Sri Indu Institute of Engineering & Technology

Recognized Under 2(f) of UGC Act 1956
Approved by AICTE, New Delhi
Affiliated to JNTUH, Hyderabad.

COURSE FILE

ON

CONTROL SYSTEMS

Course Code - EC503PC

III B.Tech I-SEMESTER

A.Y.: 2022-2023

Prepared by

Mr. K. SRIKANTH
Assistant Professor

Head of the Department
Electronics and Communication Engg. Dept
SRI INDU INSTITUTE OF ENGG & TECH
Sheriguda(V), Ibrahimpatnam(M), R.R.Dist-501 510

PRINCIPAL
Sri Indu Institute of Engineering & Tech
Sheriguda(Vill), Ibrahimpatnam
R.R. Dist. Telangana-501 510.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Academic Year	2022-2023
Course Title	CONTROL SYSTEMS
Course Code	EC503PC
Programme	B.Tech
Year & Semester	III year I-semester
Branch & Section	ECE-A
Regulation	R18
Course Faculty	Mr. K. SRIKANTH, Assistant Professor

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INSTITUTE VISION AND MISSION

Vision:

To become a premier institute of academic excellence by providing the world class education that transforms individuals into high intellectuals, by evolving them as empathetic and responsible citizens through continuous improvement.

Mission:

IM1: To offer outcome-based education and enhancement of technical and practical skills.

IM2: To Continuous assess of teaching-learning process through institute-industry collaboration.

IM3: To be a centre of excellence for innovative and emerging fields in technology development with state-of-art facilities to faculty and students' fraternity.

IM4: To Create an enterprising environment to ensure culture, ethics and social responsibility among the stakeholders.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT VISION AND MISSION

Vision:

To become a recognized center in the field of Electronics and Communication Engineering by producing creative engineers with social responsibility and address ever-changing global challenges.

Mission:

DM1: To facilitate an academic environment that enables student's centric learning.

DM2: To provide state-of-the-art hardware and software technologies to meet industry requirements.

DM3: To continuously update the Academic and Research infrastructure.

DM4: To Conduct Technical Development Programs for overall professional caliber of Stake Holders.

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PROGRAM EDUCATIONAL OBJECTIVES

Program Educational objectives are to Promote:

PEO1: Graduates with a strong foundation in Electronics and Communication Engineering, Science and Technology to become successful in the chosen professional career.

PEO2: Graduates with ability to execute innovative ideas for Research and Development with continuous learning.

PEO3: Graduates inculcated with industry based soft-skills to enable employability.

PEO4: Graduates demonstrate with ability to work in interdisciplinary teams and ethical professional behavior.

PROGRAM SPECIFIC OUTCOMES

PSO 1: Design Skills: Design, analysis and development a economical system in the area of Embedded system & VLSI design.

PSO 2: Software Usage: Ability to investigate and solve the engineering problems using MATLAB, Keil and Xilinx.

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PROGRAM OUTCOMES

1. **ENGINEERING KNOWLEDGE**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **PROBLEM ANALYSIS**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **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.

4. **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.

5. **MODERN TOOL USAGE**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **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.

7. **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.

8. **ETHICS**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **INDIVIDUAL AND TEAM WORK**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **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, give and receive clear instructions.

11. **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.

12. **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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech. in ELECTRONICS AND COMMUNICATION ENGINEERING
III YEAR COURSE STRUCTURE AND SYLLABUS (R18)
Applicable From 2018-19 Admitted Batch

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	EC501PC	Microprocessors & Microcontrollers	3	1	0	4
2	EC502PC	Data Communications and Networks	3	1	0	4
3	EC503PC	Control Systems	3	1	0	4
4	SM504MS	Business Economics & Financial Analysis	3	0	0	3
5		Professional Elective - I	3	0	0	3
6	EC505PC	Microprocessors & Microcontrollers Lab	0	0	3	1.5
7	EC506PC	Data Communications and Networks Lab	0	0	3	1.5
8	EN508HS	Advanced Communication Skills Lab	0	0	2	1
9	*MC510	Intellectual Property Rights	3	0	0	0
		Total Credits	18	3	8	22

III YEAR II SEMESTER

S. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	EC601PC	Antennas and Propagation	3	1	0	4
2	EC602PC	Digital Signal Processing	3	1	0	4
3	EC603PC	VLSI Design	3	1	0	4
4		Professional Elective - II	3	0	0	3
5		Open Elective - I	3	0	0	3
6	EC604PC	Digital Signal Processing Lab	0	0	3	1.5
7	EC605PC	e – CAD Lab	0	0	3	1.5
8	EC606PC	Scripting Languages Lab	0	0	2	1
9	*MC609	Environmental Science	3	0	0	0
		Total Credits	**18**	**3**	**8**	**22**

***MC - Environmental Science – Should be Registered by Lateral Entry Students Only.**

Note: Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

Professional Elective – I

EC511PE	Computer Organization & Operating Systems
EC512PE	Error Correcting Codes
EC513PE	Electronic Measurements and Instrumentation

Professional Elective – II

EC611PE	Object Oriented Programming through Java
EC612PE	Mobile Communications and Networks
EC613PE	Embedded System Design

EC503PC: CONTROL SYSTEMS

B.Tech. III Year I Semester **L T P C**

3 1 0 4

Prerequisite: Linear Algebra and Calculus, Ordinary Differential Equations and Multivariable CalculusLaplace Transforms, Numerical Methods and Complex variables

Course objectives:

- To understand the different ways of system representations such as Transfer functionrepresentation and state space representations and to assess the system dynamic response
- To assess the system performance using time domain analysis and methods for improving it
- To assess the system performance using frequency domain analysis and techniques forimproving the performance
- To design various controllers and compensators to improve system performance

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the modeling of linear-time-invariant systems using transfer function and state-space representations.
- Understand the concept of stability and its assessment for linear-time invariant systems.
- Design simple feedback controllers.

UNT - I

Introduction to Control Problem: Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

UNT - II

Time Response Analysis of Standard Test Signals: Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

UNT - III

Frequency-Response Analysis: Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

UNT - IV

Introduction to Controller Design: Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog andDigital implementation of controllers.

UNT - V

State Variable Analysis and Concepts of State Variables: State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

TEXT BOOKS:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

REFERENCE BOOKS:

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
1. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009

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Website: https://siiet.ac.in/

COs and Mapping with PO/PSO

Course: CONTROL SYSTEMS (C313) **Class: III ECE-A**

Course Outcomes

After completing this course, the student will be able to:

C313.1: Create mathematical model using Laplace Transform and define the Transfer Function of an LTI system in various ways. [Application, Knowledge]

C313.2: Analyze the response of First and second order systems in time domain using characteristic Equations for feedback control systems, and also evaluate the stability of a system in Time Domain using RH Criterion and Root Locus [Analysis, Evaluation]

C313.3: Examine Frequency response analysis of a Control System and Solve the stability of the system using BODE Plots [Analysis, Evaluation]

C313.4: Analyze the stability of a system in frequency domain using polar and Nyquist plots [Analysis]

C313.5: Design and implementation of Compensators and Controllers to improve stability. [Synthesis]

C313.6: Design state model of a system and determine the transfer function for Linear Time Variant Systems [Synthesis]

Mapping of course outcomes with program outcomes:

High -3 Medium -2 Low-1

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
C313.1	3	3	3	3	-	-	-	-	1	1	1	2	1	-
C313.2	3	3	3	3	-	-	-	-	1	1	1	2	1	-
C313.3	3	3	3	3	-	-	-	-	1	1	1	2	1	-
C313.4	3	3	3	3	-	-	-	-	1	1	1	2	1	-
C313.5	3	3	3	3	-	-	-	-	1	1	1	2	1	-
C313.6	3	3	3	3	-	-	-	-	1	1	1	2	1	-
	3.00.	**3.00**	**3.00**	**3.00**	**-**	**-**	**-**	**-**	**1.00**	**1.00**	**1.00**	**2.00**	**1.00**	**-**

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CO- PO/PSO Mapping - Justification

Course: CONTROL SYSTEMS (C313) **Class: III ECE-A**

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, 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 considerations 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.
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, 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.
PSO1.	**Design Skills:** Design, analysis and development a economical system in the area of Embedded system & VLSI design.

CO-PO mapping Justification

C313.1: Create mathematical model using Laplace Transform and define the Transfer Function of an LTI system in various ways. [Application, Knowledge]

	Justification
PO1	Gains knowledge on Open and Closed loop systems and Servomotors, classification of control systems, feedback mechanism.
PO2	Analyze the feedback characteristics, solving differential equations using rotational, mechanical methods and also reduction methods
PO3	Develop a solution for Block diagram algebra by Signal flow graph and by using the Mason's gain formula.
PO4	Student can solve the complicated Block Diagram problems.
PO9	Students can solve the complex problems and assignments with individual and team work.
PO10	Students can share information about the complex problems and assignments.
PO11	Students can use the Basics of control system in managing project work.
PO12	Students can learn about block diagram and signal flow graph
PSO1	Students can use this concept in design, analysis and development a system in the area of Embedded system & VLSI design

C313.2: Analyze the response of First and second order systems in time domain using characteristic Equations for feedback control systems, and also evaluate the stability of a system in Time Domain using RH Criterion and Root Locus [Analysis, Evaluation]

	Justification
PO1	Gains the knowledge on time response of first and second order systems and time domains
PO2	Solving the problems on root locus, R-H criteria.
PO3	Develop a solution for stability by using root locus
PO4	Student can solve the complicated root locus problems and they can plot the graph.
PO9	Students can solve the complex problems and assignments with individual and team work.
PO10	Students can share information about the complex problems and assignments.
PO11	Students can use the stability of the system concept to managing project work.
PO12	Students can learn about the root locus and Routh's stability criterion
PSO1	Students can use this concept in design, analysis and development a system in the area of Embedded system & VLSI design

C313.3: Examine Frequency response analysis of a Control System and Solve the stability of the system using BODE Plots [Analysis, Evaluation]

	Justification
PO1	Gains knowledge to plot the graph on the Bode Diagram –Phase margin and Gain margin
PO2	Analyze the problems on the frequency domains, bode plot and stability analysis
PO3	Develop a solution for stability by using bode plot
PO4	Students can solve the complicated stability problems by using bode plot
PO9	Students can solve the complex problems and assignments with individual and team work.
PO10	Students can share information about the complex problems and assignments.
PO11	Students can use the stability of the system concept to managing project work.
PO12	Students can learn about bode plot
PSO1	Students can use this concept in design, analysis and development a system in the area of Embedded system & VLSI design

C313.4: Analyze the stability of a system in frequency domain using polar and Nyquist plots. [Analysis]

	Justification
PO1	Gains knowledge to plot the graph on the polar and nyquist plot-Phase margin and Gain margin
PO2	Analyze the problems on the frequency domains, polar and nyquist plot and stability analysis
PO3	Develop a solution for stability by using polar and nyquist plot
PO4	Students can solve the complicated stability problems by using polar and nyquist plot.
PO9	Students can solve the complex problems and assignments with individual and team work.
PO10	Students can share information about the complex problems and assignments.
PO11	Students can use the stability of the system concept to managing project work.
PO12	Students can learn about polar and nyquist plot.
PSO1	Students can use this concept in design, analysis and development a system in the area of Embedded system & VLSI design

C313.5: Design and implementation of Compensators and Controllers to improve stability. [Synthesis]

	Justification
PO1	Gains the knowledge on how to improve stability by using compensators and controllers
PO2	Analyze the problems on improving the stability by compensators and controllers
PO3	Develop a solution for improve stability by lead ,lag compensators
PO4	Students can solve the complicated stability problems by using compensators and controllers
PO9	Students can solve the complex problems and assignments with individual and team work.
PO10	Students can share information about the complex problems and assignments.
PO11	Students can use the Compensators and controllers concept to do project work.
PO12	Students can learn about compensators and controllers
PSO1	Students can use this concept in design, analysis and development a system in the area of Embedded system & VLSI design

C313.6: Design state model of a system and determine the transfer function for Linear Time Variant Systems. [Synthesis]

	Justification
PO1	Gains the knowledge on determine the transfer function of Linear Time Invariant systems
PO2	Analyze the problems on LTI systems by using state space model
PO3	Develop a solution for state equations
PO4	Student can solve the complicated transfer function for linear time invariant system.
PO9	Students can solve the complex problems and assignments with individual and team work.
PO10	Students can share information about the complex problems and assignments.
PO11	Students can use the stability and state equations of the system concept to managing project work.
PO12	Students can learn about Linear time invariant systems
PSO1	Students can use this concept in design, analysis and development a system in the area of Embedded system & VLSI design

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

ACADEMIC CALENDAR 2022-23

B. Tech./B. Pharm. III YEAR I & II SEMESTERS

I SEM

S. No	Description	Duration	
		From	To
1	Commencement of I Semester classwork	**09.09.2022**	
2	1st Spell of Instructions (including Dussehra Recess)	09.09.2022	10.11.2022 (9 Weeks)
3	Dussehra Recess	03.10.2022	08.10.2022 (1 Week)
4	First Mid Term Examinations	11.11.2022	17.11.2022 (1 Week)
5	Submission of First Mid Term Exam Marks to the University on or before	24.11.2022	
6	2nd Spell of Instructions	18.11.2022	12.01.2023 (8 Weeks)
7	Second Mid Term Examinations	16.01.2023	21.01.2023 (1 Week)
8	Preparation Holidays and Practical Examinations	23.01.2023	28.01.2023 (1 Week)
9	Submission of Second Mid Term Exam Marks to the University on or before	30.01.2023	
10	End Semester Examinations	30.01.2023	11.02.2023 (2 Weeks)

Note: No. of Working/ instructional days: 92

II SEM

S. No	Description	Duration	
		From	To
1	Commencement of II Semester classwork	**13.02.2023**	
2	1st Spell of Instructions	13.02.2023	08.04.2023 (8 Weeks)
3	First Mid Term Examinations	10.04.2023	15.04.2023 (1 Week)
4	Submission of First Mid Term Exam Marks to the University on or before	22.04.2023	
5	2nd Spell of Instructions (including Summer Vacation)	17.04.2023	24.06.2023 (10 Weeks)
6	**Summer Vacation**	15.05.2023	27.05.2023 (2 Weeks)
7	Second Mid Term Examinations	26.06.2023	01.07.2023 (1 Week)
8	Preparation Holidays and Practical Examinations	03.07.2023	08.07.2023 (1 Week)
9	Submission of Second Mid Term Exam Marks to the University on or before	08.07.2023	
10	End Semester Examinations	10.07.2023	22.07.2023 (2 Weeks)

Note: No. of Working/ instructional days: 90

REGISTRAR

SRI INDU INSTITUTE OF ENGINEERING AND TECHNOLOGY

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Class Timetable

CLASS: III-B.Tech ECE-A **A.Y:2022-23** **SEMESTER: I** **LH: C-201**

TIME/ DAY	I 9:40-10:30	II 10:30 -11:20	III 11:20-12:10	IV 12:10-1:00	1:00-1:30	V 1:30-2:20	VI 2:20-3:10	VII 3:10-4:00
MON	DCN	IPR	CS	LIB	LUNCH	MPMC LAB / DCN LAB		
TUE	CS	MPMC	EMI	DCN		CYB	BEFA	SPORTS
WED	CYB	MPMC(T)/DCN(T)	CS	EMI		DCN LAB / MPMC LAB		
THU	EMI	DCN	CO-CU/DAA			IPR	MPMC	CS(T)/MPMC(T)
FRI	CS	BEFA	EMI	MPMC		DCN(T)/CS(T)	ACS LAB	
SAT	MPMC	IPR	MPMC(ADJUNCT)			BEFA	DCN	COUN

*(T) – Tutorial Concern Faculty

Course Code	Course Name	Name of the Faculty
EC501PC	MPMC- Microprocessors & Microcontrollers	I.Venu
EC502PC	DCN-Data Communications and Networks	Y.Raju
EC503PC	CS-Control Systems	K.Srikanth
SM504MS	BEFA- Business Economics & Financial Analysis	K V Nagamani
EC513PE	EMI-Electronic Measurements and Instrumentation (PE-I)	M.Ganesh
*CYB	Cyber Security	T.Divya

Course Code	Course Name	Name of the Faculty
EC505PC	MPMC LAB- Microprocessors & Microcontrollers Lab	I.Venu/K.Srikanth/P.Srilatha
EC506PC	DCN LAB- Data Communications and Networks Lab	J.Anand Rao/ M.Ganesh/Y.Raju
EN508HS	ACS LAB- Advanced Communication Skills Lab	D.Ananda Rao
*MC510	IPR-Intellectual Property Rights	S.Srinivas
MPMC(ADJUNCT)	G.Chandrasekhar	
LIB	Library	B.Jyothirmai/S.Alekhya
COUN	Counseling	Dr.S.Suresh/S.Alekhya/M.Ganesh
CO-CU/DAA	Co-Curricular/Dept.Assc.Act.	M.Ganesh/S.Naresh/P.KrishnaRao
SPORTS	Sports	M.Ganesh/K.Padma

Class Incharge

Head of the Department

Head of the Department
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LESSON PLAN

Programme: B.Tech	Academic Year: 2022-23
Year: III	Semester: I
Course Title: CONTROL SYSTEMS	Course Code: EC503PC
Name of Faculty: K SRIKANTH	

Unit-I Syllabus

Introduction to Control Problem: Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

No. of Sessions Planned	Topics	Reference	Teaching Method/ Aids
1	Introduction to Control systems	T2, R 1	BB
1	Classification control systems	T2, R 1	BB
1	Industrial control examples	T2, R 1	BB
1	Transfer Function – Definition and examples	T2, R 2	BB
1	Mathematical Models – Electrical Systems	T2, R 2	BB
1	Mathematical Models– Translational Mechanical Systems	T1, R2	BB
1	Mathematical Models – Rotational Mechanical Systems	T1, R2	BB
1	Analogies: Electrical – Mechanical, Problems	T1	BB
2	Transfer Function of AC,DC Servo Motor	T1, R1	BB
2	Synchro Transmitter and Receiver -Pair	T1, R1	BB
1	Block Diagram Algebra – Rules	T1	BB
2	Problems using Block Diagram Algebra	T1	BB
2	Signal Flow Graph – Definition, Elements, Rules, Reduction using Mason's Gain Formula. PROBLEMS	T1, R2	BB
1	SOME PROBLEMS	T1, R2	BB
Gap beyond syllabus(if any):			
Gap within the syllabus(if any)			
Course Outcome 1: Create mathematical model using Laplace Transform and define the Transfer Function of an LTI system in various ways.			

*Session Duration: 50 minutes

*Total Number of Hours/Unit: 15

Unit-II Syllabus

Time Response Analysis of Standard Test Signals: Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

No. of Sessions Planned	Topics	Reference	Teaching Method/ Aids
2	Standard Test Signals – Step, Ramp, Parabola, Impulse, Functions as Inputs, Impulse Response, Inverse Laplace	T1, R 2	BB
2	Time Response of First order Systems, Order of the system, Characteristic Equation, Partial Fraction	T2,R 2	BB
1	Transient Response of Second order Systems – Undamped, Underdamped,	T2,R 2	BB
1	Critically damped and over damped conditions, Derivations & Problems	T2,R 1	BB
1	Time Domain Specifications – Delay Time, Rise Time– Derivations & Problems	T2	BB
1	Peak Time, Peak overshoot, Settle Time – Derivations & Problems	T2,R1	BB
2	Steady State Response – Definition, Derivation, Steady State Errors and Error Constants – Positional, Velocity and acceleration.	T2,R2	BB
1	The Concept of Stability – Definition, HERWITZ method.	T1	BB
1	Routh's Stability Criterion – Definition,	T2	BB
1	Advantages and Limitations of Routh's Stability, problems	T1, R 2	BB
2	Root Locus Technique – The Root Locus Concept, Definition Construction of Root Loci – Rules,	T2, R 1	BB
1	Problems on Root Locus Technique	T2, R 1	BB
Gap beyond syllabus (if any):			
Gap within the syllabus (if any)			
Course Outcome 1: Analyze the response of First and second order systems in time domain using characteristic Equations for feedback control systems, and also evaluate the stability of a system in Time Domain using RH Criterion and Root Locus			

*Session Duration: 50 minutes

*Total Number of Hours/Unit: 15

Unit-III Syllabus

Frequency-Response Analysis: Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

No. of Sessions Planned	Topics	Reference	Teaching Method/ Aids
1	Introduction – Relation between Time and Frequency Domain	T1,R1	BB
2	Frequency Domain Specifications – Resonant Peak, Resonant Frequency, Bandwidth, -Definition, Derivations & Problems	T1	BB
2	Cut-off Rate, Gain Margin, Phase Margin – Definition, Derivations & Problems	T1, R 1	BB
2	Bode Diagrams – Rules and Procedure for Construction	T1, R 1	BB
2	Polar Plots – Design Rules, Construction Procedure, Problems, Stability Analysis	T1, R 1	BB
1	Problems on bode diagram	T1, R 2	BB
1	Problems on polar plot	T1, R 1	BB
2	Nyquist Plots – Design Rules, Construction Procedure, Problems, Stability Analysis	T1, R2	BB
1	Problems on Nyquist plot	R1	BB
1	Problems on Phase margin and Gain margin	T2,R2	BB
1	Closed loop frequency response	T2	BB
Gap beyond syllabus(if any):			
Gap within the syllabus(if any)			
Course Outcome 1: Examine Frequency response analysis of a Control System and Solve the stability of the system using BODE Plots **COURSE OUTCOME 2:** Analyze the stability of a system in frequency domain using polar and Nyquist plots			

*Session Duration: 50minutes

*Total Number of Hours/Unit: 15

Unit-IV Syllabus

Introduction to Controller Design: Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

No. of Sessions Planned	Topics	Reference	Teaching Method/ Aids
1	Stability, steady-state accuracy, transient accuracy,	T2,R2	BB
1	disturbance rejection, insensitivity and robustness of control systems.	R2	BB
1	Root-loci method of feedback controller design.	T2,R1	BB
1	Design specifications in frequency-domain	T2, R2	BB
1	Frequency-domain methods of design.	T2, R 1	BB
2	Types of Controllers – P, PI, PD, PID – Definitions and Derivations, Effects of Proportional Derivative systems	T2	BB
1	Effects of Proportional Integral Systems.	T2	BB
2	Compensation Techniques – Lag, Lead and Lag-Lead Compensators	T1	BB
1	Lag Controller Design in Frequency Domain – Procedures, Problems	T2, R1	BB
1	Lead Controller Design in Frequency Domain – Procedure, Problems	T2,R2	BB
1	Lead-Lag Controller Design in Frequency Domain – Procedure, Problems	R2	BB
1	Analog and digital implementation of controllers	T2,R2	BB
Gap beyond syllabus(if any):			
Gap within the syllabus(if any)			
Course Outcome 1: Design and implementation of Compensators and Controllers to improve stability.			

*Session Duration: 50minutes

*Total Number of Hours/Unit: 15

Unit-V Syllabus

State Variable Analysis and Concepts of State Variables: State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

No. of Sessions Planned	Topics	Reference	Teaching Method/ Aids
2	Concepts of State, State Variables and State Model – Definitions, Derivations	T2,R2	BB
1	Diagonalization of State Matrix.	T2,R2	BB
1	Solution of state equations.	T2	BB
1	Eigen values and Stability Analysis.	T1, R 1	BB
2	Concepts of Controllability – Derivation, Problems	T1, R 1	BB
2	Concepts of Observability – Derivation, Problems	T1	BB
1	Pole-placement by state feedback.	T2	BB
1	Discrete-time systems. Difference Equations.	T1, R 1	BB
2	State-space models of linear discrete-time systems.	T2, R 1	BB
1	Stability of linear discrete-time systems.	T2, R 2	BB
1	Problems.	T1, R 2	BB
Gap beyond syllabus(if any):			
Gap within the syllabus(if any)			
Course Outcome 1: Design state model of a system and determine the transfer function for Linear Time Variant Systems			

*Session Duration: 50minutes

*Total Number of Hours/Unit: 10

TEXT BOOKS:
T1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
T2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.
REFERENCE BOOKS:
R1. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
R2. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009.

WEB REFERENCES:

+

S.No.	Web Link
1	https://nptel.ac.in/courses/108101037/
2	https://ocw.mit.edu/resources/res-6-010-electronic-feedback-systems-spring-2013/course-videos/
3	https://www.youtube.com/watch?v=TyJSMVarQZQ
4	https://archive.nptel.ac.in/courses/107/106/107106081/
5	https://www.youtube.com/watch?v=vVFDm__CdQw

Lecture notes

Unit 1 link:

https://drive.google.com/file/d/1YyfUk6fubnMTCf9xaBSRqXxUq1a4wz1J/view?usp=sharing

Unit 2 link:

https://drive.google.com/file/d/12xHRhQ6bcGRCVP2nt4XJAN6nxv-3gBpn/view?usp=sharing

Unit 3 link:

https://drive.google.com/file/d/1jutDFbbyHuD9FJTAp69Sw-_YhlIvOk9U/view?usp=sharing

Unit 4 link:

https://drive.google.com/file/d/1S9oWLqABLw6zITUoCBy-sh6hjwEEuvU7/view?usp=sharing

Unit 5 link:

https://drive.google.com/file/d/1Y9hxrDb-SZ5_kG3nJHsUWvjBn_DOgteq/view?usp=sharing

Power point presentation

PPT link:

https://docs.google.com/presentation/d/1RvzxYzR4vnc_2iDiJw7VcB5ZnUTikNGY/edit?usp=sharing&ouid=109692577134569542336&rtpof=true&sd=true

Code No: 155AR **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, January/February - 2023
CONTROL SYSTEMS
(Common to ECE, EIE)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a) What is the basic rule used for block diagram reduction technique? [2]
b) Write the force balance equation of an ideal mass, ideal dashpot and ideal spring element. [3]
c) List the time domain specifications. [2]
d) Define Centroid. How do you determine the centroid and angle of asymptotes in root locus technique? [3]
e) What is Polar plot? [2]
f) Define Phase Margin, Gain Margin with reference to Bode plot. [3]
g) What is the function of P and I Controllers? [2]
h) Define the terms Steady State Accuracy and transient accuracy of the system. [3]
i) Define Controllability. [2]
j) State the properties of state transition matrix. [3]

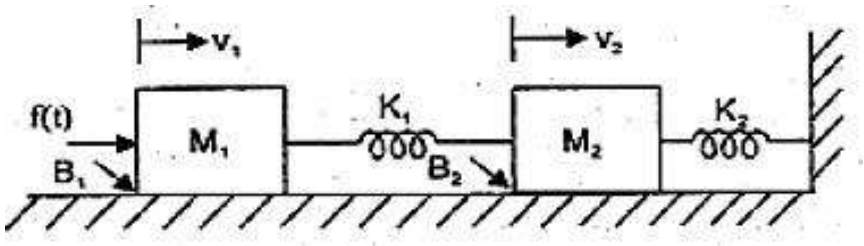
PART – B

(50 Marks)

2. Compare the Open loop and Closed loop Control Systems with examples in detail. [10]

OR

3. Determine the Force voltage and Force current analogy for given mechanical system. [10]



4. The characteristic polynomial of a system is $s^7+9s^6+24s^5+24s^4+24s^3+24s^2+23s+15=0$. Determine the location of roots on s-plane and hence the stability of the system. [10]

OR

5. Sketch the root locus of the system whose open loop transfer function is $G(s)=K/s(s+2)(s+4)$. Find the value of K so that the damping ratio of the closed loop system is 0.5. [10]

6. Sketch the polar plot for the following transfer function, Determine phase margin and gain margin. [10]

$$G(s) = \frac{k}{s^2(1+s)(1+2s)}$$

OR

7. Sketch the Bode plot of the given system and determine the phase margin and gain margin of the system. [10]

$$G(s) = \frac{20\ (0.1s+1)}{S^2(0.2s+1)(0.02s+1)}$$

8. Explain the step by step procedure of Root-loci method of feedback controller design. [10]

OR

9. Discuss the Analog and Digital implementation of controllers. [10]

10. Consider a system with state model given below:

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 5 \\ -24 \end{bmatrix} u; \quad y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \end{bmatrix} u$$

Verify, the system is observable and controllable. [10]

OR

11. Explain about diagonalization and also obtain the state model of the given transfer function [10]

$$\frac{Y(S)}{U(S)} = \frac{5}{s^2+6s+7}$$

---ooOoo---

Code No: 155AR **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, March - 2021
CONTROL SYSTEMS
(Common to ECE, EIE)

Time: 3 Hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1.a) List the differences between open loop and closed loop systems with suitable examples.
b) Obtain the transfer function $\frac{\theta(s)}{V_a(s)}$ for armature controlled dc servomotor. [8+7]

2.a) What is meant by time response? Explain about (i) Steady- state response (ii) Transient response.
b) Find the steady-state error for unit step, unit ramp and unit acceleration inputs for the following systems.
i) 10/ s(0.ls + 1)(0.5s + 1)
ii) 1000/ s^2(s + 1)(s +20) [8+7]

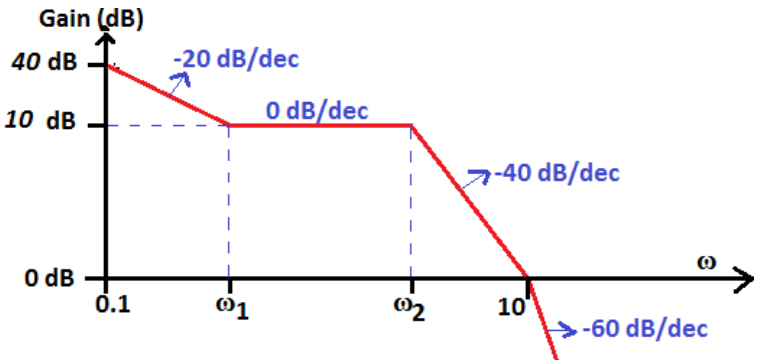
3.a) List the properties of root locus and sketch the root locus of the unity feedback system with

$$G(s) = \frac{K}{s(s+2)(s^2+2s+4)}$$

b) A unity feed-back system is characterized by an open loop T.F G(s) = K/ s(s+10) Determine the gain K so that the system will have a damping ratio of 0.5. For this value of K, determine Ts, Tp and Mp for a unit step input. [8+7]

4.a) Explain clearly the steps involved in the construction of Bode plots of a system with loop transfer function consisting of
i) An open loop gain K
ii) One pole at origin
iii) One quadratic factor.
b) State and explain Nyquist Stability Criterion. [8+7]

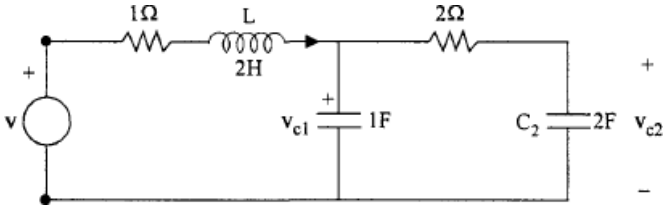
5. What is Phase Margin and gain margin? Determine the transfer function whose Bode diagram is given by [15]



6. Discuss the procedural steps of lag compensation design in frequency domain. [15]

7.a) Define the terms: i) State variable ii) State transition matrix.

b) Obtain the state space representation of the electrical system shown below.



Take $x_1=i_L$, $x_2=vc_1$, $x_3=vc_2$ $v=u$ and $y= vc_2$ [6+9]

8.a) An LTI system is characterized by the homogeneous state equation:

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}1\\ 0\end{bmatrix} u$$

Compute the solution of the homogeneous equation assuming the initial state vector $X_0 = \begin{bmatrix}1\\ 0\end{bmatrix}$

b) The system is represented by the differential equation $\ddot{y}+5\dot{y}+6y=u$. Find the transfer from state variable representation. [8+7]

---ooOoo---

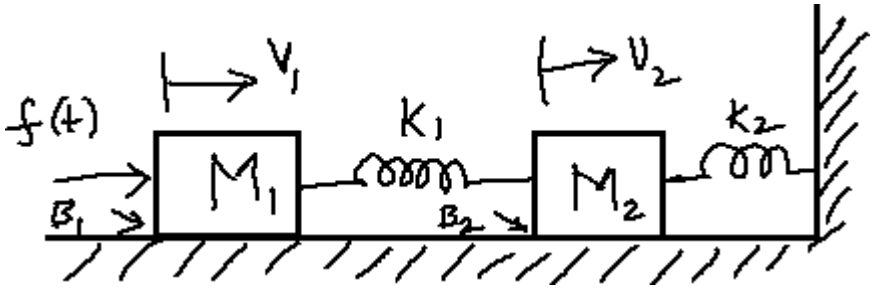
Code No: 155AR **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, September - 2021
CONTROL SYSTEMS
(Common to ECE, EIE)

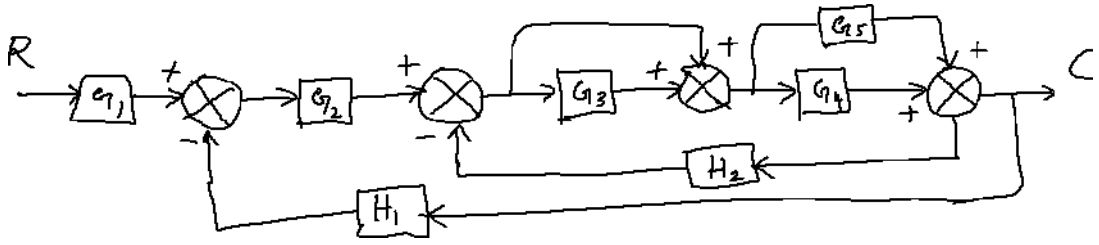
Time: 3 Hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1.a) Explain the benefits of feedback in detail.
b) For the mechanical system below, derive the transfer function, f(*t*) is the input, where as V_2 is output. [6+9]



2.a) What are the basic blocks used in mathematical modeling of rotational systems? Explain.
b) Using block diagram algebra, determine C/R. [6+9]



3.a) Discuss about initial and final value theorems used in time response analysis.
b) Using Routh criterion, determine the stability of the system whose characteristic equation is given by [6+9]

$$9s^5 - 20s^4 + 8s^3 - 8s^2 - 6s + 5 = 0$$

4. Explain different steps involved in construction of root-loci. [15]

5.a) How to draw bode plot? Explain.
b) Sketch the polar plot of the following transfer function. [6+9]

$$G(s) = \frac{10(1+s)}{(2+s)(4+s)}$$

6.a) How to find Relative stability using Nyquist criterion? Explain.
b) Sketch the bode plot of the following open loop transfer function. [6+9]

$$G(s) = \frac{50(1+0.1s)}{(1+0.01s)(1+s)}$$

7. Explain about Root-loci method of feedback controller design. [15]

8. a) Determine the state and output equations in vector matrix form for the system whose transfer function is given by

$$G(s) = \frac{(s+2)}{s(s^2+8s+11)}$$

b) Verify whether the following system is observable or not. [8+7]

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -2 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

---ooOoo---

Sri Indu Institute of Engineering & Technology

Sheriguda (V), Ibrahimpatnam (M), R.R.Dist-501 510

I - Mid Examinations, NOV -2022

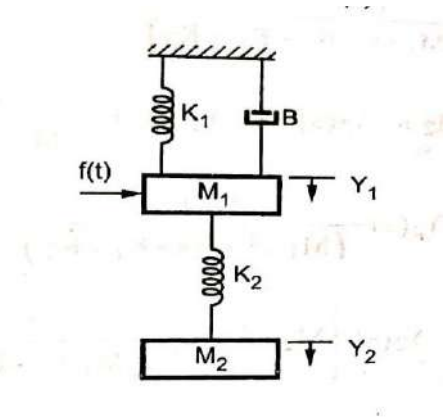
Set -II

Year & Branch: **III –ECE (A,B,C)** **Date: 12/11/22(FN)**

Subject: **CS** Max. Marks: 10 Time: 60 mins

Answer any **TWO** Questions. All Question Carry Equal Marks 2*5=10 marks

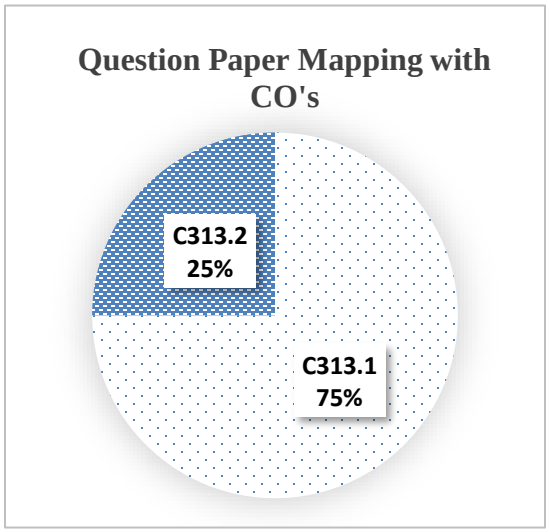
1. Compare open loop and closed loop control system? (C313.1) (5M) (Analysis)
2. State & Derive the transfer function ($Y_2(s)/f(s)$) (C313.1) (5M) (Knowledge)

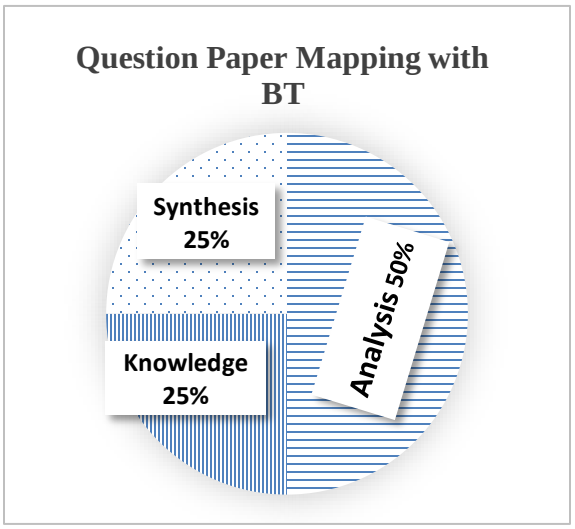


3. Construct the root locus of the system whose (C313.2) (5M) (Synthesis)

$$G(s) = \frac{K(s+15)}{s(s+1)(s+5)}$$

4. Compare AC and DC servomotors? (C313.1) (5M) (Analysis)





Sri Indu Institute of Engineering & Technology

Sheriguda (V), Ibrahimpatnam (M), R.R.Dist-501 510

II - Mid Examinations, JAN -2023

Set -I

Year & Branch: **III –ECE (A,B,C)** **Date: 20/01/23 (FN)**

Subject: **CS** Max. Marks: 10 Time: 60 mins

Answer any **TWO** Questions. All Question Carry Equal Marks 2*5=10 marks

1. A) Analyze the stability of a system in frequency domain using polar plot

$$G(s)\,H(s) = \frac{1}{s(1+s)^2}$$

(C313.4) (3M) (Analysis)

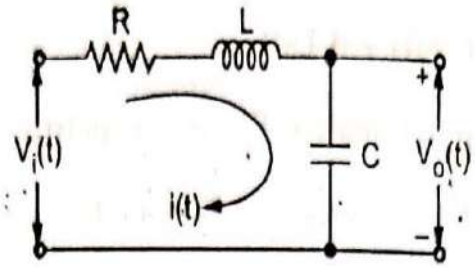
B) Write the slope (db/dec) for K, 1/S , S^2, 1/1+ST (C313.3) (2M) (Knowledge)

2. Design PI and PD type of Controllers? (C313.5) (5M) (Synthesis)

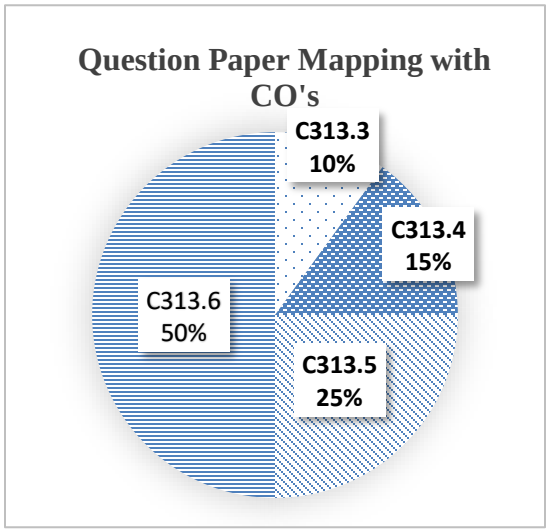
3. Examine the transfer matrix (Transfer function) (C313.6) (5M) (Analysis)

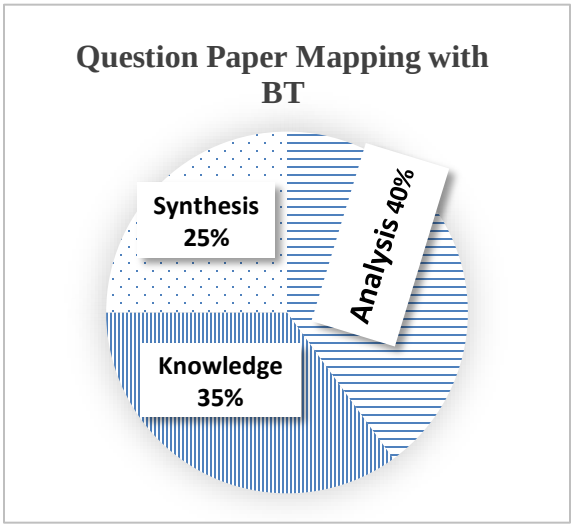
$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} 0 & 3 \\ -2 & -5 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} U_1 \\ U_2 \end{bmatrix}, \quad \begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

4. Write the state model of given electrical system.



. (C313.6) (5M) (Knowledge)





Sri Indu Institute of Engineering & Technology

Sheriguda (V), Ibrahimpatnam (M), R.R.Dist-501 510

B-Tech I - Mid Examinations, NOV-2022

Objective Type Exam

Year &Branch: III –ECE-A, B&C **Date: 12-11-2022(FN)**

Subject: CS Max. Marks: 10 Time: 20 mins

Name: ……..Roll No……

I. Choose the correct alternative:

1) The input signal is represented by_____ [ ]

a. b(t) b. c(t) c. e(t) d. r(t)

2) How is an output represented in the control systems? [ ]

a. r(t) b. c(t) c. x(t) d. y(t)

3) Which notation represents the error signal [ ]

a. b(t) b. c(t) c. e(t) d. r(t)

4) Which among the following is not an advantage of an open loop system? [ ]

a. Simplicity in construction & design b. Easy maintenance

c. Rare problems of stability d. Requirement of system recalibration from time to time

5) In an open loop control system [ ]

(a) Output is independent of control input

(b) Output is dependent on control input

(c) Only system parameters have effect on the control output

(d) None of the above

6) According to signal flow graph, which among the following represents the relationship between nodes by drawing a line between them? [ ]

a. Branch b. Self-loop c. Semi-node d. Mesh

7) A control system in which the control action is somehow dependent on the output is known as [ ]

(a) Closed loop system (b) Semi closed loop system

(c) Open system (d) None of the above

8) A good control system has all the following features except [ ]

(a) good stability (b) slow response

(c) good accuracy (d) sufficient power handling capacity

9) The output of a feedback control system must be a function of [ ]

(a) reference and output (b) reference and input

(c) input and feedback signal (d) output and feedback signal

10) In a signal flow graph method, how is an overall transfer function of a system obtained? [ ]

a. Poisson's equation b. Block diagram reduction rules

c. Mason's equation d. Lagrange's equation

Fill in the blanks:

1) By equating the denominator of transfer function to zero, ---------- will be obtained?

2) ---------- notation represents the feedback path in closed loop system representation?

3) MASON'S gain formulae_____

4) In Routh array, if zero is found in the first column, then by which term it needs to be Replaced----------

5) In S/S+2 equation poles are ----------

6) In (S+2)(S+3)/S^2+2S+3 Zeros are----------

7) If the control system is both linear and time-variant then the type of system is _____

8) Two loops are said to be non-touching only if no common _____exists between them.

9) How many types of feedbacks are there ----------

10) Angle of asymptote formulae ----------

Sri Indu Institute of Engineering & Technology

Sheriguda (V), Ibrahimpatnam (M), R.R.Dist-501 510

B-Tech II - Mid Examinations, JAN-2023

Objective Type Exam

Year &Branch: III –ECE-A, B&C **Date: 20/01/23 (FN)**

Subject: CS Max. Marks: 10 Time: 20 mins

Name: …….. Roll No……

I. Choose the correct alternative:

1. State space analysis is applicable even if the initial conditions are [ ]

   a. Zero b. Non-zero c. Equal d. Not equal

2. Conventional control theory is applicable to _____ systems [ ]

   a. SISO b. MIMO c. Time varying d. Non-linear

3. What is the value of steady state error in closed loop control systems? [ ]

   a. Zero b. Unity c. Infinity d. Unpredictable

4. How is the sinusoidal transfer function obtained from the system transfer function in frequency domain? [ ]

   a. Replacement of 'jω' by 's' b. Replacement of 's' by 'ω'
   c. Replacement of 's' by 'jω' d. Replacement of 'ω' by 's'

5. Which among the following plays a crucial role in determining the state of dynamic system? [ ]

   a. State variables b. State vector c. State space d. State scalar

6. The frequency at which the phase of the system acquires ____ is known as 'Phase crossover frequency'. [ ]

   a. 90° b. -90° c. 270° d. -180°

7. At which frequency does the magnitude of the system becomes zero dB [ ]

   a. Resonant frequency b. Cut-off frequency
   c. Gain crossover frequency d. Phase crossover frequency

8. For Nyquist contour, the size of radius is [ ]

   a. 25 b. 0 c. 1 d. ∞

9. The values of the characteristic equation is given by: [ ]
   a) Eigen values b) State matrix c) Eigen vector d) None

10. The diagonalizing matrix is also known as: [ ]
    a) Eigen matrix b) Modal matrix c) Constant matrix d) State matrix

Fill in the blanks:

11. PD full form----------

12. PD controller improves ----------Response

13. Types of compensators----------

14. Types of compensating networks----------

15. What is matrix A----------

16. Characteristic equation formulae in state space----------

17. The composite matrix Q_c is given by----------

18. The composite matrix Q_o is given by----------

19. PID controller improves----------,----------

20. Root locus is used to calculate----------

Sri Indu Institute of Engineering & Technology

Sheriguda (V), Ibrahimpatnam (M), R.R.Dist-501 510

B-Tech I - Mid Examinations, NOV-2022

Year &Branch: III –ECE-A, B&C **Date: 02-11-2022(FN)**

Subject: CS

ANSWER KEY

Descriptive paper key link:

https://drive.google.com/file/d/1nrJ-QEw7yPrwf0nGKgE7mW1uPhOsirOO/view?usp=sharing

Objective Key Paper

I. Choose the correct alternative:

1) d. r(t)
2) b. c(t)
3) c. e(t)
4) d. Requirement of system recalibration from time to time
5) a. Output is independent of control input
6) a. Branch
7) a. Closed loop system
8) b. slow response
9) a. reference and output
10) c. Mason's equation

Fill in the blanks:

1) POLES
2) f(t) OR b(t)
3) $T=\frac{1}{\Delta}\sum_k P_k\Delta_k$
4) ε
5) S= -2
6) S= -2, -3
7 linear time-variant
8) Node
9) 2 or two
10) $\theta=\frac{2q+1}{P-Z}180^0$ Where q=0,1,2 ……. (n-1)

Sri Indu Institute of Engineering & Technology

Sheriguda (V), Ibrahimpatnam (M), R.R.Dist-501 510

B-Tech II - Mid Examinations, JAN-2023

Year &Branch: III –ECE-A, B&C **Date: 20/01/23 (FN)**

Subject: CS

ANSWER KEY

Descriptive paper key link:

https://drive.google.com/file/d/1ZQwSRMzkephkUXDb5j0PauwrT4bJpw0S/view?usp=sharing

Objective/Quiz Key Paper

I. Choose the correct alternative:

1) a. Zero
2) a. SISO
3) a. Zero
4) c. Replacement of 's' by 'jω'
5) a. State variables
6) d. -180°
7) c. Gain crossover frequency
8) d. ∞
9) a) Eigen values
10) b) Modal matrix

Fill in the blanks:

1) Proportional derivative
2) Transient response
3) Series, Parallel, Series-parallel
4) Lead, Lag, Lag-Lead
5) System Matrix
6) $C[SI-A]^{-1}B+D$
7) $Q_{c=}[B: AB: A^2B: \ldots A^{N-1}B]$
8) $Q_{o=}[C^T : A^TC^T : \ldots\ldots (A^T)^{N-1}C^T]$
9) Transient response and steady state response
10) Relative stability

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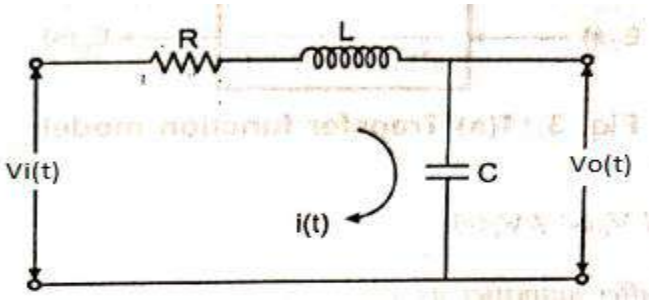
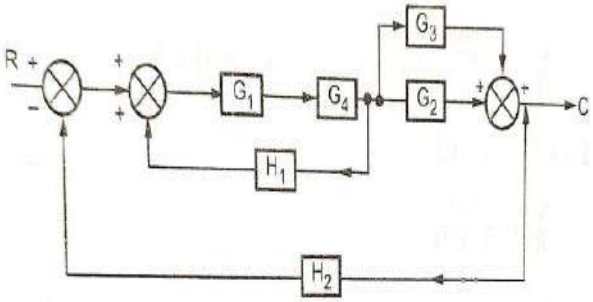
Khalsa Ibrahimpatnam, Sheriguda (V), Ibrahimpatnam (M), Ranga Reddy Dist., Telangana – 501 510
Website: https://siiet.ac.in/

ASSIGNMENT- 1 **SUBJECT: CONTROL SYSTEMS**

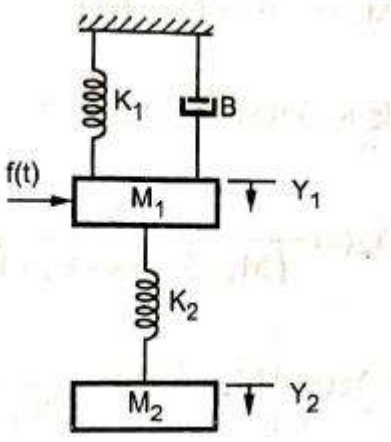
1) Find the transfer function for the below circuit? (C313.1) (Knowledge)



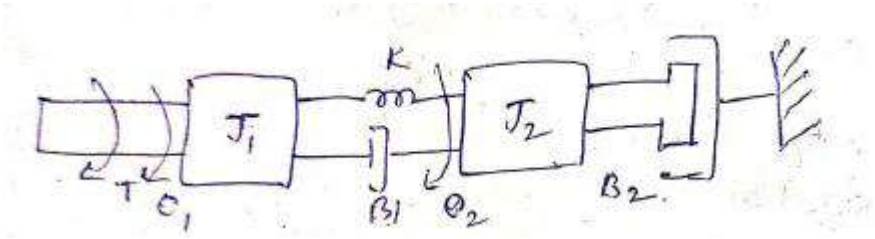
2) Find the overall gain C/R represented by block diagram (C313.1) (Knowledge)



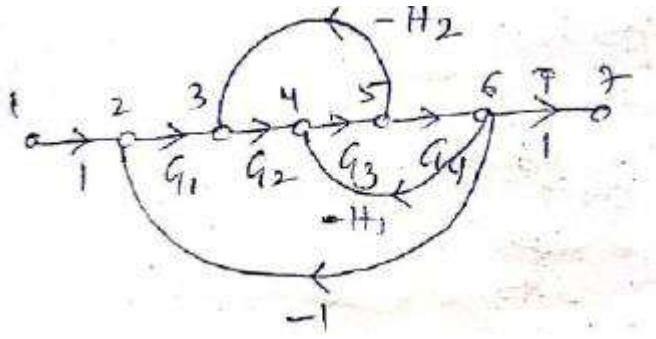
3) Write the differential equations for the mechanical system as shown below figure and obtain transfer function $Y_2(S)/f(S)$? (C313.1) (Knowledge)



4) Write the differential equations for the mechanical system as shown below figure and obtain transfer function $\theta_2(S)/T(S)$? (C313.1) (Knowledge)



5) Find the transfer function for the below signal flow graph? (C313.1) (Knowledge)



6) Analyze the response of under damped system when input is unit step? (C313.2) (Analysis)

$$\frac{C(S)}{R(S)} = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

7) Solve the R- H stability of given characteristic equation (C313.2) (Evaluation)

$$s^5 + s^4 + 2s^3 + 2s^2 + 3s + 15 = 0$$

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ASSIGNMENT- 2 **SUBJECT: CONTROL SYSTEMS**

1. Analyze the stability of a system in frequency domain using polar plot

$$G(s)\,H(s) = \frac{1}{s(1+s)^2}$$

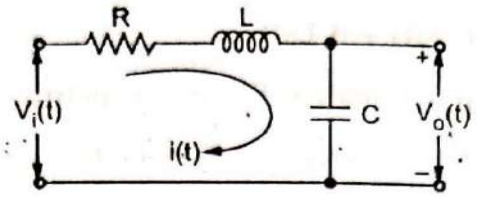
(C313.4) (Analysis)

2. Design PI and PD type of Controllers? (C313.5) (Synthesis)

3. Obtain the transfer matrix (function) (C313.6) (Knowledge)

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} 0 & 3 \\ -2 & -5 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} U_1 \\ U_2 \end{bmatrix}, \quad \begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

4. Obtain state model of given electrical system.



. (C313.6) (Knowledge)

5.

: *Evaluate the observability of the system with*

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \text{ and } C = [3 \;\; 4 \;\; 1]$$

(C313.6) (Analysis)

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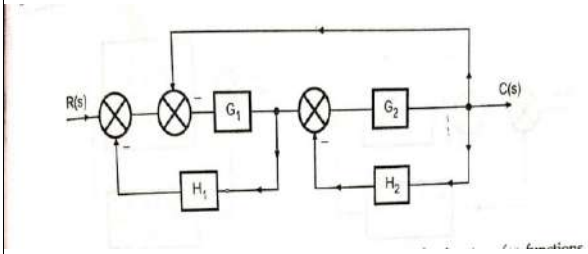
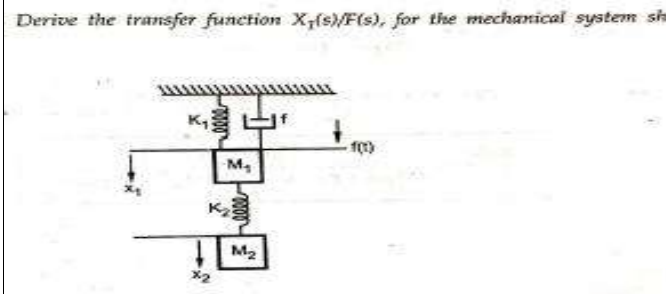
TUTORIAL TOPICS **SUBJECT: CONTROL SYSTEMS**

S.NO	Unit	TOPIC	Number of Sessions Planned	Teaching method/Aids
1.	1	Analyze the overall gain C/R represented by block diagram 	1	**BB**
2.		State the transfer function 	1	BB
3.	2	Analyze and sketch the root locus of the system whoose $G(s)=\frac{K(s+15)}{s(s+1)(s+5)}$	1	BB
4.		Determine the R- H stability of given characteristic equation $s^4+8s^3+18s^2+16s+5=0.$	1	BB

5.	3	Sketch the Bode Plot for the Transfer Function G(S) = 10 / S (S + 5). Calculate Gain Crossover Frequency.	1	BB
6.		Explain about the Frequency Domain Specifications in brief.	1	BB
7.	4	PID type of controller.	1	BB
8.		Lag-Lead Compensator.	1	BB
9.	5	Find state transition matrix $A = \begin{bmatrix} 0 & -1 \\ +2 & -3 \end{bmatrix}$	1	BB
10.		Find if the system is controllable $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \quad B = \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 1 & 0 \end{bmatrix}$	1	BB
11.		Find if the system is observable $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ and $C = [3 \ 4 \ 1]$	1	BB

Course Title	CONTROL SYSTEMS
Course Code	EC503PC
Programme	B.Tech
Year & Semester	III year I-semester, A sec
Regulation	R18
Course Faculty	K. SRIKANTH, Assistant Professor, ECE

Slow learners:

S No	Roll no	No of backlogs	Internal-I Status	Internal-II Status
1	20X31A0401	4	20	20
2	20X31A0403	5	15	14
3	20X31A0406	4	17	21
4	20X31A0407	3	20	19
5	20X31A0408	3	16	19
6	20X31A0410	5	19	18
7	20X31A0411	4	18	21
8	20X31A0412	5	14	15
9	20X31A0413	4	14	21
10	20X31A0418	8	14	14
11	20X31A0419	4	17	20
12	20X31A0423	3	23	21
13	20X31A0427	3	21	18
14	20X31A0428	4	23	22
15	20X31A0430	4	24	23
16	20X31A0431	5	24	17
17	20X31A0433	3	20	17
18	20X31A0435	3	16	18
19	20X31A0436	5	19	19
20	20X31A0440	4	20	22
22	20X31A0445	4	23	21

23	20X31A0447	3	22	22
24	20X31A0450	4	22	22
25	20X31A0453	4	18	21
26	20X31A0454	5	14	20
27	20X31A0455	4	18	21
28	20X31A0456	5	14	21
30	20X31A0458	3	21	20
31	20X31A0462	3	21	22

Advanced learners:

S.NO	ROLL.NO.	GATE MATERIAL
1	20X31A0404	Steady state error, Steady state output of the system, Root locus, Pole-zero plot, Routh array, State Space Analysis, Block Diagram, Time Domain Analysis, Nyquist plot, Compensators, transfer function, Nyquist plot, RH criterion, Compensator, Root locus, Steady-state error, TDA.
2	20X31A0409	
3	20X31A0415	
4	20X31A0416	
5	20X31A0420	
6	20X31A0421	
7	20X31A0422	
8	20X31A0425	
9	20X31A0432	
10	20X31A0434	
11	20X31A0437	
12	20X31A0438	
13	20X31A0439	
14	20X31A0442	
15	20X31A0444	
16	20X31A0449	
17	20X31A0452	
18	20X31A0459	
19	20X31A0460	

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BATCH ECE-III BTECH I SEM ECE-A RESULT ANALYSIS

ACADAMIC YEAR	COURSE NAME	NUMBER OF STUDENTS		QUESTION PAPER SETTING		PASS%
		APPEARED	PASSED	INTERNAL	EXTERNAL	
2022-23	CONTROL SYSTEM	60	38	COURSE FACULTY	JNTUH	63.33

CONTROL SYSTEM (C313) RESULT ANALYSIS

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

REMEDIAL CLASSES TIME TABLE

A.Y 2022-23 **SEMESTER-I**

BRANCH/ SEC	MON 4.00 PM-5.00 PM	TUE 4.00 PM-5.00 PM	WED 4.00 PM-5.00 PM	THUR 4.00 PM-5.00 PM	FRI 4.00 PM-5.00 PM
II ECE-A	EDC	NATL	DSD	PTSP	SS
II ECE-B	NATL	DSD	PTSP	SS	EDC
III ECE-A	MPMC	DCCN	CS	BEFA	EMI
III ECE-B	DCCN	CS	BEFA	EMI	MPMC
III ECE-C	CS	BEFA	EMI	MPMC	DCCN
IV ECE-A	MW&OC	DIP	PPLE	NS&C	JAVA
IV ECE-B	DIP	PPLE	NS&C	JAVA	MW&OC
IV ECE-C	PPLE	NS&C	JAVA	MW&OC	DIP

Head of the Department
Electronics and Communication Engg. Dept.
SRI INDU INSTITUTE OF ENGG & TECH,
Sheriguda(V), Ibrahimpatnam(M), R.R.Dist-501 510.

PRINCIPAL
Sri Indu Institute of Engineering & Tech.
Sheriguda(Vill), Ibrahimpatnam,
R.R. Dist. Telangana -501 510.

SRI INDU INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electronics and Communication Engineering

Course Outcome Attainment (Internal Examination-1)

Name of the faculty : KONGARI SRIKANTH Academic Year: 2022-23

Branch & Section: ECE - A Examination: I Internal

Course Name: CONTROL SYSTEM Year: III Semester: I

S.No	HT No.	Q1a	Q1b	Q2a	Q2b	Q3a	Q3b	Q4a	Q4b	Obj1	A1
Max. Marks ==>		**5**		**5**		**5**		**5**		**10**	**5**
1	20X31A0401	5						4		6	5
2	20X31A0402	5						5		6	5
3	20X31A0403			3						7	5
4	20X31A0404	5						4		6	5
5	20X31A0405	3		3				3		6	5
6	20X31A0406	2						3		7	5
7	20X31A0407	2		5						8	5
8	20X31A0408			3						8	5
9	20X31A0409	5		5				5		9	5
10	20X31A0410	5						3		6	5
11	20X31A0411	4						2		7	5
12	20X31A0412	2		2						5	5
13	20X31A0413			5				4		1	5
14	20X31A0414	4				3		4		7	5
15	20X31A0415	2				3		4		8	5
16	20X31A0416	4						3		8	5
17	20X31A0417	4		5				5		8	5
18	20X31A0418			1						8	5
19	20X31A0419	4						2		6	5
20	20X31A0420	3						2		6	5
21	20X31A0421	5						4		8	5
22	20X31A0422	5		4		3		5		9	5
23	20X31A0423	5		4				4		9	5
24	20X31A0424	5		3				4		9	5
25	20X31A0425	5		4				4		9	5
26	20X31A0426	4		4				3		9	5
27	20X31A0427	4		3				2		9	5
28	20X31A0428	5		4						9	5
29	20X31A0429	5						4		9	5
30	20X31A0430	5						5		9	5
31	20X31A0431	5						5		9	5
32	20X31A0432	5						5		9	5
33	20X31A0433	3		2				4		8	5
34	20X31A0434	5		3				5		9	5
35	20X31A0435	1		3						7	5
36	20X31A0436	4		4				4		6	5
37	20X31A0437	3		5		4		5		8	5
38	20X31A0438	5		4				5		9	5
39	20X31A0439	5				2		2		9	5
40	20X31A0440	4				2		5		9	5
41	20X31A0441	5		3				5		9	5
42	20X31A0442	5						5		9	5
43	20X31A0444	5		4				5		9	5
44	20X31A0445	5						5		8	5
45	20X31A0446	5						4		8	5
46	20X31A0447	5						4		8	5

47	20X31A0448	5						5		8	5
48	20X31A0449	5		5				5		8	5
49	20X31A0450	5						5		7	5
50	20X31A0451	5						5		7	5
51	20X31A0452	5		3		3		5		9	5
52	20X31A0453	2						3		8	5
53	20X31A0454	1								8	5
54	20X31A0455							5		8	5
55	20X31A0456	3		2						4	5
56	20X31A0458	5						4		7	5
57	20X31A0459	5						5		9	5
58	20X31A0460	4						5		8	5
59	20X31A0461	4						5		7	5
60	20X31A0462	4						5		7	5
Target set by the faculty / HoD		3.00	0.00	3.00	0.00	3.00	0.00	3.00	0.00	6.00	3.00
Number of students performed above the target		48	0	23	0	5	0	46	0	57	60
Number of students attempted		55	0	27	0	7	0	51	0	60	60
Percentage of students scored more than target		87%		85%		71%		90%		95%	100%

CO Mapping with Exam Questions:

CO - 1	Y		Y				Y		Y	Y
CO - 2					Y				Y	Y
CO - 3									Y	Y
CO - 4										
CO - 5										
CO - 6										

% Students Scored >Target %	87%		85%		71%		90%		95%	100%

CO Attainment based on Exam Questions:

CO - 1	87%		85%				90%		95%	100%
CO - 2					71%				95%	100%
CO - 3									95%	100%
CO - 4										
CO - 5										
CO - 6										

CO	Subj	obj	Asgn	Overall	Level
CO-1	88%	95%	100%	94%	3.00
CO-2	71%	95%	100%	89%	3.00
CO-3		95%	100%	98%	3.00
CO-4					
CO-5					
CO-6					

Attainment Level	
1	40%
2	50%
3	60%

Attainment (Internal 1 Examination) = **3.00**

SRI INDU INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electronics and Communication Engineering

Course Outcome Attainment (Internal Examination-2)

Name of the faculty : KONGARI SRIKANTH Academic Year: 2022-23
Branch & Section: ECE - A Examination: II Internal
Course Name: CONTROL SYSTEM Year: III Semester: I

S.No	HT No.	Q1a	Q1b	Q2a	Q2b	Q3a	Q3b	Q4a	Q4b	Obj2	A2
Max. Marks ==>		3	2	5		5		5		10	5
1	20X31A0401					4		4		7	5
2	20X31A0402					5		5		9	5
3	20X31A0403			4						5	5
4	20X31A0404					4				8	5
5	20X31A0405			4				4		8	5
6	20X31A0406	2				4				8	5
7	20X31A0407	2				4				8	5
8	20X31A0408	2						4		8	5
9	20X31A0409					5		5		8	5
10	20X31A0410	2						4		7	5
11	20X31A0411					5		3		8	5
12	20X31A0412					2		2		6	5
13	20X31A0413	3				5				8	5
14	20X31A0414	3				4				8	5
15	20X31A0415					4		5		9	5
16	20X31A0416	3						5		9	5
17	20X31A0417					5		4		8	5
18	20X31A0418	3				2				4	5
19	20X31A0419	3						4		7	5
20	20X31A0420	3				5				8	5
21	20X31A0421					1		5		9	5
22	20X31A0422					5		4		9	5
23	20X31A0423					3		4		9	5
24	20X31A0424					3		5		9	5
25	20X31A0425					3		4		9	5
26	20X31A0426					5				4	5
27	20X31A0427							4		9	5
28	20X31A0428			4				4		9	5
29	20X31A0429			3				4		9	5
30	20X31A0430					5		4		9	5
31	20X31A0431					1		3		8	5
32	20X31A0432					5		5		9	5
33	20X31A0433			5						7	5
34	20X31A0434					5		5		9	5
35	20X31A0435	3				4				6	5
36	20X31A0436	3				5				6	5
37	20X31A0437	3	2					5		9	5
38	20X31A0438					5		5		9	5
39	20X31A0439					5		5		9	5
40	20X31A0440			4				4		9	5
41	20X31A0441					3		4		9	5
42	20X31A0442					5		4		9	5
43	20X31A0444					5		5		9	5
44	20X31A0445	3				4				9	5

45	20X31A0446	3				4				9	5
46	20X31A0447	3				4				8	5
47	20X31A0448	3	1			4				9	5
48	20X31A0449					5		5		9	5
49	20X31A0450					4		4		9	5
50	20X31A0451					5		4		9	5
51	20X31A0452					5		5		9	5
52	20X31A0453					4		4		8	5
53	20X31A0454					4		4		7	5
54	20X31A0455					4		4		8	5
55	20X31A0456					4		4		8	5
56	20X31A0458					3		4		8	5
57	20X31A0459					5		5		9	5
58	20X31A0460					4		4		9	5
59	20X31A0461					4		5		9	5
60	20X31A0462					4		4		9	5
Target set by the faculty / HoD		1.80	1.20	3.00	0.00	3.00	0.00	3.00	0.00	6.00	3.00
Number of students performed above the target		17	1	6	0	44	0	43	0	57	60
Number of students attempted		17	2	6	0	48	0	44	0	60	60
Percentage of students scored more than target		100%	50%	100%		92%		98%		95%	100%

CO Mapping with Exam Questions:

CO - 1										
CO - 2										
CO - 3		Y							Y	Y
CO - 4	Y								Y	Y
CO - 5			Y						Y	Y
CO - 6					Y		Y		Y	Y

CO Attainment based on Exam Questions:

CO - 1										
CO - 2										
CO - 3		50%							95%	100%
CO - 4	100%								95%	100%
CO - 5			100%						95%	100%
CO - 6					92%		98%		95%	100%

CO	**Subj**	obj	Asgn	Overall	Level
CO-1					
CO-2					
CO-3	50%	95%	100%	82%	3.00
CO-4	100%	95%	100%	98%	3.00
CO-5	100%	95%	100%	98%	3.00
CO-6	95%	95%	100%	97%	3.00

Attainment Level	
1	40%
2	50%
3	60%

Attainment (Internal Examination-2) = **3.00**

SRI INDU INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electronics and Communication Engineering

Course Outcome Attainment (University Examinations)

Name of the faculty : KONGARI SRIKANTH Academic Year: 2022-23

Branch & Section: ECE - A Year / Semester: III / I

Course Name: CONTROL SYSTEM

S.No	Roll Number	Marks Secured
1	20X31A0401	18
2	20X31A0402	26
3	20X31A0403	0
4	20X31A0404	32
5	20X31A0405	30
6	20X31A0406	13
7	20X31A0407	32
8	20X31A0408	26
9	20X31A0409	30
10	20X31A0410	3
11	20X31A0411	11
12	20X31A0412	1
13	20X31A0413	11
14	20X31A0414	35
15	20X31A0415	39
16	20X31A0416	26
17	20X31A0417	34
18	20X31A0418	0
19	20X31A0419	28
20	20X31A0420	26
21	20X31A0421	34
22	20X31A0422	31
23	20X31A0423	15
24	20X31A0424	30
25	20X31A0425	31
26	20X31A0426	26
27	20X31A0427	26
28	20X31A0428	26
29	20X31A0429	31
30	20X31A0430	26
31	20X31A0431	19
32	20X31A0432	32
33	20X31A0433	11
34	20X31A0434	26
35	20X31A0435	7
Max Marks		75

S.No	Roll Number	Marks Secured
36	20X31A0436	6
37	20X31A0437	26
38	20X31A0438	44
39	20X31A0439	45
40	20X31A0440	16
41	20X31A0441	17
42	20X31A0442	39
43	20X31A0444	43
44	20X31A0445	26
45	20X31A0446	30
46	20X31A0447	26
47	20X31A0448	26
48	20X31A0449	43
49	20X31A0450	8
50	20X31A0451	35
51	20X31A0452	46
52	20X31A0453	10
53	20X31A0454	4
54	20X31A0455	0
55	20X31A0456	0
56	20X31A0458	18
57	20X31A0459	40
58	20X31A0460	30
59	20X31A0461	19
60	20X31A0462	26

Class Average mark	24
Number of students performed above the target	38
Number of successful students	60

Attainment Level	% students
1	40%
2	50%

Percentage of students scored more than target	63%
Attainment level	**3**

3	60%

SRI INDU INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electronics and Communication Engineering

Course Outcome Attainment

Name of the faculty	KONGARI SRIKANTH	Academic Year:	2022-23
Branch & Section:	ECE - A	Examination:	I Internal
Course Name:	CONTROL SYSTEM	Year:	III
		Semester:	I

Course Outcomes	1st Internal Exam	2nd Internal Exam	Internal Exam	University Exam	Attainment Level
CO1	3.00		3.00	3.00	3.00
CO2	3.00		3.00	3.00	3.00
CO3	3.00	3.00	3.00	3.00	3.00
CO4		3.00	3.00	3.00	3.00
CO5		3.00	3.00	3.00	3.00
CO6		3.00	3.00	3.00	3.00
Internal & University Attainment:			3.00	3.00	
Weightage			25%	75%	
O Attainment for the course (Internal, Universi			0.75	2.25	
CO Attainment for the course (Direct Method)			3.00		

Overall course attainment level **3.00**

SRI INDU INSTITUTE OF ENGINEERING & TECHNOLOGY

Department of Electronics and Communication Engineering

Program Outcome Attainment (from Course)

Name of Faculty:	KONGARI SRIKANTH	Academic Year:	2022-23
Branch & Section:	ECE - A	Year:	III
Course Name:	CONTROL SYSTEM	Semester:	I

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	1	1	1	2	1	-
CO2	3	3	3	3	-	-	-	-	1	1	1	2	1	-
CO3	3	3	3	3	-	-	-	-	1	1	1	2	1	-
CO4	3	3	3	3	-	-	-	-	1	1	1	2	1	-
CO5	3	3	3	3	-	-	-	-	1	1	1	2	1	-
CO6	3	3	3	3	-	-	-	-	1	1	1	2	1	-
Course	**3.00**	**3.00**	**3.00**	**3.00**	-	-	-	-	**1.00**	**1.00**	**1.00**	**2.00**	**1.00**	-

CO	**Course Outcome Attainment**
CO1	3.00
CO2	3.00
CO3	3.00
CO4	3.00
CO5	3.00
CO6	3.00
Overall course attainment level	**3.00**

PO-ATTAINMENT

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO Attainment	**3.00**	**3.00**	**3.00**	**3.00**	-	-	-	-	**1.00**	**1.00**	**1.00**	**2.00**	**1.00**	-

CO contribution to PO - 33%, 67%, 100% (Level 1/2/3)

ASSIGNMENTS AND REGISTERS

Assignment 1 script link:

https://drive.google.com/file/d/1MV443WHodvWwe5Rfe5CeuYPRdDuj0r7C/view?usp=sharing

Assignment 2 script link:

https://drive.google.com/file/d/1VIQ9SBJjyMIP9wUZvl9mtfus2kRxlcNS/view?usp=sharing

Attendance register link:

https://drive.google.com/file/d/1w8hTgCeE1Tad3QFooLTjWjlwrfIs2Yyr/view?usp=sharing