure**	Stability assessment ensures safe and reliable operation of engineering systems, which is essential for sustainable industrial growth.
5	Compensation Techniques (Lead, Lag, Lead-Lag)	**SDG 7: Affordable and Clean Energy**	Compensation techniques improve the efficiency and dynamic performance of electrical and energy conversion systems, reducing energy losses.
6	State Space Analysis, Controllability and Observability	**SDG 9: Industry, Innovation and Infrastructure**	Modern control methods support the design of advanced automation, robotics, aerospace, and smart manufacturing systems.
7	Application of Control Systems in Industries and Automation	**SDG 12: Responsible Consumption and Production**	Automated control systems optimize resource utilization, reduce waste, and improve production efficiency

12. CRITERIA FOR COURSE OUTCOME ATTAINMENT CALCULATION:

TABLE 8: Threshold and Target Set for Course Outcomes				
Sl. No	**C.O. No.**	**Course Outcomes**	**Threshold in %**	**Target in %**
1.	CO1	Derive transfer function model of basic electrical and mechanical systems	60%	70%
2.	CO2	Solve for transfer function model of control systems using block diagram	65%	75%

		reduction and signal flow graphs by Mason's Gain Formula.		
3.	CO3	Analyze the time response characteristics of first and second-order systems for standard test inputs and analyze the effect of P, PI, and PID controllers	65%	75%
4.	CO4	Analyze the stability and performance of control systems using time-domain and frequency domain approaches	50%	60%
5.	CO5	Select appropriate lead, lag, and lead-lag compensators to achieve desired system performance specifications	50%	60%
6.	CO6	Develop state-space models and determine the controllability and observability of dynamic systems using standard criteria	70%	75%

13. SUMMARY:

TABLE 9: SUMMARY OF COURSE SCHEDULE

Sl. No.	Activity	Start date	End date	Total number of Sessions
1.	Program Integration & Overview of the course and modules	05-08-2026	08-08-2026	**2**
2.	**Module: 01**	05-08-2026	25-08-2026	**12**
3.	**CA1**	09-09-2026	12-09-2026	**-**
4.	**Module: 02**	16-09-2026	02-10-2026	**12**
5.	**Midterm Exam**	05-10-2026	09-10-2026	**-**
6.	Midterm Exam question paper discussion	12-10-2026	12-10-2026	**1**
7.	**Module: 03**	13-10-2026	20-11-2026	**20**
8.	**CA2**	31-10-2026	03-11-2026	**-**
9.	**Module: 04**	23-11-2026	01-12-20206	**16**

CONTACT TIMINGS IN THE CHAMBER FOR DISCUSSION

Students can meet the respective course instructors during the Chamber Consultation Hour to clarify doubts related to the course.

SPECIFIC GUIDELINES TO STUDENTS, IF ANY:

- Attend all classes regularly.
- Bring a scientific calculator to every class.
- Refer to online study materials and watch the suggested videos available on the NPTEL website.
- Skill in simulation using MATALB and Python is recommended.

Dr Saravanakumar Gurusamy

Name and Signature of the course In-Charge

APPROVAL:

This course has been duly verified and approved by the Departmental Academic Committee (DAC).

Name and Signature of the Chairperson – DAC