V. V. Sangha's

Rao Bahadur Y. Mahabaleswarappa Engineering College

Cantonment, Ballari – 583104, Karnataka

Department of Electronics & Communication Engineering

CONTROL SYSTEMS [18EC43].

COURSE FILE.

(EVEN SEM).

Academic Year

20 20 - 20 21.

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department Electronics And communication Engineering

CONTENT

VISION AND MISSION OF THE INSTITUTE AND DEPARTMENT

VISION OF THE INSTITUTION

To Produce Professionally Excellent, Knowledgeable, Globally Competitive and Socially Responsible Engineers and Entrepreneurs.

MISSION OF THE INSTITUTION

M1	To Provide Quality Education in Engineering and Management.
M2	To Establish a Continuous Industry-Institute Interaction, Participation and Collaboration to Contribute Skilled Engineers.
M3	To Develop Human Values, Social Values, Entrepreneurship Skills and Professional Ethics among the Technocrats.
M4	To Focus on Innovation and Development of Technologies by Engaging in Cutting Edge Research areas.

VISION OF THE DEPARTMENT

To Produce Professionally Excellent, Knowledgeable, Globally Competitive and Socially Responsible Electronics and Communication Engineers and Entrepreneurs.

MISSION OF THE DEPARTMENT

M1	To Provide Quality Education in Electronics and Communication Engineering.
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M4	To Focus on Innovation and Development of Technologies by Engaging in Electronics and Communication Research areas.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1	Graduates of Electronics & Communication Engineering course will have successful professional career.
PEO2	Graduates of Electronics & Communication Engineering course will pursue higher education or to become an Entrepreneur.
PEO3	Graduates of Electronics & Communication Engineering course will have ability for lifelong learning and to serve the society.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO 1	Ability to Design, Develop and Test the Electronics Circuits & Communication Systems.
PSO 2	Ability to Develop Excellent Programming and Problem Solving skills in the field of Embedded System.

PROGRAM OUTCOMES (PO)

PO 1	**Engineering Knowledge**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**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.
PO 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.
PO 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.
PO 5	**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.
PO 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.
PO 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.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 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, and give and receive clear instructions.
PO 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.
PO 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.

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF ELECTRONICS &COMMUNICATIONENGINEERING

Name of the Staff: Mrs.SUVARNA PATIL, Mr. SHARANA BASAVARAJ B.				
Course Name: Control Systems				
Course Code: 18EC43	**Sem:**	**4**	**Year**	**2020-21**

COURSE OUTCOME STATEMENTS	
	At the end of the course, students will be able to ….
C211.1	Develop the mathematical model of mechanical and electrical systems.
C211.2	Use block diagram reduction techniques & Masons Gain formulae to obtain transfer function.
C211.3	Analyze time domain specifications for first and second order systems.
C211.4	Determine the stability of a system in the time domain using Routh Hurwitz criteria and root locus technique, stability of a system in frequency domain using Bode plots.
C211.5	Use Nyquist plot stability of a system in frequency domain; develop a control system in continuous and discrete time using state variable techniques

CO-PO/PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C211.1	3	3	3											
C211.2	3	3	3											
C211.3	3	3	3											
C211.4	3	3	3											
C211.5	3	3	3											
AVG	3	3	3											

CO	PO	Mapping	Justification
C211.1	PO1	3	Students apply mathematics to solve problems on transfer function with respect to mechanical & electrical networks.
	PO2	3	Students do problem analysis for different mechanical & electrical networks.
	PO3	3	Students obtain solution for problems on mechanical & electrical network.
C211.2	PO1	3	Students apply mathematics to solve problems involving Masons Gain Formulae.
	PO2	3	Students do problem analysis for given block diagram and signal flow graph.
	PO3	3	Students obtain solution in the form of transfer function for a given block diagram or signal flow graph.
C211.3	PO1	3	Students apply mathematics to solve problems for time domain parameters.
	PO2	3	Students do problem analysis for Control system for time domain parameters such as rise time, fall time, peak overshoot etc.
	PO3	3	Students obtain solution for given first or second order control system such as output response of a system.
C211.4	PO1	3	Students apply mathematics to solve problems for a control system using RH criterion, root locus technique & Bode Plot.
	PO2	3	Students do problem analysis for a control system using RH criterion, root locus technique & Bode Plot.
	PO3	3	Students obtain solution and comment on the stability of the system using RH criterion, root locus technique & Bode Plot.
C211.5	PO1	3	Students apply mathematics to solve problems for a control system using Nyquist Plot & State variable techniques.
	PO2	3	Students do problem analysis for a control system using Nyquist Plot & State variable technique.
	PO3	3	Students obtain solution and comment on the stability of the system using Nyquist Plot, Zero input response of a system using State variable technique.

Course Coordinator

Staff Signature

CO ANALYSIS

Name of the Staff: Mrs. SUVARNA PATIL, Mr. SHARANA BASAVARAJ B.				
Course Name: Control Systems				
Course Code: 18EC43	Sem:	4	Year	2020-21

CO	Description
C211.1	Develop the mathematical model of mechanical and electrical systems. **Action:** Develop **Knowledge:** mathematical model of mechanical and electrical systems, **Condition:** transfer function. **Criterion:** None
C211.2	Use block diagram reduction techniques & Masons Gain formulae to obtain transfer function. **Action:** Use **Knowledge:** block diagram reduction techniques & Masons Gain formulae **Condition:** transfer function **Criterion:** None
C211.3	Analyze time domain specifications for first and second order systems. **Action:** Analyze **Knowledge:** time domain specifications **Condition:** first and second order systems. **Criterion:** None.
C211.4	Determine the stability of a system in the time domain using Routh Hurwitz criteria and root locus technique, stability of a system in frequency domain using Bode plots. **Action:** Determine **Knowledge:** Routh Hurwitz criteria, root locus technique & Bode plots. **Condition**: stability of a system in time domain & frequency domain. **Criterion:** None
C211.5	Use Nyquist plot stability of a system in frequency domain; develop a control system in continuous and discrete time using state variable technique. **Action:** Use, Develop. **Knowledge:** Nyquist plot & state variable techniques. **Condition:** stability of a system in frequency domain. **Criterion:** None

[Staff Sign].

Academic Calendar of EVEN Semesters of UG Programmes

Semesters / EVENTS	IV semester B.E./B.Tech.	IV semester B.Arch./ B.Plan.	VI semester B.E./B.Tech.	VI semester B.Plan./B.Arch	VIII semester B.E./B.Tech.	VII semester B.Plan./B.Arch.
Commencement of EVEN Semester	19.04.2021	19.04.2021	19.04.2021	19.04.2021	19.04.2021	19.04.2021
Last Working day of EVEN Semester	07.08.2021	07.08.2021	07.08.2021	07.08.2021	20.07.2021	20.07.2021
Practical Examinations	09.08.2021 To 19.08.2021	09.08.2021 To 19.08.2021	09.08.2021 To 19.08.2021	---	---	---
Theory Examinations	23.08.2021 To 09.09.2021	23.08.2021 To 09.09.2021	23.08.2021 To 09.09.2021	10.08.2021 To 31.08.2021	#22.07.2021 To 30.07.2021	#22.07.2021 To 30.07.2021
Internship	---	---	---	---	---	---
Internship Viva-Voce	---	---	---	---	02.08.2021 To 06.08.2021	---
Professional training / Organization study	---	---	---	---	---	---
Commencement of ODD Semester	13.09.2021	13.09.2021	13.09.2021	13.09.2021	---	09.08.2021 (IX sem Arch)

- The classroom sessions for even the semester should commence from the dates mentioned above. The classroom sessions for all the semesters would be in **Offline /Online/blended mode** until further orders.
- The Institute needs to function for **six days** a week with additional hours (**Saturday is a full working day).** #if required the college can plan to have extra classes even on **Sundays also**.
- If any of the above dates are declared to be a holiday then the corresponding event will come into effect on the next working day.
- Notification regarding the Calendar of Events relating to the conduct of **University Examinations** will be issued by the Registrar (Evaluation) from time to time.
- The faculty/staff shall be available to undertake any work assigned by the University.
- Academic Calendar may be modified based on guidelines/directions issued in the future by MHRD/UGC/AICTE/State Government.
- Revised Academic Calendar is also applicable for **Autonomous Colleges.** In case if any changes are to be affected by Autonomous Colleges in the academic terms and examination schedule, they could do so with the approval of the University.

15/4/2021.

REGISTRAR

RaoBahadur Y Mahabaleswarappa Engineering College, Ballari

Department of Electronics and Communication Engineering

Academic Calendar of Events
EVEN Semester 2020-21(April 2021-Sept 2021)

	III, V& VII Sem B.E/B.Tech
Pre Placement Training	For VI Semester Students of all Branches from 20th to 25th Sep 2021
Commencement of ODD Semester	19th April 2021
Admission Publicity in and around Ballari	March 2021
Six Days National Webinar on **"Intellectual Property Rights and IP Management for Start - up"** by Mrs. Priyadarshini Singh ,Research Scholar	26th April to 1st may
I Internal Assessment Test	10th, 11th & 12th June 2021 (Thu, Fri & Sat-Online)
Last date for sending IA Marks (SMS)	14st June 2021
Parents Meet	15h June 2021
2nd International Virtual Conference on **"Futuristic Trends in Embedded Systems and Networking" ICFTEN 2021** in association with IFERP and RYMEC	7th-8th July 2021
II Internal Assessment Test	16th, 17th & 18th July 2021 (Tue, Wed & Thu-Online)
Last date for sending IA Marks (SMS)	19th July 2021
Parents Meet	20th July 2021
Department forum "Talentronics"	2nd August 2021
Current Covid 19 Situation and How to Overcome All Diseases by Dr. Khadar Vali	2nd August 2021
Mini project exhibition for 8th sem students	4th august 2021
Farewell day for final year students	8th August 2021
Six Days Workshop on **Basics of Machine Learning using Python**	30th August to 4th Sept 2021
III Internal Assessment Test	12th,13th &14th August 2021(Thu, Fri & Sat-Online)
Last date for sending IA Marks (SMS)	15th August 2021
Mini project exhibition for 6th sem students	18th august 2021
Parents Meet	16th August 2021
Last Working Day	**07/08/2021**
Practical Examination	09/08/2021 to 19/08/2021
Theory Examination	23/08/2021 to 09/09/2021
NBA SAR audit by Ms. Manisha .	7th Sept 2021
NAAC Presentation by DR H Girish ,Coordinator and Dean	13th Sept 2021
Commencement of EVEN Semester	**13/09/2021**

Head of the Department
Electronics & Communication Engg.
R. Y. M. Engineering College,
(Formerly Vijayanagar Engg. College)
HOD ECE
BELLARY-583 104.

V.V.Sangha's

RAO BAHADUR Y MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Electronics & Communication Engineering

Time Table

Staff Name: SHARANA BASAVARAJ.B	**Sem :** 4th **Sec:** B
Course Name: CONTROL SYSTEMS	**Course Code:** 18EC43 [4th B]
Lab Name: EMBEDDED SYSTEMS [UG] ADVANCED COMMUNICATION LAB-2 [PG]	**Code:** 18ECL66 20ECSL26

Day	9am-9:55am	9:55am-10:50am	10:50am-11:00am	11.00am-11.55am	11.55am-12.50pm	12.50pm-2.15pm	2.15pm-3.10pm	3.10pm-4.05pm	4.05pm-5pm
Monday			BREAK			BREAK			
Tuesday				CS					
Wednesday	CS								
Thursday	←	EMBEDDED		SYSTEMS →			CS		
Friday	← EMBEDDED SYSTEMS →								
Saturday	←	ADVANCED COMMUNICATION LAB-2 [PG] →							

B. E. (EC / TC)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – III

CONTROL SYSTEMS

Course Code	**18EC43**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**3**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (08 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

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

Modules	RBT Level
Module – 1	
Introduction to Control Systems: Types of Control Systems, Effect of Feedback System s, Differential equation of Physical Systems –Mechanical Systems, Electrical Systems, Electromechanical systems, Analogous Systems.	**L1, L2, L3**
Module – 2	
Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs.	**L1, L2, L3**
Module – 3	
Time Response of feedback control systems: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers (excluding design).	**L1, L2, L3**
Module – 4	
Stability analysis: Concepts of stability, Necessary conditions for Stability, Routhstability criterion, Relative stability analysis: more on the Routh stability criterion. Introduction to Root-Locus Techniques, The root locus concepts, Construction of rootloci. **Frequency domain analysis and stability:** Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function.	**L1, L2, L3**
Module – 5	
Introduction to Polar Plots, (Inverse Polar Plots excluded) Mathematical preliminaries, Nyquist Stability criterion, (System s with transportation lag excluded) Introduction to lead, lag and lead- lag compensating networks (excluding design). **Introduction to State variable analysis:** Concepts of state, state variable and state models for electrical systems, Solution of state equations.	**L1, L2, L3**

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

- Develop the mathematical model of mechanical and electrical systems.
- Develop transfer function for a given control system using block diagram reduction techniques and signal flow graph method.
- Determine the time domain specification s for first an d second order systems.
- Deter mine the stability of a system in the time domain using Routh-Hurwitz criterion and Root-locus technique.
- Determine the s stability of a system in the frequency domain u sing Nyquist and bode plots.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Book:

J. Nagarath an d M.Gopal, " Control System s Engineering", New Age International(P) Limited, Publishers, Fifthedition- 2005,ISBN: 81 - 224 - 2008-7.

Reference Books:

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

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
Department of Electronics and Communication Engineering

COURSE PLAN 2020-21 EVEN SEM

Staff Name: Sharana Basavaraj B	**Course Type: Core**	**Sem / Sec: 4th/B**
Course Name: CONTROL SYSTEMS	**Course Code: 18EC43**	**Total Number of Lecture Hours:40**
Max marks: 100	**Prerequisites: Mathematics & Network Theory**	

Sl.No	Module Name	Lecture Hours Required
01	Introduction to Control Systems.	**8**
02	Block diagrams and signal flow graphs.	**8**
03	Time Response of feedback control systems.	**10**
04	Stability analysis, Bode Plots.	**10**
05	Nyquist Plots, introduction to State variable analysis.	**10**

Sl.No	Date	Hour	Topic to be Covered
1	20-04-2021	2nd	**Introduction to Control Systems: Introduction.**
2	22-04-2021	3rd	Types of Control Systems.
3	27-04-2021	2nd	Effect of Feedback Systems
4	28-04-2021	1st	Differential equation of Physical Systems –Mechanical Systems
5	29-04-2021	3rd	Differential equation of Physical Systems – Electrical Systems
6	04-05-2021	2nd	Electromechanical systems, Analogous Systems, Problems
7	05-05-2021	1st	Problems
8	06-05-2021	3rd	Problems
9	11-05-2021	2nd	**Block diagrams and signal flow graphs**
10	12-05-2021	1st	Transfer function Block diagram algebra rules
11	13-05-2021	3rd	Transfer function Block diagram algebra problems
12	18-05-2021	2nd	Transfer function Block diagram algebra problems
13	19-05-2021	1st	Transfer function Block diagram algebra problems
14	20-05-2021	3rd	Transfer function Block diagram algebra problems
15	25-05-2021	2nd	Signal Flow graphs definitions and Masons gain formulae
16	26-05-2021	1st	Transfer functions using Signal Flow graphs problems
17	27-05-2021	3rd	Transfer function using Signal Flow graphs problems
18	01-06-2021	2nd	Transfer function using Signal Flow graphs problems
19	02-06-2021	1st	**Time Response of feedback control systems:** Standard test signals
20	03-06-2021	3rd	Unit step response of First and Second order Systems
21	08-06-2021	2nd	Time response specifications
22	09-06-2021	1st	Time response specifications of second order systems, Problems
23	15-06-2021	2nd	Problems
24	16-06-2021	1st	steady state errors and error constants, Problems
25	17-06-2021	3rd	Problems
26	22-06-2021	2nd	Introduction to PI, PD and PID Controllers

Sl.No	Date	Hour	Topic to be Covered
27	23-06-2021	1st	**Stability analysis**: Concepts of stability
28	24-06-2021	3rd	Necessary conditions for Stability, RH criterion, Problems
29	29-06-2021	2nd	Relative stability analysis: more on the RH criterion Problems
30	30-06-2021	1st	Problems
31	01-07-2021	3rd	**Introduction to Root-Locus Techniques** The root locus concepts,
32	06-07-2021	2nd	Construction of Root locus.
33	07-07-2021	1st	Construction of Root locus.
34	08-07-2021	3rd	Frequency domain analysis and stability: Correlation between time and frequency response
35	13-07-2021	2nd	Bode Plots
36	14-07-2021	1st	Experimental determination of transfer function
37	15-07-2021	3rd	Experimental determination of transfer function
38	20-07-2021	2nd	Introduction to Polar Plots.
39	21-07-2021	1st	Nyquist Stability criterion based problems.
40	22-07-2021	3rd	Nyquist Stability criterion based problems.
41	27-07-2021	2nd	Introduction to lead, lag and lead- lag compensating networks
42	28-07-2021	1st	**Introduction to State variable analysis:** Concepts of state.
43	29-07-2021	3rd	State variable and state models for electrical systems.
44	03-08-2021	2nd	Solution of state equations.
45	04-08-2021	1st	Problems
46	05-08-2021	3rd	Problems

Teaching and Learning Tools: Chalk and Blackboard.

Text Books:

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

Digital Library/E-Resources:

1. **http://192.168.8.8:8080**
2. **http://192.168.8.8/gdlcn**
3. **http://192.168.8.8/gdlcn4-- for VTU Elearning-NPTEL**

Innovative Practices:

1. **Key points summarizing all formulae's for each module.**
2. **Solving VTU Question Papers.**

Note: Planning of syllabus is done as per VTU curriculum

Staff Signature

HOD

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Title: Report on Syllabus Status

Semester & Section	Subject & Subject Code	Academic Year	Name of Staff
4th B	CONTROL SYSTEMS [18EC43]	2020-21	SHARANA BASAVARAJ.B.

Sl. No	Date	Period	Topics Covered	Remarks
1)	20/4/2021	2nd	Introduction to Control systems.	
2)	22/4/21	3rd	Types of Control Systems.	
3)	28/4/21	3rd	open loop & Closed loop systems.	
4)	29/4/21	3rd	F-C voltage analogy.	
5)	4/5/21	2nd	F-C voltage, F-I analogy Problems.	
6)	5/5/21	1st	Torque voltage Analogy Problems.	
7)	6/5/21	3rd	F-V & T-I Analogous Network Problems.	
8)	11/5/21	2nd	Torque voltage Analogous, Transfer function Problems.	
9)	18/5/21	2nd	Block diagram reduction rules.	
10)	25/5/21	2nd	Block diagram reduction & Transfer function	
11)	26/5/21	1st	Transfer function using Block diagram	
12)	27/5/21	3rd	Transfer function using Block diagram rules.	
13)	1/6/21	2nd	Transfer function using Block diagram rules.	
14)	2/6/21	1st	Transfer function using Block diagram rules.	
15)	3/6/21	3rd	Revision of module 2.	
16)	8/6/21	2nd	Revision of module 1 for 1st IA.	
17)	15/6/21	1st	Module 4: Routh Hourwitz Criterion.	
18)	16/6/21	1st	RH Criterion Problems.	
19)	17/6/21	3rd	RH Criterion Problems → Range of gain	
20)	22/6/21	2nd	RH Criterion Problems → Sustained osc. freq.	
21)	23/6/21	1st	RH criterion relative stability.	
22)	24/6/21	3rd	Revision of RH Criterion.	
23)	29/6/21	2nd	Root Locus Steps.	
24)	30/6/21	1st	Root Locus Problems.	

Faculty Signature

HOD ECE

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Title: Report on Syllabus Status

Semester & Section	Subject & Subject Code	Academic Year	Name of Staff
4th B	CONTROL SYSTEMS [18EC43]	2020-21	SHARANA BASAVARAJ.B

Sl. No	Date	Period	Topics Covered	Remarks
25)	1/7/2021	3rd	Root Locus Problems.	
26)	6/7/2021	2nd	State Space Variables.	
27)	13/7/2021	2nd	State Space Variables Problems.	
28)	14/7/2021	1st	State Transition matrix Problems.	
29)	22/7/2021	3rd	State Space Variables: STM.	
30)	27/7/2021	2nd	State Space Variable: Electrical n/w's.	
31)	28/7/2021	1st	State Space: Electrical n/w problems.	
32)	29/7/2021	3rd	Differential Equations in State Space.	
33)	3/8/2021	2nd	Nyquist plot: Basics, Problems.	
34)	4/8/2021	1st	Nyquist plot: Problems.	
35)	5/8/2021	3rd	Polar Plot Problems.	

Faculty Signature

HOD ECE

COURSE EVALUATION AND ASSESSMENT SCHEME-2018

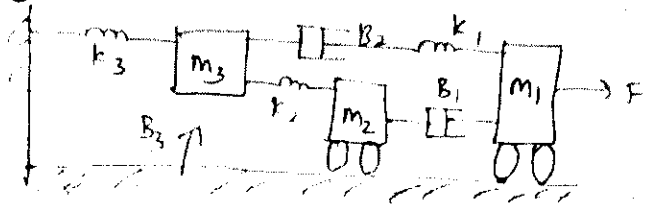
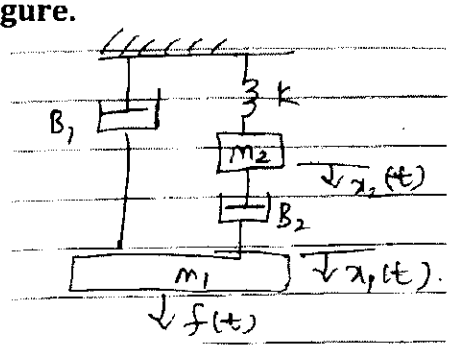
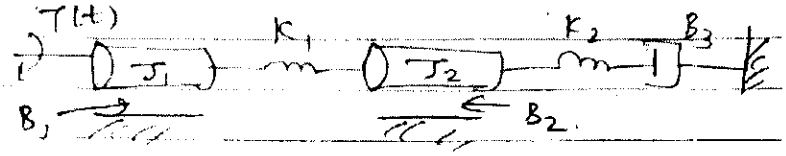
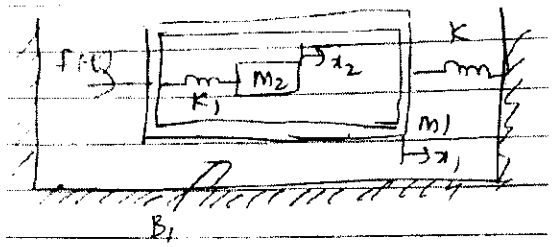
	What		To Whom	When/ Where (Frequency in the course)	Max Marks	Evidence Collected
Direct Assessment Methods	IA	Internal Assessment Tests	Students	Thrice(Average of three IA Tests)	30	Blue Books
		Assignment		Thrice(Before IA Test and average of 3 is taken)	10	Assignment Books
		Practical Assessment		Once	40	Practical evaluation
	FE	Final Examination		End of Course (Answering One of two questions from five Modules	100	Result sheet
		Practical Examination		One question from lot	100	Result sheet
Indirect Assessment Methods	Students Feedback		Students	End of the course	-	Questionnaire
	Course Exit Survey					

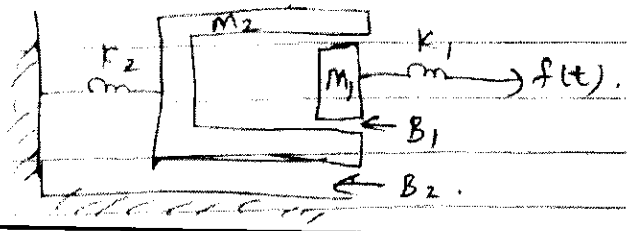
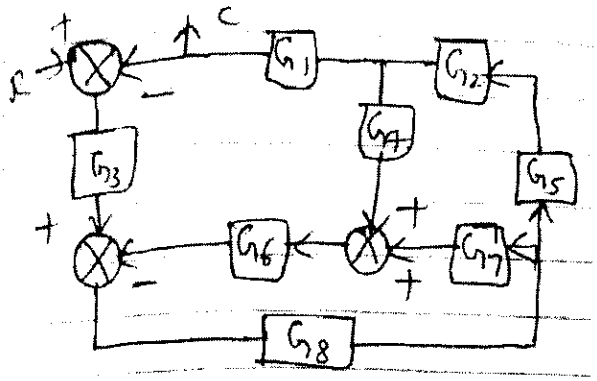
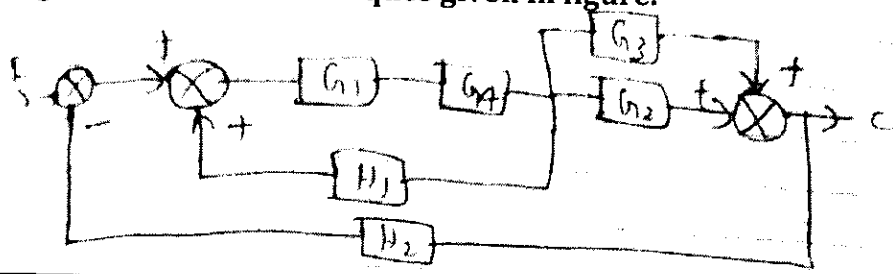
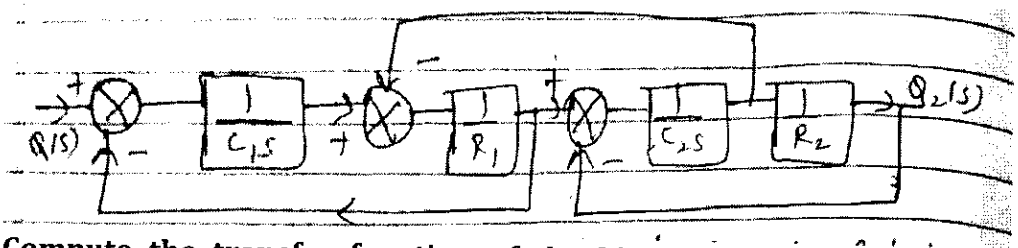
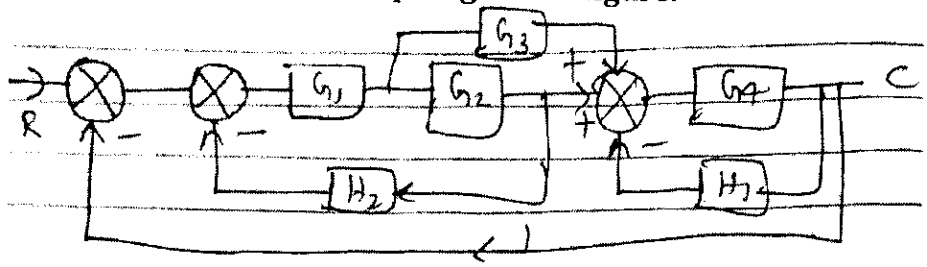
Questions for IA and FE will be designed to evaluate the various educational components (Bloom's taxonomy)

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
ASSIGNMENT -I (20-21 Even Sem)

Staff Name : Mrs.Suvarna Patil / Mr.Sharana Basavaraj B	**Sem :4th Sec: A & B**
Course Name : Control Systems	**Course Code : 18EC43**
Prerequisites: Mathematics & Network Theory.	

NOTE: Answer all assignment questions

Q No	QUESTIONS	BTL	CO	PO
1	**Sketch the Force Current analogy of the mechanical network given in figure.** 	3	1	1,2,3
2	**a. Explain Classifications of Control systems.** **b. Distinguish between open & closed loop systems.**	2		1
3	**Sketch the Force Voltage & Force Current analogy of the mechanical network given in figure.** 	3	1	1,2,3
4	**Sketch the Torque Current & Torque Voltage analogy of the mechanical network given in figure.** 			
5	**Compute the transfer function of the mechanical network given in figure.** 	3	1	1,2,3

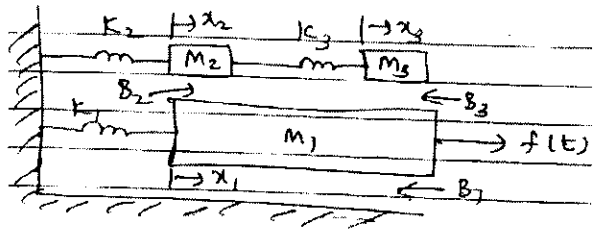
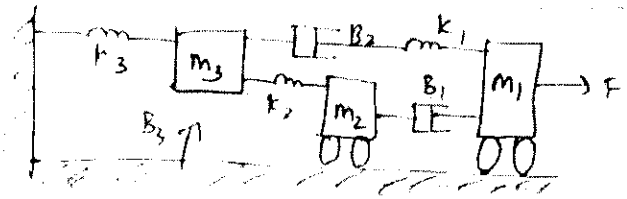
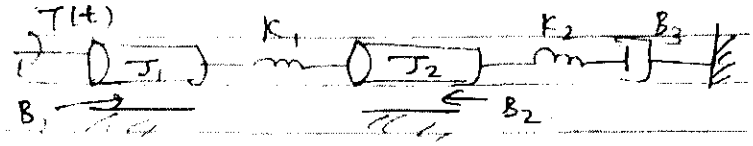
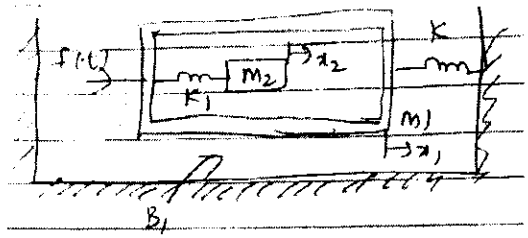
6	Sketch the Force voltage analogy of the mechanical network given in figure. 			
7	Compute the transfer function of the block diagram given in figure using block diagram reduction techniques. 	3	2	1,2,3
8	Compute the transfer function of the block diagram using block diagram reduction techniques given in figure. 			
9	Compute the transfer function of the block diagram given in figure using block diagram reduction techniques. 	3	2	1,2,3
10	Compute the transfer function of the block diagram using block diagram reduction techniques given in figure. 			

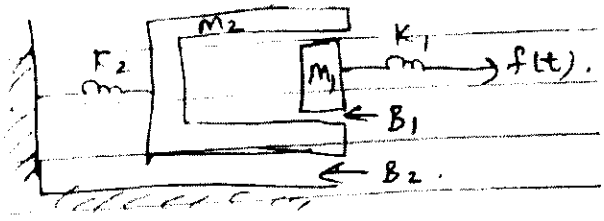
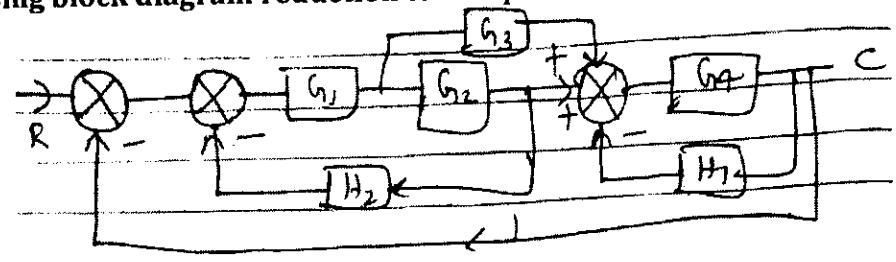
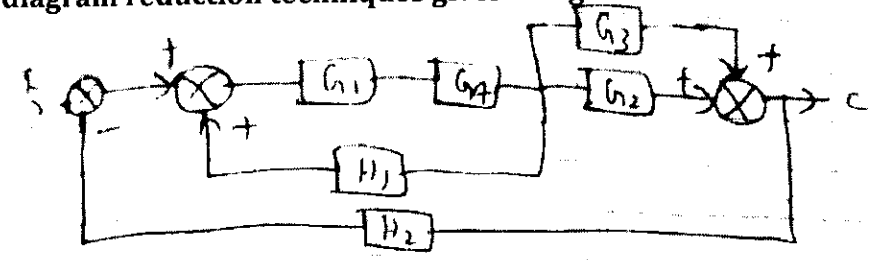
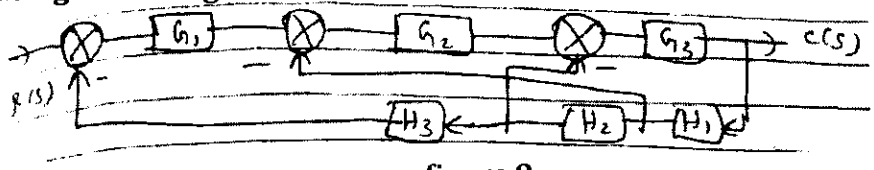
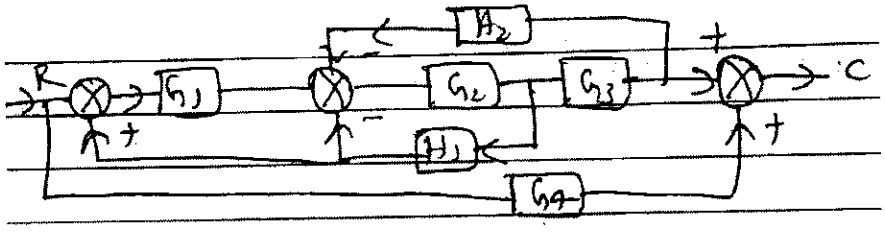
Signature of Faculty

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
INTERNAL ASSESSMENT -I (20-21 Even Sem)

Staff Name : Mrs.Suvarna Patil / Mr.Sharana Basavaraj B	Sem :4th Sec: A & B	Date:11/06/2021 Time:10.30am to 12pm
Course Name : Control Systems	Course Code : 18EC43	
Prerequisites: Mathematics & Network Theory.		

NOTE: Answer five questions, each carries 10marks **Max Marks:5*10= 50**

Q No	QUESTIONS	BTL	CO	PO
1	Sketch the Force Current analogy of the mechanical network given in figure 1.	3	1	1,2,3
2	 figure 1 OR a. Explain any 5 Classifications of Control systems. b. Distinguish between open & closed loop systems (any 5 differences).	2	1	1
3	Sketch the Force Voltage analogy of the mechanical network given in figure 2.	3	1	1,2,3
4	 figure 2 OR Sketch the Torque Current & Torque Voltage analogy of the mechanical network given in figure 3.  figure 3			
5	Compute the transfer function of the mechanical network given in figure 4.	3	1	1,2,3
	 figure 4 OR			

6	Sketch the Force Current analogy of the mechanical network given in figure 5.  figure 5			
7	Compute the transfer function of the block diagram given in figure 6 using block diagram reduction techniques.  figure 6 OR	3	2	1,2,3
8	Compute the transfer function of the block diagram using block diagram reduction techniques given in figure 7.  figure 7			
9	Compute the transfer function of the block diagram given in figure 8 using block diagram reduction techniques.  figure 8 OR	3	2	1,2,3
10	Compute the transfer function of the block diagram using block diagram reduction techniques given in figure 9.  figure 9			

Note: BTL (Blooms Taxonomy Level) CO (Course Outcome) PO (Program Outcome)

IA Coordinator

Signature of faculty

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF EVALUATION CIE 1 (20-21 Even Sem)

Staff Name : Mrs.Suvarna Patil / Mr.Sharana Basavaraj B	Sem :4th Sec: A & B	Date:11/06/2021 Time:10.30am to 12pm
Course Name : Control Systems	Course Code : 18EC43	
Prerequisites: Mathematics & Network Theory.		

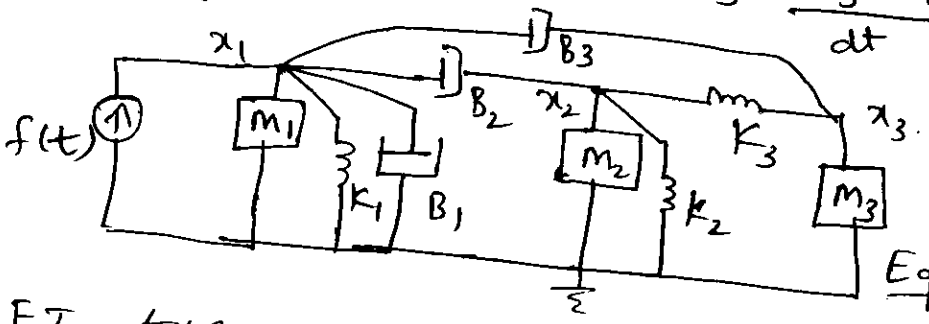
1) There are 3 displacements, so 3 differential equations one for each displacement.

$$f(t) = m_1\frac{d^2x_1}{dt^2} + K_1x_1 + B_1\frac{dx_1}{dt} + B_2\frac{d(x_1-x_2)}{dt} + B_3\frac{d(x_1-x_3)}{dt} \rightarrow (1)$$

$$0 = m_2\frac{d^2x_2}{dt^2} + K_2x_2 + B_2\frac{d(x_2-x_1)}{dt} + K_3(x_2-x_3) \rightarrow (2).$$

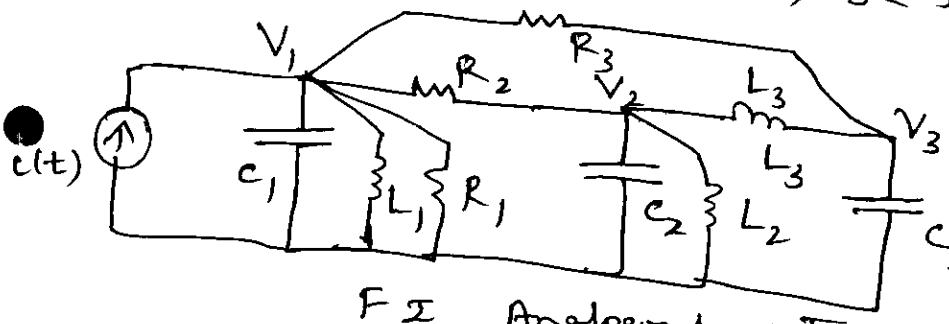
$$0 = m_3\frac{d^2x_3}{dt^2} + K_3(x_3-x_2) + B_3\frac{d(x_3-x_1)}{dt} \rightarrow (3).$$

→ 3m.



Equivalent mechanical → 2m.

F I of mechanical System are analogous with following substitutions :- F ↔ I; M ↔ C; B ↔ $\frac{1}{R}$; K ↔ $\frac{1}{C}$; $\frac{dx}{dt} = V(t)$. 5m



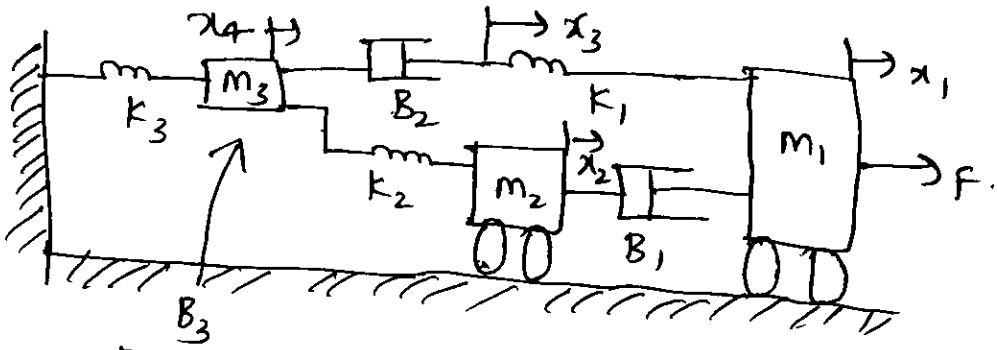
F I Analogous Network → 5m.

---

2) (a) Any 5 Classification & Explanation from :- 1*5 = 5m.
(1) Natural Control S/m (2) Man made Control S/m.
(3) Mixed Control S/m (4) Time Valying & Time Invariant.
(5) Linear & Non Linear S/m (6) Continuous time & Discrete Time.
(7) Deterministic & Stochastic (8) Lumped & Distributed Parameter.
(9) SISO & MIMO (10) open Loop & Closed Loop Systems.

(b) Any 5 differences :- 1*5 = 5m.

(3)



Since there are four displacements, there will be 4 differential equations.

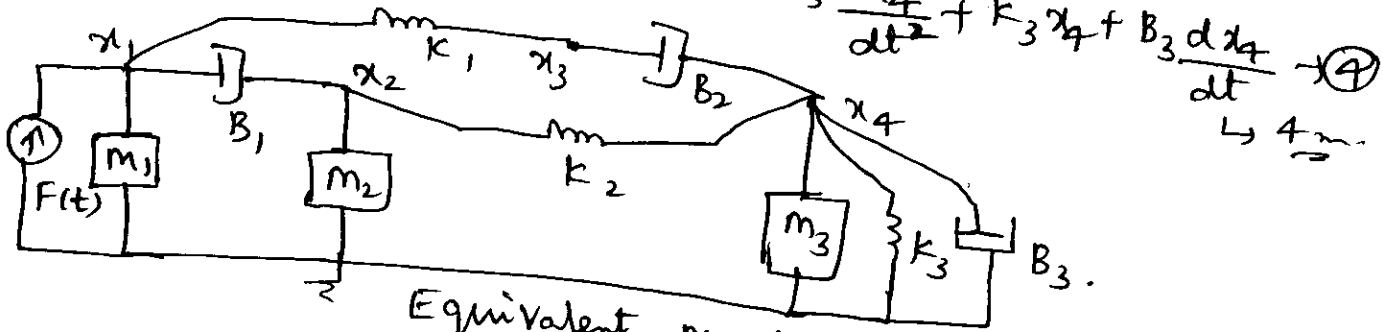
$$F(t) = m_1\frac{d^2x_1}{dt^2} + B_1\frac{d(x_1-x_2)}{dt} + K_1(x_1-x_3) \rightarrow (1).$$

$$0 = m_2\frac{d^2x_2}{dt^2} + B_1\frac{d(x_2-x_1)}{dt} + K_2(x_2-x_4) \rightarrow (2).$$

$$0 = K_1(x_3-x_1) + B_2\frac{d(x_3-x_4)}{dt} \rightarrow (3).$$

$$0 = B_2\frac{d(x_4-x_3)}{dt} + K_2(x_4-x_2) + m_3\frac{d^2x_4}{dt^2} + K_3x_4 + B_3\frac{dx_4}{dt} \rightarrow (4)$$

↳ 4m

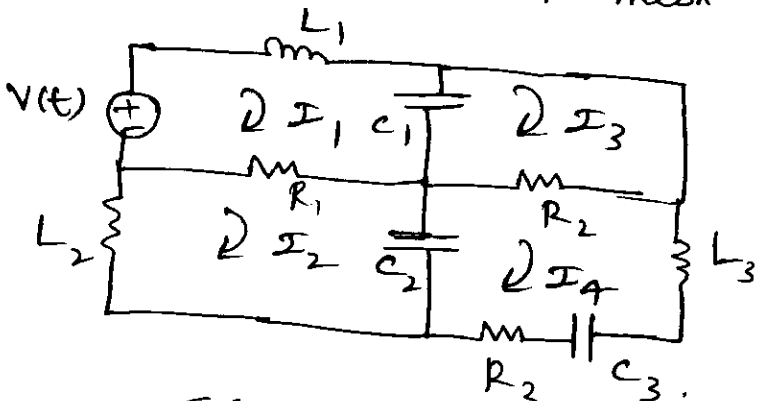


Equivalent mechanical Network → 1m

Force voltage Analogous Elements:

$F \leftrightarrow V(t)$; $\frac{dx(t)}{dt} \leftrightarrow i(t)$; $M \leftrightarrow L$; $B \leftrightarrow R$; $K \leftrightarrow \frac{1}{C}$.

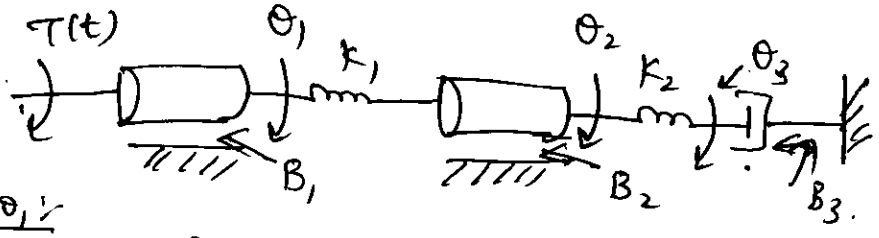
4 displacements so 4 mesh I_1 to I_4.



→ 5m

Force voltage Analogous Network.

4).

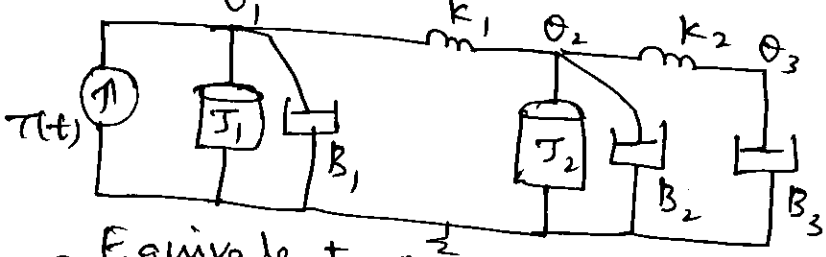


At θ_1 :-

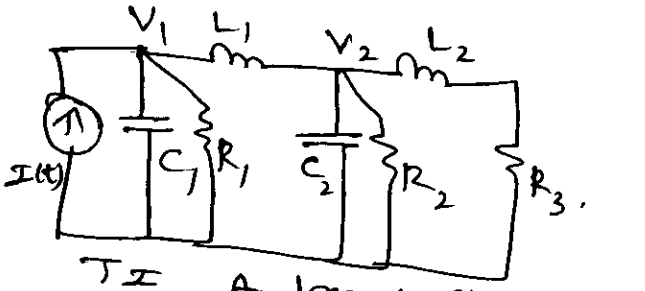
$$T(t) = J_1 \frac{d^2\theta_1}{dt^2} + K_1(\theta_1 - \theta_2) + B_1 \frac{d\theta_1}{dt} \rightarrow (1).$$

$$0 = J_2 \frac{d^2\theta_2}{dt^2} + K_1(\theta_2 - \theta_1) + K_2(\theta_2 - \theta_3) + B_2 \frac{d\theta_2}{dt} \rightarrow (2).$$

$$0 = B_3 \frac{d\theta_3}{dt} + K_2(\theta_3 - \theta_2) \rightarrow (3). \quad \rightarrow 3m.$$



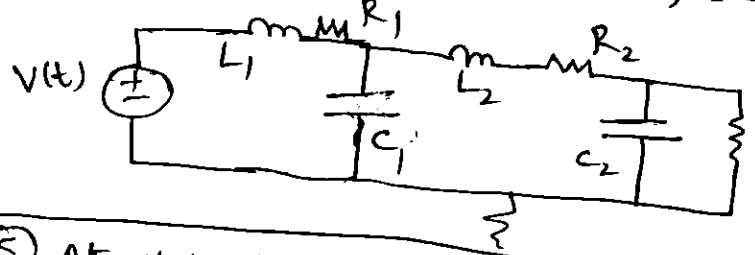
Equivalent Mechanical S/m. $\rightarrow 2m$



TI Analogous N/w. $\rightarrow 2.5m$

TI Analogous Elements :- $T \leftrightarrow I$; $J \leftrightarrow C$; $B \leftrightarrow \frac{1}{R}$; $K \leftrightarrow \frac{1}{L}$; $\frac{d\theta}{dt} = V(t)$.

TV Analogous Elements :- $T \leftrightarrow V$; $J \leftrightarrow L$; $B \leftrightarrow R$; $K \leftrightarrow \frac{1}{C}$; $\frac{d\theta}{dt} = i(t)$.



$\rightarrow 2.5m$

TV Analogous N/w.

---

(5) At x_1 :- $f(t) = m_1 \frac{d^2x_1}{dt^2} + B_1 \frac{dx_1}{dt} + K_1(x_1 - x_2) + Kx_1 \rightarrow (1).$

At x_2 :- $0 = m_2 \frac{d^2x_2}{dt^2} + K_1(x_2 - x_1) \rightarrow (2).$

Take Laplace Transform :-

$$F(s) = m_1 s^2 X_1(s) + B_1 s X_1(s) + K_1(X_1(s) - X_2(s)) + K X_1(s) \rightarrow (3).$$

$$0 = m_2 s^2 X_2(s) + K_1(X_2(s) - X_1(s)) \rightarrow (4)$$

$$K_1 X_1(s) = m_2 s^2 X_2(s) + K_1 X_2(s).$$

$$X_1(s) = \left(\frac{m_2 s^2 + K_1}{K_1}\right) X_2(s) \rightarrow (5). \quad \rightarrow 4m.$$

Substitute $X_1(s)$ into eqn (3)

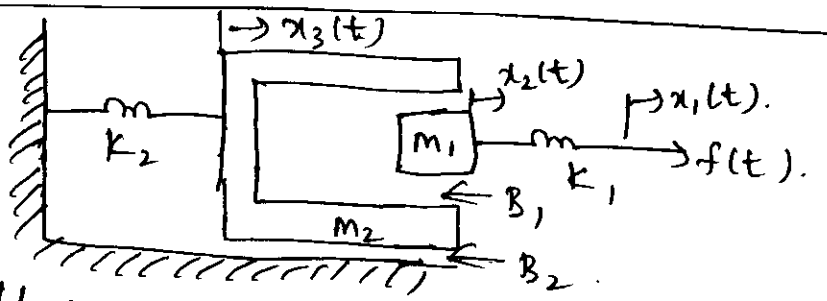
$$F(s) = (m_1 s^2 + B_1 s + K_1 + K) X_1(s) - K_1 X_2(s).$$

$$= (m_1 s^2 + B_1 s + K_1 + K)\left(\frac{m_2 s^2 + K_1}{K_1}\right) X_2(s) - K_1 X_2(s).$$

$$F(s) = \frac{\left((m_1 s^2 + B_1 s + K_1 + K)(m_2 s^2 + K_1) - K_1^2\right) X_2(s)}{K_1}$$

$$\frac{X_2(s)}{F(s)} = \frac{K_1}{(m_1 s^2 + B_1 s + K_1 + K)(m_2 s^2 + K_1) - K_1^2} \rightarrow 6m$$

(6)

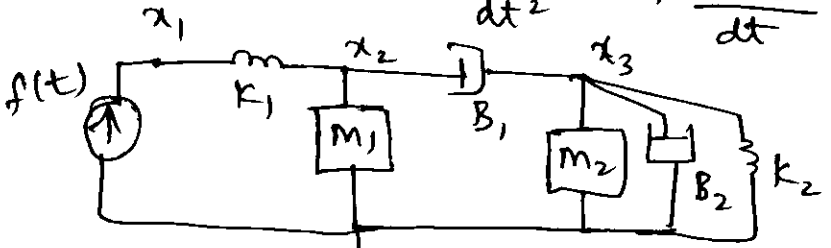


Differential equation :-

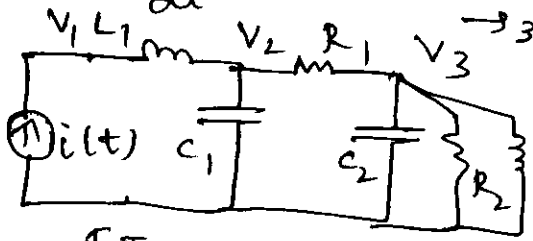
$x_1(t)$:- $f(t) = K_1(x_1(t) - x_2(t)) \rightarrow (1)$.

$x_2(t)$:- $0 = m_1 \frac{d^2 x_2(t)}{dt^2} + K_1(x_2 - x_1) + B_1 \frac{d(x_2 - x_3)}{dt} \rightarrow (2)$.

$x_3(t)$:- $0 = m_2 \frac{d^2 x_3(t)}{dt^2} + B_1 \frac{d(x_3 - x_2)}{dt} + B_2 \frac{d(x_3)}{dt} + K_2 x_3(t) \rightarrow (3)$.



Equivalent mechanical s/m $\rightarrow 2m$

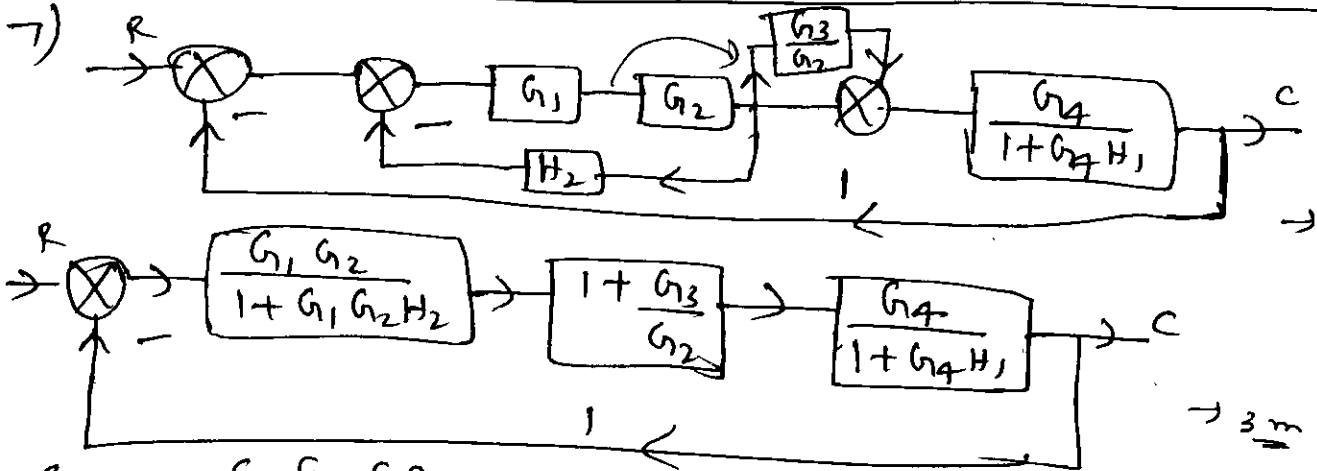


FI Analogous N/w. $\rightarrow 3m$

Mechanical s/m & FI analogous s/m are similar. $\rightarrow 5m$

$f(t) \leftrightarrow i(t)$; $\frac{dx(t)}{dt} \leftrightarrow V(t)$; $M \leftrightarrow C$; $B \leftrightarrow \frac{1}{R}$; $K \leftrightarrow \frac{1}{C}$.

7)

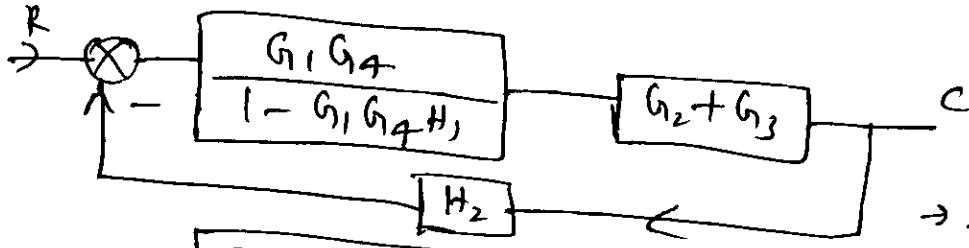


$\rightarrow 2m$

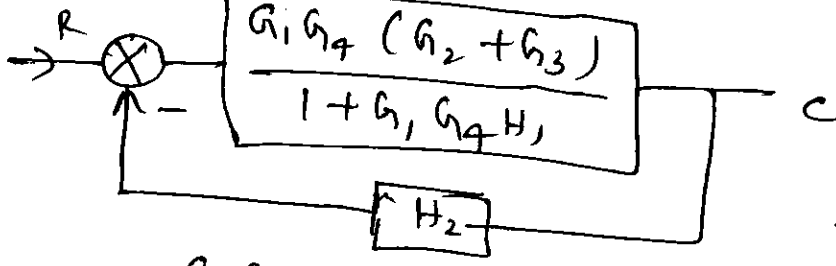
$\rightarrow 3m$.

$$\frac{C}{R} = \frac{\frac{G_1 G_4 (G_2 + G_3)}{(1 + G_1 G_2 H_2)(1 + G_4 H_1)}}{1 + \left(\frac{G_1 G_4 (G_2 + G_3)}{(1 + G_1 G_2 H_2)(1 + G_4 H_1)}\right)(1)} = \frac{G_1 G_4 (G_2 + G_3)}{(1 + G_1 G_2 H_2)(1 + G_4 H_1) + G_1 G_4 (G_2 + G_3)} \rightarrow 5m.$$

(8)



→ 2m



→ 3m

$$\frac{C}{R} = \frac{\frac{G_1 G_4 (G_2 + G_3)}{1 - G_1 G_4 H_1}}{1 + \left(\frac{G_1 G_4 (G_2 + G_3)}{1 - G_1 G_4 H_1}\right) H_2} = \frac{G_1 G_4 (G_2 + G_3)}{1 - G_1 G_4 H_1 + G_1 G_4 H_2 (G_2 + G_3)}$$ → 5m

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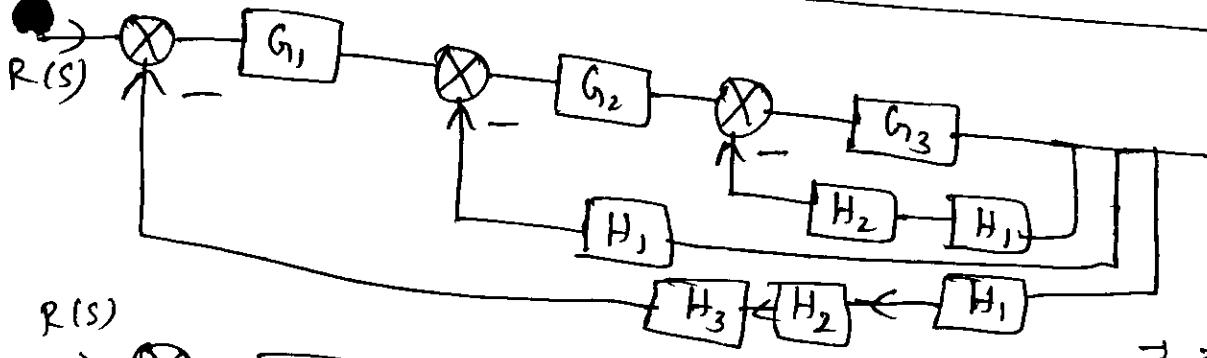
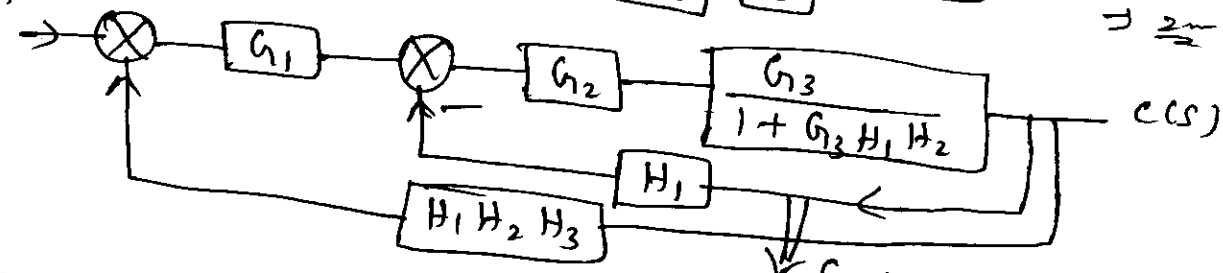
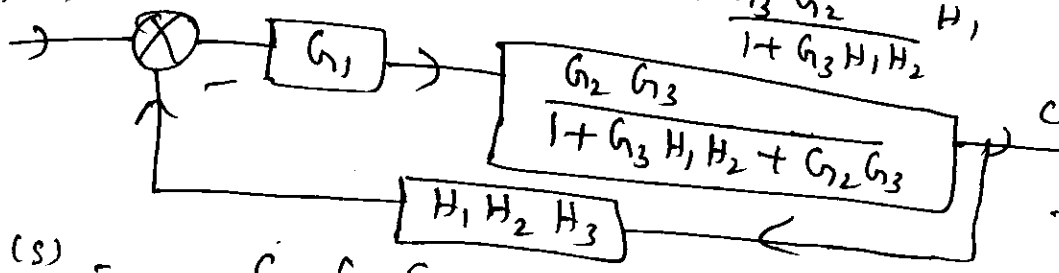
(9)



→ 2m



$$\frac{\frac{G_2 G_3}{1 + G_3 H_1 H_2}}{1 + \frac{G_3 G_2}{1 + G_3 H_1 H_2} H_1} = \frac{G_2 G_3}{1 + G_3 H_1 H_2 + G_2 G_3 H_1}$$

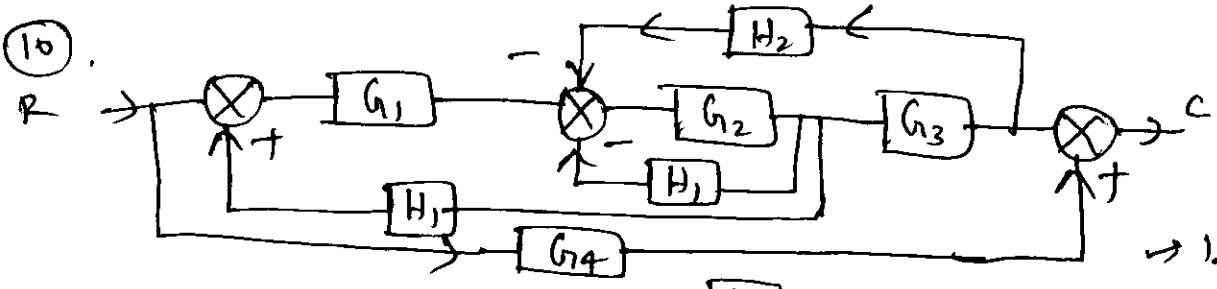


→ 3m

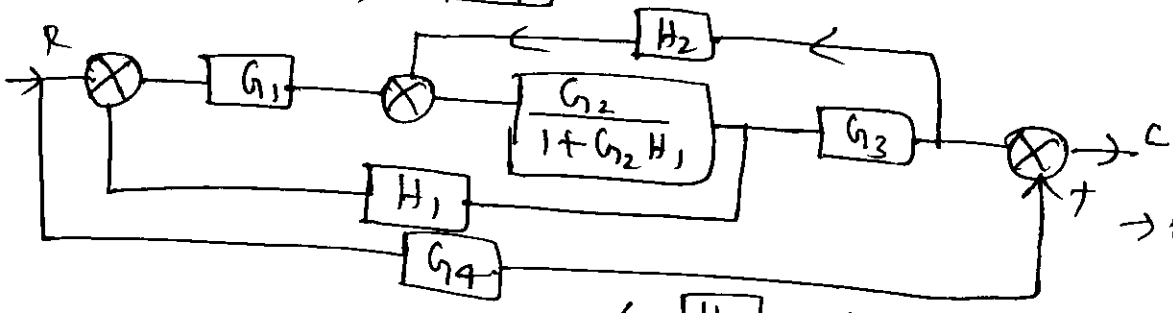
$$\frac{C(s)}{R(s)} = \frac{\frac{G_1 G_2 G_3}{1 + G_3 H_1 H_2 + G_2 G_3}}{1 + \left(\frac{G_1 G_2 G_3}{1 + G_3 H_1 H_2 + G_2 G_3 H_1}\right) H_1 H_2 H_3}$$

$$\frac{C(s)}{R(s)} = \frac{G_1 G_2 G_3}{1 + G_3 H_1 H_2 + G_2 G_3 H_1 + G_1 G_2 G_3 H_1 H_2 H_3}$$ → 5m

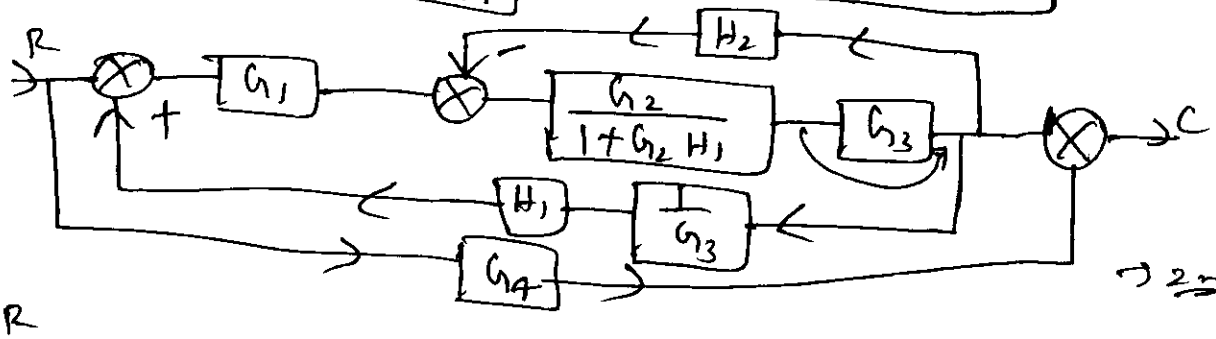
(10).



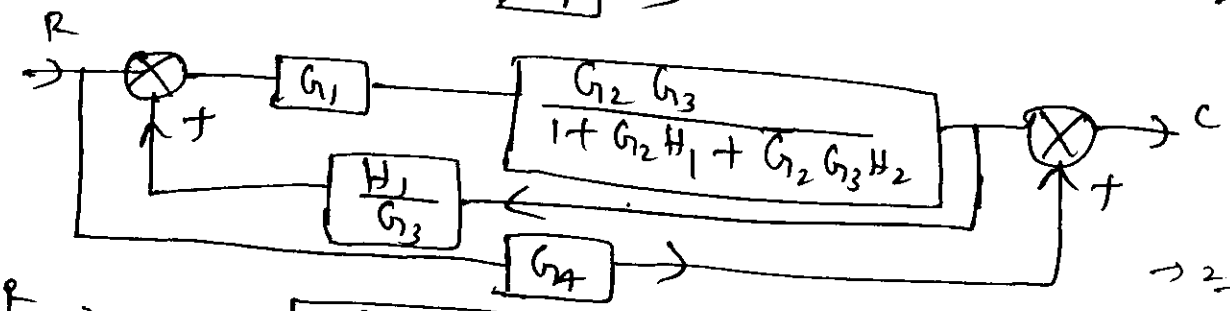
→ 1m



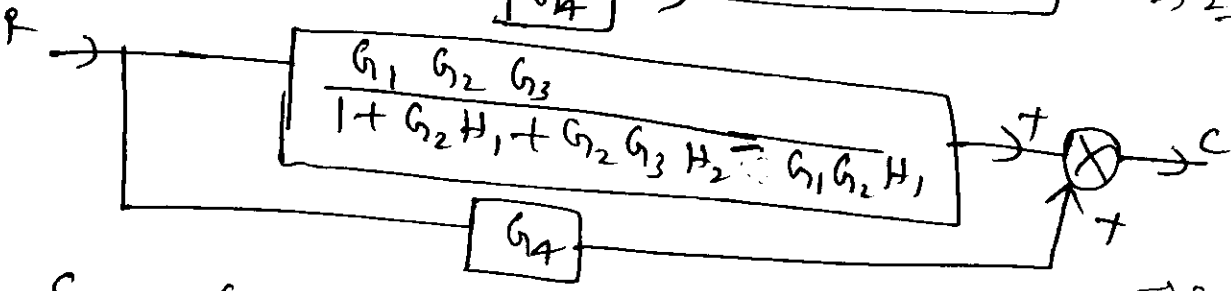
→ 1m



→ 2m



→ 2m



→ 2m

$$\frac{C}{R} = G_4 + \frac{G_1G_2G_3}{1+G_2H_1+G_2G_3H_2+G_1G_2H_1}$$ → 2m

[Signature of Staff]

Sh

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
Department of Electronics and Communication Engineering

CONTINUOUS INTERNAL EVALUATION ASSESSMENT REPORT

Staff Name: Mrs.Suvarna Patil / Mr.Sharana Basavaraj B **Sem/Sec:** IV/A&B **Academic year:** 2020-21

Course Name: Control Systems **Course code:** 18EC43 **CIE:** 1

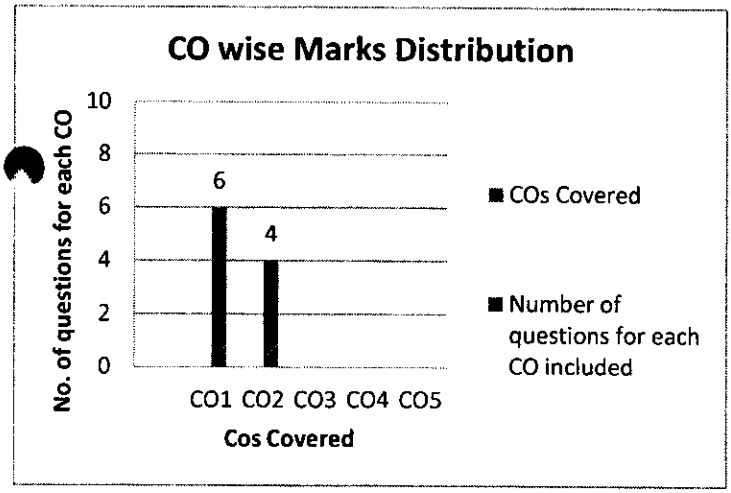
Mention the Syllabus included for CIE:

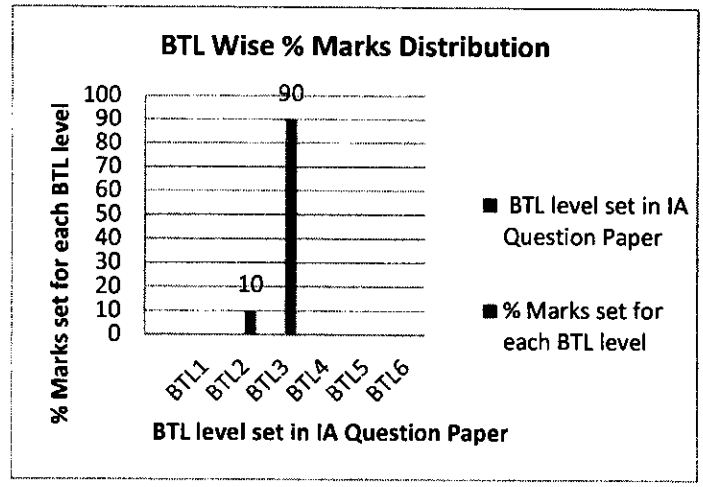
1	**MODULE NUMBERS**	1 & 2
2	**CO s COVERED**	1 & 2
3	**BTL LEVELS ADDRESSED**	L2, L3

Mention following details of CIE Questions Paper setting :

1	**COs Covered**	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
		Y	Y			
2	**Number of questions for each CO included**	6	4			

1	**BTL level set in IA Question Paper**	**BTL1**	**BTL2**	**BTL3**	**BTL4**	**BTL5**	**BTL6**
			Y	Y			
2	**% Marks set for each BTL level**		10	90			





Staff Signature

IA-1 PERFORMANCE ANALYSIS 2020-21 Even Sem

Internal Assessment 1: Control Systems (18EC43)

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
CO mapping	C211.1	C211.1	C211.1	C211.1	C211.1	C211.1	C211.2	C211.2	C211.2	C211.2
Max Marks /Question	10	10	10	10	10	10	10	10	10	10
Total marks of class /question	339	50	259	90	159	191	130	245	257	76
No. of students attended	34	5	27	10	16	20	13	25	29	8
No of students scored > 65% of marks/Question	34	5	26	10	16	19	13	25	29	8
Percentage of students scored>65% of marks/Question	100.00	100.00	96.30	100.00	100.00	95.00	100.00	100.00	100.00	100.00

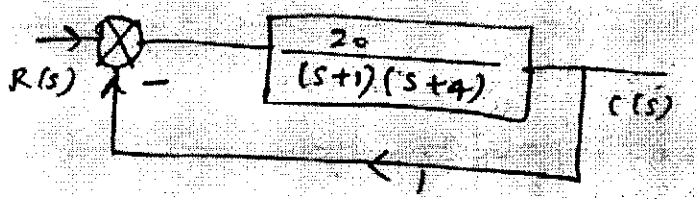
Mark range	0 to 10	11 to 20	21 to 30	31 to 40	41 to 50
No. Of Students	0	0	0	0	37

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

ASSIGNMENT -II (20-21 Even Sem)

Staff Name : Mrs.Suvarna Patil / Mr.Sharana Basavaraj B	Sem :4th Sec: A & B
Course Name : Control Systems	Course Code : 18EC43
Prerequisites: Mathematics & Network Theory.	

NOTE: Answer all assignment questions

Q No	QUESTIONS	BTL	CO	PO
1	Compute steady state error when the applied input is $40+2t+20t^2$ for an unity feedback system having $G(S)=\frac{40(1+S)}{S^2(2+S)(4+S)}$	3	3	1,2,3
2	Compute steady state error when the applied input is $3+2t+1/6t^2$ for an unity feedback system having $G(S)=\frac{10(S+2)}{S^2(S+1)}$			
3	Calculate rise time, peak time, peak overshoot & settling time for an second order system having transfer function $\frac{16}{S^2+6S+16}$	3	3	1,2,3
4	Calculate peak time, peak overshoot & settling time for an second order system having differential equation in S domain as $Y(S)[S^2+6S+10]=10X(S)$.			
5	Calculate the value of K for $\xi=0.5$ for a closed loop transfer function of a system given by $\frac{K}{S^2+10S+K}$	3	3	1,2,3
6	Compute peak time, peak overshoot & settling time for the above value of K. Compute steady state error when the applied input is $3+t+t^2$ for an unity feedback system having $G(S)\,H(S)=\frac{10(S+2)(S+3)}{S(S+1)(S+4)(S+5)}$			
7	Calculate damping ratio, natural frequency & expression for output response if subjected to unit step input as shown in the figure below: 	3	3	1,2,3
8	Compute the value of gain K to limit steady state error to 5 when the input to the system is $1+10t+20t^2$ for a given system $G(S)H(S)=\frac{K}{S^2(S+20)(S+30)}$			
9	Compute the range of K, marginal value of K & frequency of sustained oscillations using RH criterion for $G(S)H(S)=\frac{K}{S(1+0.4S)(1+0.25S)}$	3	4	1,2,3
10	Compute the number of roots with positive real part using RH criterion for the characteristic equation $S^6+S^5+3S^4+2S^3+5S^2+3S+1=0$			

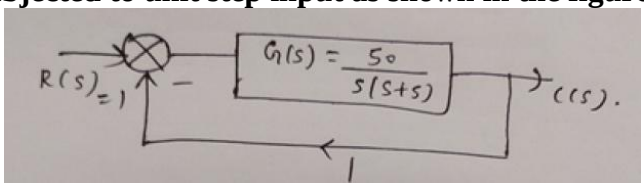
11	Use RH criterion comment on the stability for the characteristic equation $S^6+2S^5+5S^4+8S^3+8S^2+8S+4=0$	3	4	1,2,3
12	Calculate the range of K for the system to be stable using RH criterion for $G(S)H(S)=\frac{K(1-S)}{S(S^2+5S+9)}$	3	4	1,2,3
13	Compute range of K for closed loop poles more negative than -1 for a system with $G(S)H(S)=\frac{K(S+13)}{(S^2+3S)(S+7)}$	3	4	1,2,3

Signature of Faculty

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
CONTINOUS INTERNAL EVALUATION -II (20-21 Even Sem)

Staff Name : Mrs.Suvarna Patil / Mr.Sharana Basavaraj B	**Sem :4th Sec: A & B**	**Date:17/07/2021 Time:3pm to 4.30pm**
Course Name : Control Systems	**Course Code : 18EC43**	
Prerequisites: Mathematics & Network Theory.		

NOTE: Answer five questions, each carries 10marks **Max Marks: 5*10= 50**

Q No	QUESTIONS	BTL	CO	PO
1	Compute steady state error when the applied input is $3+2t+1/6t^2$ for an unity feedback system having $G(S)=\frac{15(S+2)}{S^2(S+1)}$	3	3	1,2,3
	OR			
2	Compute the value of gain K to limit steady state error to 4 when the input to system is $1+10t+80t^2$ for a given system $G(S)H(S)=\frac{K}{S^2(S+20)(S+30)}$			
3	Calculate rise time, peak time, peak overshoot & settling time for an second order system having transfer function $\frac{25}{S^2+8S+25}$	3	3	1,2,3
	OR			
4	Calculate peak time, peak overshoot & settling time for an second order system having differential equation in S domain as $Y(S)[S^2+5S+9]=9X(S)$.			
5	Define the terms Delay time, rise time, peak time & peak overshoot with equation & diagram.	1	3	1,2,3
	OR			
6	Calculate damping ratio, natural frequency & expression for output response if subjected to unit step input as shown in the figure below: 	3		
7	Compute the range of K, marginal value of K & frequency of sustained oscillations using RH criterion for characteristic equation $S^4+22S^3+10S^2+S+K=0$.	3	4	1,2,3
	OR			
8	Use RH criterion comment on the stability for the characteristic equation $S^5+2S^4+3S^3+4S^2+5S+6=0$			
9	Use RH criterion comment on the stability for the characteristic equation $S^6+S^5+3S^4+2S^3+5S^2+3S+1=0$	3	4	1,2,3
	OR			
10	Compute range of K for closed loop poles more negative than -1 for a system with characteristic equation $S^3+3(K+1)S^2+(7K+5)S+(4K+7)=0$			

Note: BTL (Blooms Taxonomy Level) CO (Course Outcome) PO (Program Outcome)

IA Coordinator **Signature of faculty**

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

SCHEME OF EVALUATION CIE -II (20-21 Even Sem)

Staff Name : Mrs.Suvarna Patil / Mr.Sharana Basavaraj B	Sem :4th Sec: A & B	Date:17/07/2021 Time:3pm to 4.30pm
Course Name : Control Systems	Course Code : 18EC43	
Prerequisites: Mathematics & Network Theory.		

1) $K_p = \lim_{s\to 0} G(s)H(s) = \lim_{s\to 0} \frac{15(0+2)}{0^2(0+1)} = \frac{15\times 2}{0} = \infty.$

$K_v = \lim_{s\to 0} sG(s)H(s) = \lim_{s\to 0} \frac{15(0+2)}{0(0+1)} = \frac{15\times 2}{0} = \infty.$

$K_a = \lim_{s\to 0} s^2 G(s)H(s) = \lim_{s\to 0} \frac{15(0+2)}{(0+1)} = \frac{15\times 2}{1} = 30.$ → 5m.

$e_{ss} = \frac{A_1}{1+K_p} + \frac{A_2}{K_v} + \frac{2\times A_3}{K_a} = \frac{3}{1+\infty} + \frac{2}{\infty} + \frac{2\times 1/6}{30}$

$= 0 + 0 + \frac{1}{6\times 15} = 0.011.$ → 5m.

2) $K_p = \lim_{s\to 0} G(s)H(s) = \lim_{s\to 0} \frac{K}{0^2(0+20)(0+30)} = \frac{K}{0^2} = \infty.$

$K_v = \lim_{s\to 0} sG(s)H(s) = \frac{K}{0} = \infty.$

$K_a = \lim_{s\to 0} s^2 G(s)H(s) = \frac{K}{(0+20)(0+30)} = \frac{K}{20\times 30} = \frac{K}{600}.$ 5m.

$e_{ss} = \frac{A_1}{1+K_p} + \frac{A_2}{K_v} + \frac{2\times A_3}{K_a}.$

$4 = \frac{1}{1+\infty} + \frac{10}{\infty} + \frac{2\times 80\times 600}{K}$

$K = \frac{2\times 80\times 600}{4} = 24000$ 5m.

3) $TF = \frac{25}{s^2+8s+25} = \frac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}.$

$\omega_n = \sqrt{25} = 5$ rad/sec.

$2\zeta\omega_n = 8.$

$2\times\zeta\times 5 = 8.$ $\zeta = \frac{8}{2\times 5} = 0.8.$ → 2m.

$\theta = \tan^{-1}\left[\frac{\sqrt{1-\zeta^2}}{\zeta}\right] = \tan^{-1}\left[\frac{\sqrt{1-0.8^2}}{0.8}\right] = 0.643$ rad. → 2m.

$T_r = \frac{\pi-\theta}{\omega_d} = \frac{\pi - 0.643}{\omega_n\sqrt{1-\zeta^2}} = \frac{\pi - 0.643}{5\sqrt{1-0.8^2}} = 0.832$ sec. → 2m.

$T_p = \frac{\pi}{\omega_d} = \frac{\pi}{5\sqrt{1-0.8^2}} = 1.047$ sec. → 1m.

$M_p = e^{-\pi\zeta/\sqrt{1-\zeta^2}} \times 100\% = e^{-\pi\times 0.8/\sqrt{1-0.8^2}} \times 100\%$ → 2m.

$= 1.51$.

$T_s = \frac{4}{\zeta\omega_n} = \frac{4}{0.8\times 5} = 1$ sec. → 1m.

---

4) $Y(s)[s^2+6s+9] = 9X(s)$.

$TF = \frac{Y(s)}{X(s)} = \frac{9}{s^2+5s+9} = \frac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$

$\omega_n = \sqrt{9} = 3$ rad/sec.

$2\zeta\omega_n = 5$; $\zeta = \frac{5}{2\times\omega_n} = \frac{5}{2\times 3} = \frac{5}{6} = 0.833$ → 4m.

$T_p = \frac{\pi}{\omega_d} = \frac{\pi}{\omega_n\sqrt{1-\zeta^2}} = \frac{\pi}{3\times\sqrt{1-0.833^2}} = \frac{\pi}{3\times\sqrt{1-0.833^2}} = 1.89$ sec.

↳ 2m

$M_p = e^{-\pi\zeta/\sqrt{1-\zeta^2}} \times 100 = 0.88$. → 2m.

$T_s = \frac{4}{\zeta\omega_n} = \frac{4}{0.833\times 3} = \frac{4}{2.55} = 1.60$ sec. → 2m.

---

5) $TF = \frac{C(s)}{R(s)} = \frac{50/s^2+5s}{1+\left(\frac{50}{s^2+5s}\right)1} = \frac{50}{s^2+5s+50} = \frac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$

$\omega_n = \sqrt{50} = 7.07$ rad/sec.

$2\zeta\omega_n = 5$; $\zeta = \frac{5}{2\times\omega_n} = \frac{5}{2\times 7.07} = 0.353$ → 4m.

$\omega_d = \omega_n\sqrt{1-\zeta^2} = 7.07\sqrt{1-0.353^2} = 6.61$ rad/sec. → 1m.

$\theta = \tan^{-1}\left(\frac{\sqrt{1-\zeta^2}}{\zeta}\right) = \tan^{-1}\left[\frac{\sqrt{1-0.353^2}}{0.353}\right] = 1.21$ rad.

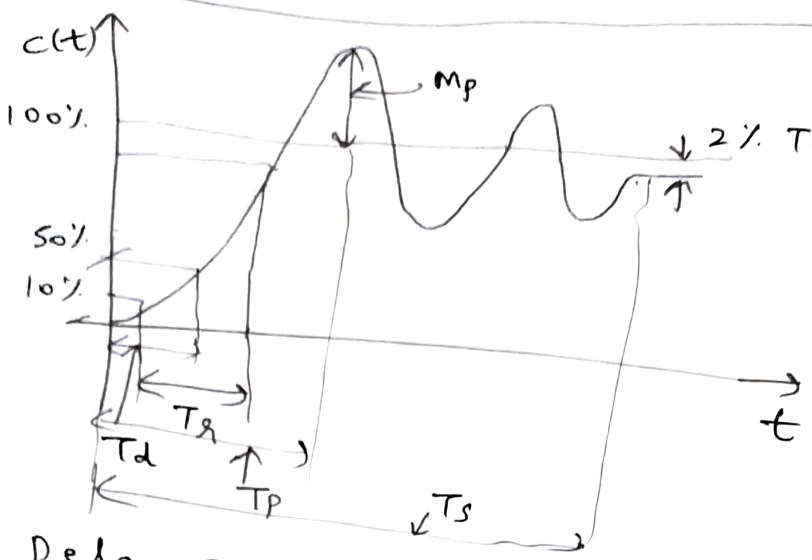
↳ 1m.

$C(t) = 1 - \frac{e^{-\zeta\omega_n t}}{\sqrt{1-\zeta^2}}\sin(\omega_d t+\theta)$.

$= 1 - \frac{e^{-0.353\times 7.07 t}}{\sqrt{1-0.353^2}}\sin[6.61t+1.21]$.

$c(t) = 1 - 1.06\, e^{-2.5t} \sin[6.61t + 1.21]$ → 4m.

5)



→ 2m.

1) Delay Time :- Time taken from 0 to 50%.

$T_d = \frac{1 + 0.7\zeta}{\omega_n}$ sec.

→ 2m

2) Rise Time :- T_r Time taken for o/p to rise from 10% to 90%.

$T_r = \frac{\pi - \theta}{\omega_d}$ sec.

→ 2m.

3) Peak Time :- Time taken for o/p to rise from 0 to max o/p Value.

$T_p = \frac{\pi}{\omega_d} = \frac{\pi}{\omega_n\sqrt{1-\zeta^2}}$.

→ 2m.

4) Peak overshoot :- $M_p = \{c(t)|_{t=T_p}\} - 1 = e^{-\pi\zeta/\sqrt{1-\zeta^2}} \times 100.$

↳ 2m.

---

1) $CE = s^4 + 22s^3 + 10s^2 + s + k = 0.$

s^4	1	10	k
s^3	22	1	
s^2	$\frac{219}{22} = 9.95$	k.	
s^1	$\frac{9.95 - 22k}{9.95}$		
s^0	k.		

↳ 5m.

From s^1

$9.95 - 22k > 0.$

$k < \frac{9.95}{22} < 0.45.$

From s^0

$k > 0.$

$0 < k < 0.45.$

$k_{max} = 0.45.$

From s^2

$9.95s^2 + 0.45 = 0.$

$s^2 = -\frac{0.45}{9.95} = -0.045.$

$s = \pm j0.212.$

$\omega = 0.212$ rad/sec.

→ 5m.

8) $CE = s^5 + 2s^4 + 3s^3 + 4s^2 + 5s + 6 = 0$

s^5	1	3	5
s^4	2	4	6.
s^3	1	2	
s^2	0	6	
	$[\epsilon]$		
s^1	$\frac{2\epsilon - 6}{\epsilon}$	0.	
s^0	6.		

→ (5m)

From s^1 row → $\frac{2\epsilon - 6}{\epsilon} \rightarrow \frac{2 \times 0 - 6}{\epsilon} \rightarrow \frac{-6}{\epsilon}$ → -ve value.

Thus there are 2 sign changes from $\epsilon \rightarrow \frac{-6}{\epsilon}$ & $\frac{-6}{\epsilon}$ to ϵ.

So s/m is unstable & 2 poles lie on right hand side of s-plane. → (5m).

9) $CE = s^6 + s^5 + 3s^4 + 2s^3 + 5s^2 + 3s + 1 = 0.$

s^6	1	3	5
s^5	1	2	3
s^4	1	2	1
s^3	0	2	0.
	$[\epsilon]$		
s^2	$\frac{2\epsilon - 2}{\epsilon}$	$\frac{\epsilon \times 1}{\epsilon} = 1$	
s^1	$\frac{\left(\frac{2\epsilon-2}{\epsilon}\right)(2) - \epsilon^2}{\frac{2\epsilon-2}{\epsilon}}$	0	
s^0	1.		

↳ 6m.

s^2 row → $\frac{2\epsilon - 1 \times 2}{\epsilon} \rightarrow \frac{-2}{\epsilon}$ → -ve value

s^1 row → $\frac{\frac{4\epsilon - 4 - \epsilon}{\epsilon}}{\frac{2\epsilon - 2}{\epsilon}} = \frac{-4}{-2} = 2$

↳ +ve value.

2 sign changes, So s/m is unstable & 2 poles are present in RHS of s-plane.

↳ 4m.

10) $s^3 + 3(k+1)s^2 + (7k+5)s + (4k+7) = 0$

Put $s = x - 1$

$(x-1)^3 + 3(k+1)(x-1)^2 + (7k+5)(x-1) + (4k+7) = 0$.

$(a-b)^3 = a^3 - b^3 - 3a^2b + 3ab^2$

$x^3 + 3kx^2 + (k+2)x + 4 = 0$. → 3m

RH array:-

x^3	1	$k+2$
x^2	$3k$	4
x^1	$\frac{3k(k+2)-4}{3k}$	0
x^0	4	

→ 5m.

From x^1 row:- $3k(k+2) - 4 > 0$.

$3k^2 + 6k - 4 > 0$.

$k > 0.5275$; $k > -2.52$.

So k range is $0.5275 < k < \infty$. → 2m.

[signature of faculty]

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Electronics and Communication Engineering

CONTINUOUS INTERNAL EVALUATION ASSESSMENT REPORT

Staff Name: Mrs.Suvarna Patil / Mr.Sharana Basavaraj B **Sem/Sec:** IV/A&B **Academic year:** 2020-21

Course Name: Control Systems **Course code:** 18EC43 **CIE:** 2

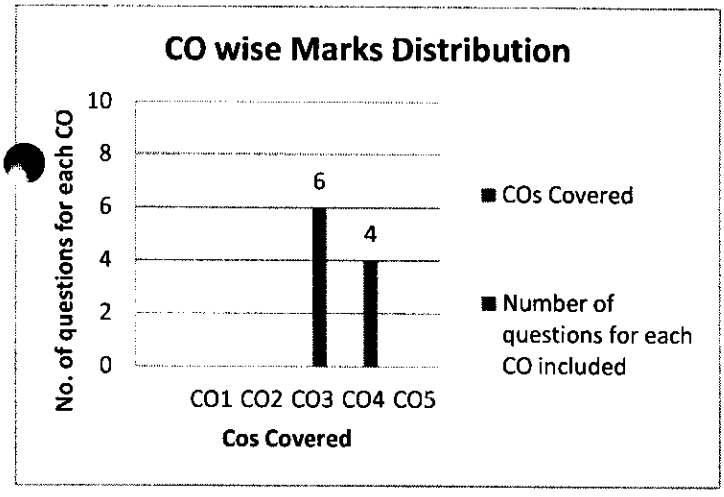
Mention the Syllabus included for CIE:

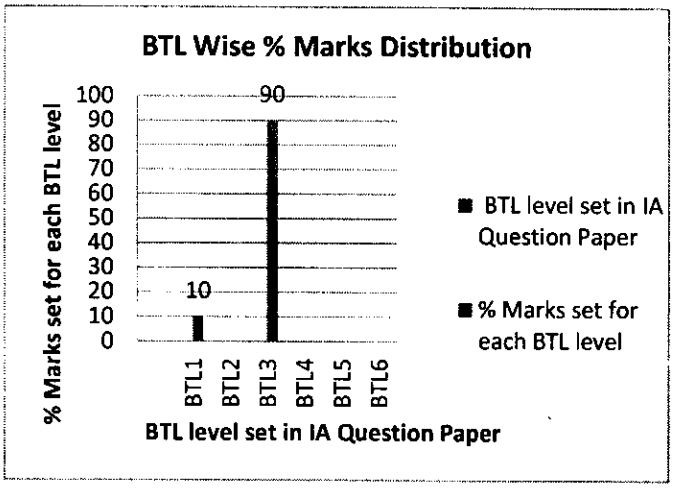
1	**MODULE NUMBERS**	3 & 4
2	**CO s COVERED**	3 & 4
3	**BTL LEVELS ADDRESSED**	L1, L3

Mention following details of CIE Questions Paper setting :

1	**COs Covered**	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
				Y	Y	
2	**Number of questions for each CO**			6	4	

1	**BTL level set in IA Question Paper**	**BTL1**	**BTL2**	**BTL3**	**BTL4**	**BTL5**	**BTL6**
		Y	Y	Y			
2	**% Marks set for each BTL level**	10		90			





Staff Signature

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Electronics and Communication Engineering

IA-2 PERFORMANCE ANALYSIS 2020-21 Even Sem

Internal Assessment 2: Control Systems (18EC43)

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
CO mapping	C211.3	C211.3	C211.3	C211.3	C211.3	C211.3	C211.4	C211.4	C211.4	C211.4
Max Marks /Question	10	10	10	10	10	10	10	10	10	10
Total marks of class /question	49	368	295	94	208	157	118	268	260	135
No. of students attended	5	37	30	10	21	16	12	27	27	14
No of students scored > 65% of marks/Question	5	37	30	9	21	16	12	27	26	14
Percentage of students scored>65% of marks/Question	100.00	100.00	100.00	90.00	100.00	100.00	100.00	100.00	96.30	100.00

Mark range	0 to 10	11 to 20	21 to 30	31 to 40	41 to 50
No. Of Students	0	0	0	01	36

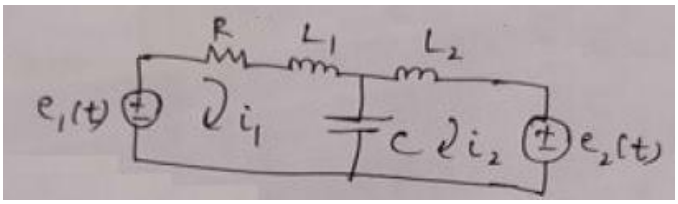
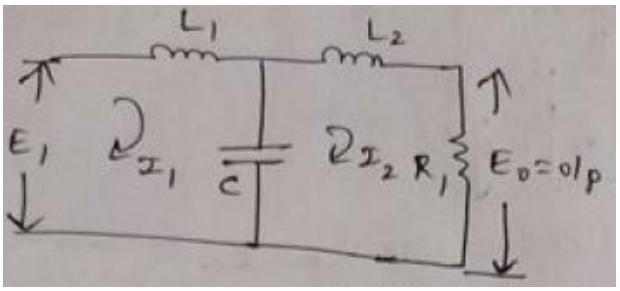
RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

ASSIGNMENT -III (20-21 Even Sem)

Staff Name : Mrs.Suvarna Patil / Mr.Sharana Basavaraj B	**Sem :4th Sec: A & B**
Course Name : Control Systems	**Course Code : 18EC43**
Prerequisites: Mathematics & Network Theory.	

NOTE: Answer all assignment questions

Q No	QUESTIONS	BTL	CO	PO
1	Explain the steps in plotting root locus with formulae's.	2	4	1
2	Sketch the complete root locus of the system $G(S)H(S) = \frac{k}{S(S+5)(S+10)}$	3		1,2,3
3	Sketch the complete root locus of the system $G(S)H(S) = \frac{k}{S(S+1)(S+2)(S+3)}$	3	4	1,2,3
4	Sketch the complete root locus of the system $G(S)H(S) = \frac{k}{S(S+3)(S^2+3S+4.5)}$	3		
5	Sketch the complete root locus of the system $G(S)H(S) = \frac{k}{S(S+3)(S^2+3S+11.25)}$	3	4	1,2,3
6	Compute Transfer function for a system having state model $\frac{dx}{dt} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u \;\&\; y = [1 \;\; 0]\, x$	3	5	1,2,3
7	Compute Transfer function for a system having state model $\begin{bmatrix} \frac{dx1}{dt} \\ \frac{dx2}{dt} \end{bmatrix} = \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 3 \\ 5 \end{bmatrix} u(t) \;\&\; y = [1 \;\; 1] \begin{bmatrix} x1 \\ x2 \end{bmatrix}$ with D=0	3	5	1,2,3
8	Compute State transition matrix $\frac{dx}{dt} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 2 & 1 \\ 0 & 1 \end{bmatrix} u(t) \;\&\; x(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$	3	5	
9	Compute State transition matrix $\begin{bmatrix} \frac{dx1}{dt} \\ \frac{dx2}{dt} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -3 & -4 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t) \& \begin{bmatrix} x1(0) \\ x2(0) \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$	3	5	1,2,3
10	Construct state model for a system with differential equation: $\frac{d^3y(t)}{dt^3} + 9\frac{d^2y(t)}{dt^2} + 26\frac{dy(t)}{dt} + 24y(t) = 6u(t)$	3	5	1,2
11	Construct state model for a system with differential equation: $\frac{d^3y(t)}{dt^3} + 4\frac{d^2y(t)}{dt^2} + 7\frac{dy(t)}{dt} + 2y(t) = 5u(t)$	3	5	1,2

12	**Construct state model for the electrical system given by:** 	**3**	**5**	**1,2,3**
13	**Construct state model for the electrical system given by:** 	**3**	**5**	**1,2,3**

Note: BTL (Blooms Taxonomy Level) CO (Course Outcome) PO (Program Outcome)

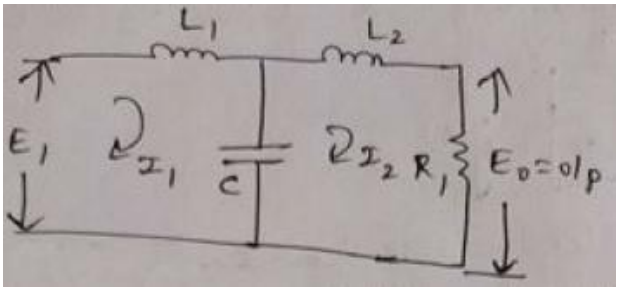
Signature of faculty

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
CONTINOUS INTERNAL EVALUATION -III (20-21 Even Sem)

Staff Name : Mrs.Suvarna Patil / Mr.Sharana Basavaraj B	Sem :4th Sec: A & B	Date:13/08/2021 Time:2.30 pm to 4 pm
Course Name : Control Systems	Course Code : 18EC43	
Prerequisites: Mathematics & Network Theory.		

NOTE: Answer five questions, each carries 10marks **Max Marks:5*10= 50**

Q No	QUESTIONS	BTL	CO	PO
1	Sketch the complete root locus of the system $G(S)H(S) = \frac{k}{S(S+3)(S^2+3S+11.25)}$	3	4	1,2,3
	OR			
2	Sketch the complete root locus of the system $G(S)H(S) = \frac{k}{S(S+5)(S+10)}$	3		1,2,3
3	Sketch the complete root locus of the system $G(S)H(S) = \frac{k}{S(S+1)(S+2)(S+3)}$	3	4	1,2,3
	OR			
4	Sketch the complete root locus of the system $G(S)H(S) = \frac{k}{S(S+3)(S^2+3S+4.5)}$	3		
5	Compute Transfer function for a system having state model $\frac{dx}{dt} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u \;\&\; y = [1 \;\; 0]\, x$	3	5	1,2,3
	OR			
6	Compute Transfer function for a system having state model $\begin{bmatrix} \frac{dx1}{dt} \\ \frac{dx2}{dt} \end{bmatrix} = \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 3 \\ 5 \end{bmatrix} u(t) \;\&\; y = [1 \;\; 1] \begin{bmatrix} x1 \\ x2 \end{bmatrix}$ with D=0	3		1,2,3
7	Compute State transition matrix $\begin{bmatrix} \frac{dx1}{dt} \\ \frac{dx2}{dt} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -3 & -4 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t) \;\&\; \begin{bmatrix} x1(0) \\ x2(0) \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$	3	5	1,2,3
	OR			
8	Compute State transition matrix $\frac{dx}{dt} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 2 & 1 \\ 0 & 1 \end{bmatrix} u(t) \;\&\; x(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$	3	5	
9	Construct state model for a system with differential equation: $\frac{d^3y(t)}{dt^3} + 8\frac{d^2y(t)}{dt^2} + 12\frac{dy(t)}{dt} + 10y(t) = 4u(t)$	3	5	1,2
	OR			
		3	5	1,2,3

10	**Construct state model for the electrical system given by:** 			

Note: BTL (Blooms Taxonomy Level) CO (Course Outcome) PO (Program Outcome)

IA Coordinator

Signature of faculty

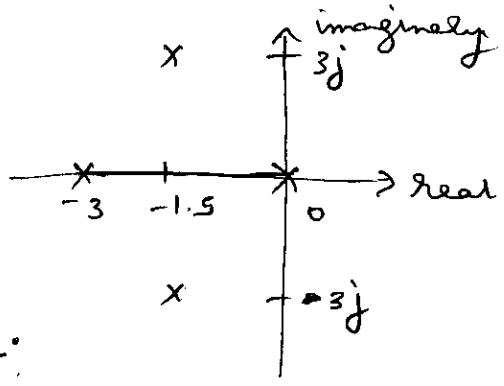
RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

SCHEME OF EVALAUTION-CONTINOUS INTERNAL EVALUATION -III (20-21 Even Sem)

Staff Name : Mrs.Suvarna Patil / Mr.Sharana Basavaraj B	Sem :4th Sec: A & B	Date:13/08/2021 Time:2.30 pm to 4 pm
Course Name : Control Systems	Course Code : 18EC43	
Prerequisites: Mathematics & Network Theory.		

1) i) $P = 4$; $Z = 0$; $N = P - Z = 4$;

ii) Pole zero plot :-



iii) Angle of Asymptotes :-

$$\theta = \frac{(2q+1)(180)}{(P-Z)} \; ; \; q = 0, 1, 2, 3.$$

$\theta_1 = 45^\circ$; $\theta_2 = 135^\circ$; $\theta_3 = 225^\circ$; $\theta_4 = 315^\circ$.

iv) $\sigma = \frac{\Sigma \text{ RP of poles} - \Sigma \text{ RP of zeros}}{P - Z} = \frac{0 - 3 - 1.5 - 1.5}{4} = -1.5$. → (3m)

v) Breakaway points :-

CE : $1 + G(s)H(s) = 0$.

$$1 + \frac{K}{s(s+3)(s^2+3s+11.25)} = 0.$$

$$s^4 + 6s^3 + 20.25s^2 + 33.75s + K = 0.$$

$$K = -s^4 - 6s^3 - 20.25s^2 - 33.75s.$$

$$\frac{dK}{ds} = -4s^3 - 18s^2 - 40.5s - 33.75 = 0.$$

$s = -1.5, -1.5, \pm j1.8371$.

All are present in root locus region. → (2m)

vi) Intersection with imaginary axis :-

s^4	1	20.25	K
s^3	6	33.75	0
s^2	14.625	K	0
s^1	$\frac{493.59 - 6K}{14.625}$	0	
s^0	K		

$K_{mal} = \frac{493.59}{6} = 82.265$.

$A(s) = 14.625s^2 + K_{mal} = 0$.

$s^2 = -5.625$.

$s = \pm j2.3717$. → (1m)

vii) Angle of Departure :-

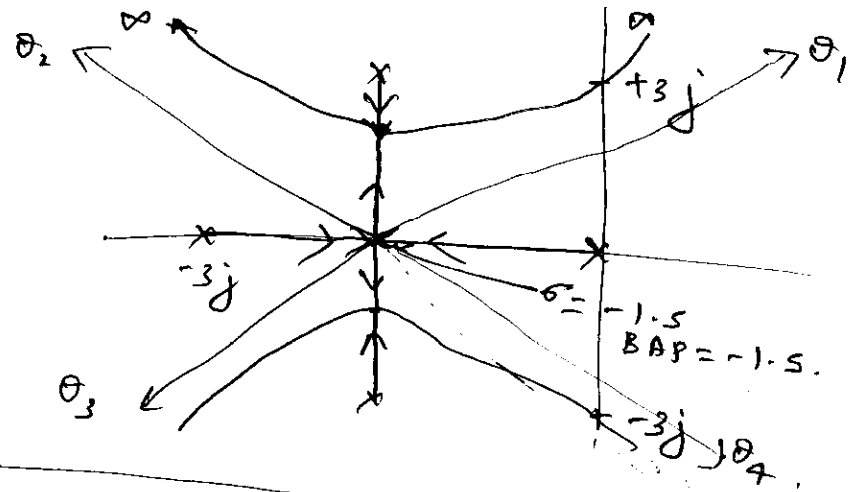
for $-1.5 + 3j$:- $\phi_{P_1} = 180 - \tan^{-1}\left(\frac{3}{1.5}\right) = 116.56^\circ$; $\phi_{P_2} = 90^\circ$

$\phi_{P_3} = \tan^{-1}\left(\frac{3}{1.5}\right) = 63.43^\circ$.

$\phi_{d_1} = 180 - \phi = 180 - (\Sigma\phi_P - \Sigma\phi_Z) = 180 - (270 - 0) = -90^\circ$.

for $-1.5 - 3j$:- $\phi_{d_2} = -\phi_{d_1} = -(-90^\circ) = 90^\circ$. → (1m)

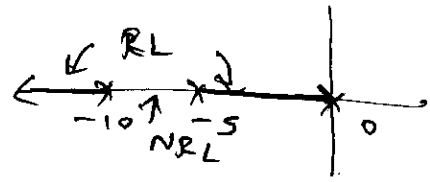
Complete Root Locus.



→ (3m)

2) i) $P = 3;\ Z = 0;\quad N = P - Z = 3 - 0.$

ii) Pole zero plot:-



iii) Angle of Asymptotes:-

$$\theta = \frac{(2q+1)(180)}{P-Z}\ ;\quad q = 0, 1, 2\ ;\quad \theta_1 = 60^\circ;\ 180^\circ;\ 300^\circ.$$

iv) $$\sigma = \frac{\Sigma \text{RP of Poles} - \Sigma \text{RP of zeroes}}{P-Z} = \frac{0-5-10-0}{3} = -5.$$

↳ (3m)

v) Breakaway point:-

$$CE = 1 + G(s)H(s) = 0.$$

$$1 + \frac{K}{s(s+5)(s+10)} = 0.$$

$$CE = s^3 + 15s^2 + 50s + K = 0.$$

$$K = -s^3 - 15s^2 - 50s.$$

$$\frac{dK}{ds} = -3s^2 - 30s - 50 = 0.$$

$$s = -2.113,\ -7.88.$$

-2.113 is valid BAP since it is in root locus region. → (2m)

vi) Intersection with imaginary axis:-

s^3	1	50
s^2	15	K.
s^1	$\frac{750-K}{15}$	
s^0	K.	

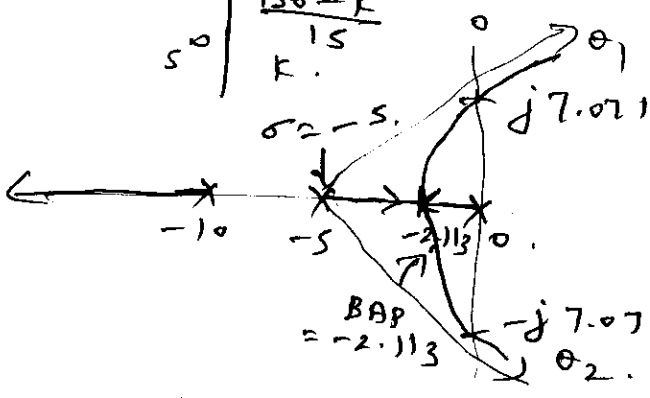
From s^1 row:- $750 - K = 0.$

$K_{mal} = 750.$

$A(s) = 15s^2 + K_{mal} = 0.$

$s^2 = -\frac{750}{15} = -50.$ → (2m)

$s = \pm j\sqrt{50} = \pm j7.071.$



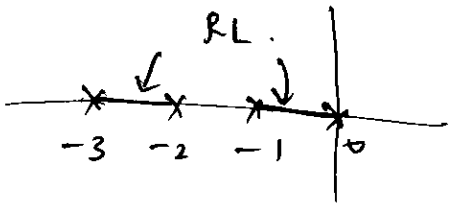
→ (3m)

Complete root locus.

3). $G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$.

i). $P = 4$; $Z = 0$; $N = P - Z = 4$.

ii) Pole zero plot :-



iii) Angle of Asymptotes :-

$\theta = \frac{(2q+1)(180)}{P-Z}$; $q = 0, 1, 2, 3$; $\theta_1 = 45°$; $\theta_2 = 135°$

$\theta_3 = 225°$; $\theta_4 = 315°$.

iv) Centroid $= \sigma = \frac{\Sigma \text{ RP of poles} - \Sigma \text{ RP of zeros}}{P-Z} = \frac{0-1-2-3}{4}$

$= -1.5$.

↳ (3m)

v) Breakaway points :-

CE $= 1 + G(s)H(s) = 0$.

$1 + \frac{K}{s(s+1)(s+2)(s+3)} = 0$.

$s^4 + 6s^3 + 11s^2 + 6s + K = 0$; $K = -s^4 - 6s^3 - 11s^2 - 6s$.

$\frac{dK}{ds} = -4s^3 - 18s^2 - 22s - 6 = 0$.

$s = -0.381, -1.5, -2.619$.

Valid BAP are $s = -0.381$ & -2.619. → (2m).

vi) Intersection with imaginary Axis :-

s^4	1	11	K
s^3	6	6	0
s^2	10	K	0
s^1	$\frac{60-6K}{10}$	0	
s^0	K.		

$60 - 6K = 0$.

$K_{mal} = 10$.

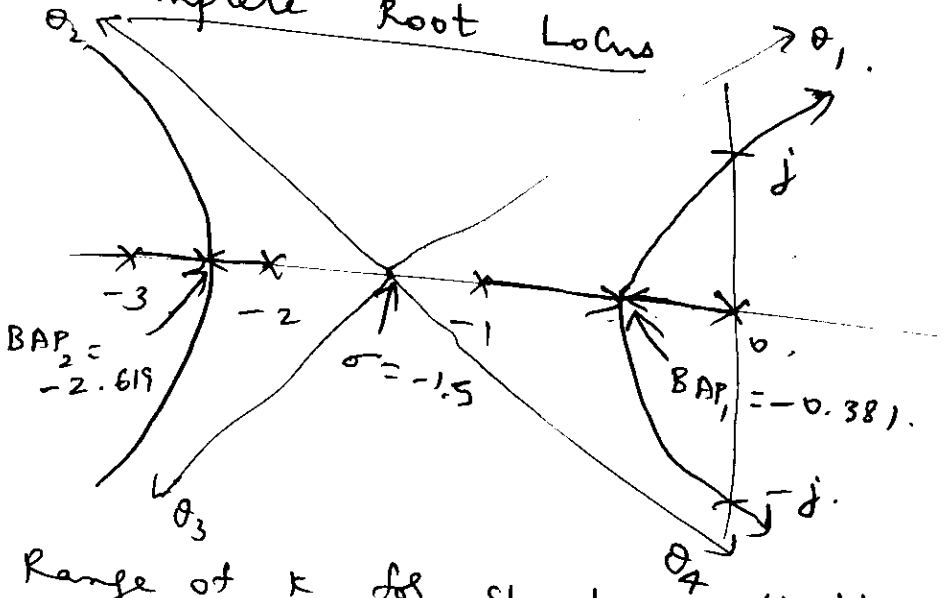
$AE = 10s^2 + K_{mal} = 0$.

$s^2 = \frac{-10}{10} = -1$.

$s = \pm j$.

→ (2m)

Complete Root Locus



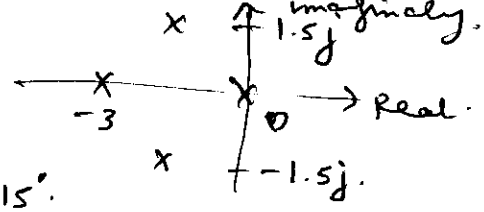
→ (3m)

Range of K for s/m to be stable :- $0 < K < 10$.

4). $G(s)H(s) = \frac{K}{s(s+3)(s^2+3s+4.5)}$

Soln:- i) $P = 4$; $Z = 0$; $N = P - Z = 4$; All 4 branches start from Pole & end at ∞.

ii) Pole Zero Plot:-



iii) Angle of Asymptotes :-

iv) $\theta_1 = 45°$; $\theta_2 = 135°$; $\theta_3 = 225°$; $\theta_4 = 315°$.

v) Centroid $= \sigma = \frac{0-3-1.5-1.5}{4} = -1.5$. → (3m)

Breakaway point :- $CE = 1 + G(s)H(s) = 0$.

$s^4 + 6s^3 + 13.5s^2 + 13.5 + K = 0$.

$K = -s^4 - 6s^3 - 13.5s^2 - 13.5s$.

$\frac{dK}{ds} = -4s^3 - 18s^2 - 27s - 13.5 = 0$.

$s = -1.5, -1.5, -1.5$ = Valid BAP's. → (1m)

vi) Intersection with imaginary axis :-

s^4	1	13.5	K
s^3	6	13.5	0
s^2	11.25	K	0
s^1	$\frac{151.87-6K}{11.25}$	0	
s^0	K.		

$151.87 - 6K = 0$.

$K_{mar} = \frac{151.87}{6} = 25.31$.

$A(s) = 11.25s^2 + K = 0$.

$s^2 = -2.25$.

$s = \pm j1.5$. → (2m)

vii) Angle of departure :-

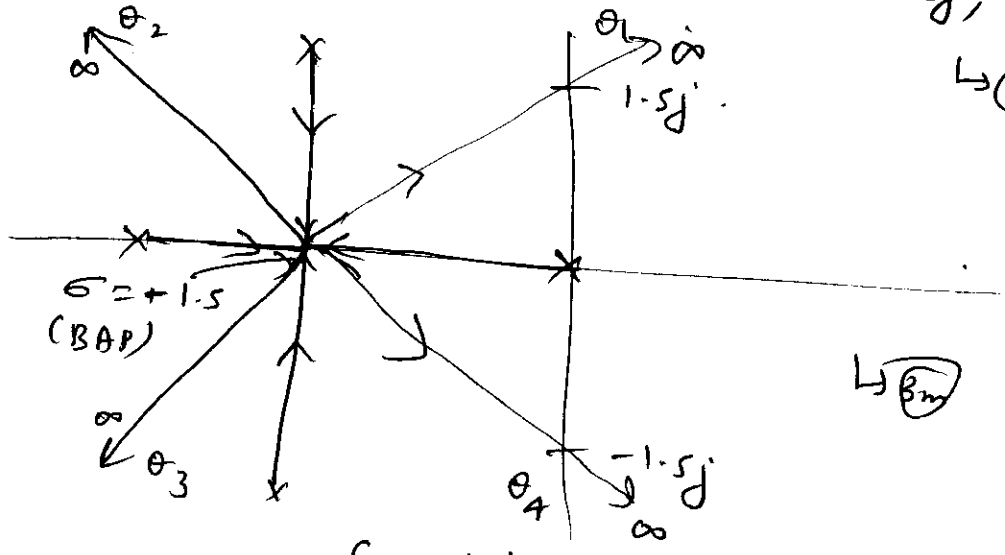
Complex pole $-1.5 + 1.5j$.

$\phi_{p_1} = 135°$; $\phi_{p_2} = 90°$; $\phi_{p_3} = 45°$; $\Sigma\phi_p = 135 + 90 + 45 = 270°$

$\Sigma\phi_2 = 0$.

$\phi = \Sigma\phi_p - \Sigma\phi_2 = 270°$.

$\phi_{d_1} = 180 - 270 = -90°$; for $-1.5 + 1.5j$; $\phi_{d_2} = 90°$; for $-1.5 \pm 1.5j$. → (7m)



→ (3m)

Complete Root Locus.

5) $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$; $B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$; $C = [1 \quad 0]$ & $D = 0$.

$\therefore$ $TF = C[SI - A]^{-1} B + D$.

$[SI - A]^{-1} = \dfrac{\text{Adj}\,|SI - A|}{|SI - A|}$.

$[SI - A] = \begin{bmatrix} S & -1 \\ 2 & S+3 \end{bmatrix}$; $\text{Adj}\,|SI - A| = \begin{bmatrix} S+3 & 1 \\ -2 & S \end{bmatrix}$. → (3m)

$|SI - A| = S^2 + 3S + 2 = (S+1)(S+2)$.

$$TF = [1 \quad 0] \frac{\begin{bmatrix} S+3 & 1 \\ -2 & S \end{bmatrix}}{(S+1)(S+2)} \begin{bmatrix} 1 \\ 0 \end{bmatrix} = [1 \quad 0] \frac{\begin{bmatrix} S+3+1(0) \\ -2+S(0) \end{bmatrix}}{(S+1)(S+2)}$$ → (3m)

$$= \frac{(1)(S+3) + 0(-2)}{(S+1)(S+2)} = \frac{S+3}{(S+1)(S+2)}$$ → (4m)

---

6) $TF = C[SI - A]^{-1} B + D$.

$A = \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix}$; $B = \begin{bmatrix} 3 \\ 5 \end{bmatrix}$; $C = [1 \quad 1]$ & $D = 0$.

$$[SI - A] = S\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix} = \begin{bmatrix} S+2 & 3 \\ -4 & S-2 \end{bmatrix}.$$

$$[SI - A]^{-1} = \frac{\text{Adj}\,|SI - A|}{|SI - A|} = \frac{\begin{bmatrix} S-2 & -3 \\ 4 & S+2 \end{bmatrix}}{S^2 + 8}$$ → (4m)

$TF = C[SI - A]^{-1} B + D$.

$$= [1 \quad 1] \frac{\begin{bmatrix} S-2 & -3 \\ 4 & S+2 \end{bmatrix}}{S^2+8} \begin{bmatrix} 3 \\ 5 \end{bmatrix} = [1 \quad 1] \frac{\begin{bmatrix} 3S-6-15 \\ 12+5S+10 \end{bmatrix}}{S^2+8}$$ → (3m)

$$= \frac{[3S-21+5S+22]}{S^2+8} = \frac{8S+1}{S^2+8}$$ → (3m)

---

7) $STM = e^{At} = L^{-1}[SI - A]^{-1}$.

$[SI - A]^{-1} = \dfrac{\begin{bmatrix} S+4 & 1 \\ -3 & S \end{bmatrix}}{(S+1)(S+3)}$. → (3m)

$$e^{At} = L^{-1} \frac{\begin{bmatrix} S+4 & 1 \\ -3 & S \end{bmatrix}}{(S+1)(S+3)} = L^{-1} \begin{bmatrix} \frac{1.5}{S+1} - \frac{0.5}{S+3} & \frac{0.5}{S+1} - \frac{0.5}{S+3} \\ \frac{-1.5}{S+1} + \frac{1.5}{S+3} & \frac{-0.5}{S+1} + \frac{1.5}{S+3} \end{bmatrix}$$

↳ (5m)

$$e^{At} = \begin{bmatrix} 1.5e^{-t} - 0.5e^{-3t} & 0.5e^{-t} - 0.5e^{-3t} \\ -1.5e^{-t} + 1.5e^{-3t} & 0.5e^{-t} + 1.5e^{-3t} \end{bmatrix}. \rightarrow (2m).$$

---

8) $e^{At} = L^{-1}[sI - A]^{-1}$.

$$[sI - A]^{-1} = \frac{Adj\,(sI - A)}{|sI - A|} = \frac{\begin{bmatrix} s+3 & 1 \\ -2 & s \end{bmatrix}}{(s+1)(s+2)}. \rightarrow (3m)$$

By partial fractions.

$$e^{At} = L^{-1}\begin{bmatrix} \frac{2}{s+1} - \frac{1}{s+2} & \frac{1}{s+1} - \frac{1}{s+2} \\ \frac{-2}{s+1} + \frac{2}{s+2} & \frac{-1}{s+1} + \frac{2}{s+2} \end{bmatrix} \rightarrow (5m)$$

$$= \begin{bmatrix} 2e^{-t} - e^{-2t} & e^{-t} - e^{-2t} \\ -2e^{-t} + 2e^{-2t} & -e^{-t} + 2e^{-2t} \end{bmatrix} \rightarrow (2m)$$

---

9). Let $y(t) = x_1(t)$.

$$\dddot{y}(t) + 8\ddot{y}(t) + 12\dot{y}(t) + 10y(t) = 4u(t).$$

$$x_2(t) = \dot{x}_1(t) = \dot{y}(t)$$

$$\dot{x}_2(t) = x_3(t) = \ddot{y}(t).$$

$$\dot{x}_3(t) = \dddot{y}(t) = 4u(t) - 10y(t) - 12\dot{y}(t) - 8\ddot{y}(t).$$

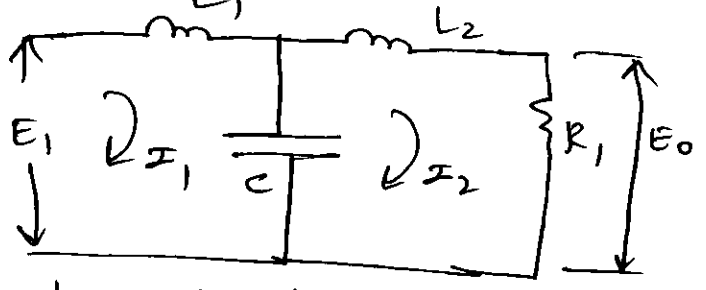
$$\dot{x}_3(t) = 4u(t) - 10x_1(t) - 12x_2(t) - 8x_3(t). \rightarrow (5m)$$

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \\ \dot{x}_3(t) \end{bmatrix} = \underbrace{\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -10 & -12 & -8 \end{bmatrix}}_{A} \begin{bmatrix} x_1(t) \\ x_2(t) \\ x_3(t) \end{bmatrix} + \underbrace{\begin{bmatrix} 0 \\ 0 \\ 4 \end{bmatrix}}_{B} u. \rightarrow (3m)$$

$$y(t) = x_1(t) = \underbrace{\begin{bmatrix} 1 & 0 & 0 \end{bmatrix}}_{C} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}. \rightarrow (2m)$$

---

10).



State Variables:-

i_{L_1}, i_{L_2} & V_c.

KVL to loop 1:-

$$E_1 = L_1 \frac{di_1}{dt} + V_c.$$

$$\frac{di_1}{dt} = \frac{1}{L_1}(E_1 - V_c) \rightarrow (1). \quad \rightarrow (2m)$$

Applying KVL to loop 2 :-

$$0 = L_2 \frac{di_2}{dt} + V_c + I_2 R_1.$$

$$\frac{di_2}{dt} = \frac{1}{L_2}(-V_c - I_2 R_1) \rightarrow (2). \quad \rightarrow (2m)$$

Current across Capacitor

$$I_1 - I_2 = C \frac{dV_c}{dt}.$$

$$\frac{dV_c}{dt} = \frac{1}{C}[I_1 - I_2] \rightarrow (3). \quad \rightarrow (2m)$$

From (1), (2) & (3) :-

$$\begin{bmatrix} \frac{di_1}{dt} \\ i_2 \\ V_c \end{bmatrix} = \underset{A}{\begin{bmatrix} 0 & 0 & -\frac{1}{L_1} \\ 0 & -\frac{R_1}{L_2} & -\frac{1}{L_2} \\ \frac{1}{C} & -\frac{1}{C} & 0 \end{bmatrix}} \begin{bmatrix} i_1 \\ i_2 \\ V_c \end{bmatrix} + \underset{B.}{\begin{bmatrix} \frac{1}{L_1} \\ 0 \\ 0 \end{bmatrix}} E_1. \quad \rightarrow (3m)$$

$$E_0 = I_2 R_1 = \underset{C.}{\begin{bmatrix} 0 & R_1 & 0 \end{bmatrix}} \begin{bmatrix} i_1 \\ i_2 \\ V_c \end{bmatrix} \quad \rightarrow (1m).$$

[Signature of faculty]

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI

Department of Electronics and Communication Engineering

CONTINUOUS INTERNAL EVALUATION ASSESSMENT REPORT

Staff Name: Mrs.Suvarna Patil / Mr.Sharana Basavaraj B **Sem/Sec:** IV/A&B **Academic year:** 2020-21

Course Name: Control Systems **Course code:** 18EC43 **CIE:** 3

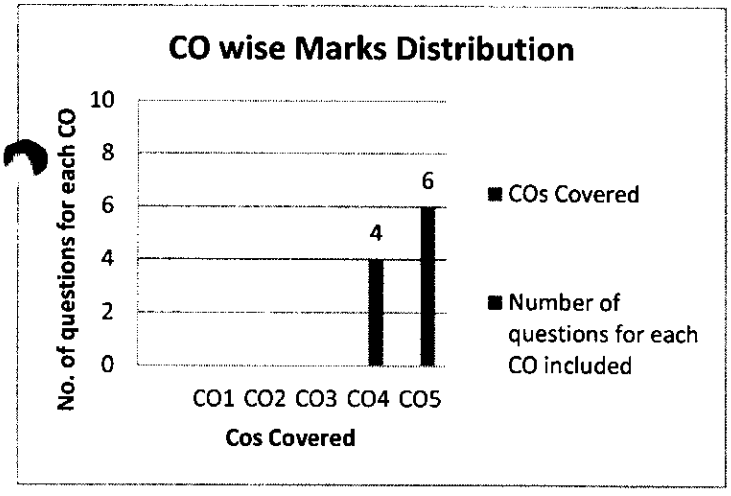
Mention the Syllabus included for CIE:

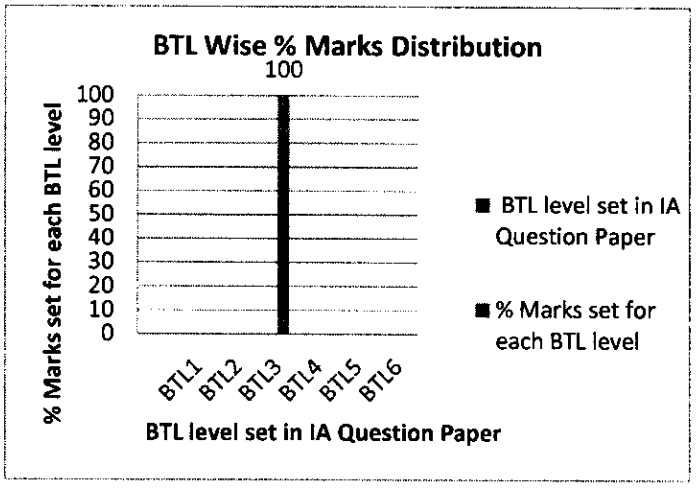
1	**MODULE NUMBERS**	4 & 5
2	**CO s COVERED**	4 & 5
3	**BTL LEVELS ADDRESSED**	L3

Mention following details of CIE Questions Paper setting :

1	**COs Covered**	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
					Y	Y
2	**Number of questions for each CO included**				4	6

1	**BTL level set in IA Question Paper**	**BTL1**	**BTL2**	**BTL3**	**BTL4**	**BTL5**	**BTL6**
		Y	Y	Y			
2	**% Marks set for each BTL level**			100			





Staff Signature

RAO BAHADUR Y. MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARI
Department of Electronics and Communication Engineering

IA-3 PERFORMANCE ANALYSIS 2020-21 Even Sem

Internal Assessment 3: Control Systems (18EC43)

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
CO mapping	C211.4	C211.4	C211.4	C211.4	C211.5	C211.5	C211.5	C211.5	C211.5	C211.5
Max Marks /Question	10	10	10	10	10	10	10	10	10	10
Total marks of class /question	12	333	129	230	339	30	89	279		335
No. of students attended	2	34	13	23	34	3	9	28		37
No of students scored > 65% of marks/Question	1	33	13	23	34	3	9	28		37
Percentage of students scored>65% of marks/Question	50.00	97.06	100.00	100.00	100.00	100.00	100.00	100.00		100.00

Mark range	0 to 10	11 to 20	21 to 30	31 to 40	41 to 50
No. Of Students	0	0	01	0	36

Faculty: Sharana Basavaraj B					
Course Name: Control Systems					
Course Code: 18EC43					
Academic Year: 2020-21					
Sl. No	USN NO	NAME	CIE	SEE	Total
1	3VC19EC001	AASHISH ROY	49	33	82
2	3VC19EC002	ABHISHEK A M	50	29	79
3	3VC19EC008	BHARATH KUMAR M	50	26	76
4	3VC19EC010	BINDUSHREE M	45	25	70
5	3VC19EC012	G P CHOODAMANIKYA	50	21	71
6	3VC19EC015	H MEGHANA	48	25	73
7	3VC19EC020	K M SOUNDARYA	50	23	73
8	3VC19EC022	KARTHIK K	42	13	55
9	3VC19EC025	KONDA BHARATH KUMAR	50	24	74
10	3VC19EC026	KOTHINTI JAGADEESHWARA REDDY	49	19	68
11	3VC19EC033	MANJUNATH S	39	11	50
12	3VC19EC035	MOHAMMED TOUSIF G P	49	18	67
13	3VC19EC036	MOHMMEDJUNAID A NAMAJKATTI	50	30	80
14	3VC19EC039	NIKHITA R	49	29	78
15	3VC19EC043	RABIYA	50	16	66
16	3VC19EC044	RAVI SHANKAR B J	50	21	71
17	3VC19EC046	SANA SAMREEN	50	39	89
18	3VC19EC049	SATVIKA N	47	23	70
19	3VC19EC051	SHIFA FARAZ	49	25	74
20	3VC19EC053	SHREEKANTH H R	50	26	76
21	3VC19EC054	SHWETA PALLED	50	29	79
22	3VC19EC056	SREEKAR R	50	36	86
23	3VC19EC057	SUDEEP ANGADI	49	23	72
24	3VC19EC059	TRIVENI M	50	26	76
25	3VC19EC061	VAISHNAVI D	50	32	82
26	3VC19EC062	VAMSHI KRISHNA K	49	25	74
27	3VC19EC065	VIDYA S V	50	35	85
28	3VC19EC067	YESHASWINI V	50	32	82
29	3VC19EC068	ZUBER M SOUDAGAR	49	20	69
30	3VC20EC400	ANIS FATHIMA	50	20	70
31	3VC20EC401	ANKITHA ARKAL	50	27	77
32	3VC20EC402	K BASAVARAJ	49	17	66
33	3VC20EC403	POORNIMA S	50	28	78
34	3VC20EC404	RAVITEJA B	45	27	72

35	3VC20EC405	SHAINAZ SULTHANA	50	21	71
36	3VC20EC406	PRHALAD ACHAR	49	19	68
37	3VC20EC407	SRIDHARA K M	50	23	73
Number of students scoring > 23 in EXTERNAL				**25**	

EXTERNAL EXAM

Number of students appeared for the exam	**37**		-
Number of students scoring >= 45% in EXTERNAL	**25**		-
Percentage	**0.68**		-
Achieved target:	**68%**		
ATTAINMENT LEVEL	[illegible]		

Faculty: Sharana Basavaraj B	
Course Name: Control Systems	
Course Code: 18EC43	**Sem: 4 B**
Academic Year: 2020-21	

Course Exit Survey

C211.1	Develop the mathematical model of mechanical and electrical systems.
C211.2	Use block diagram reduction techniques & Masons Gain formulae to obtain transfer function.
C211.3	Analyze time domain specifications for first and second order systems.
C211.4	Determine the stability of a system in the time domain using Routh Hurwitz criteria and root locus technique, stability of a system in frequency domain using Bode plots.
C211.5	Use Nyquist plot stability of a system in frequency domain; develop a control system in continuous and discrete time using state variable techniques

Course Exit Survey Guidelines: Excellent –5, Very Good – 4, Good – 3, Average – 2, Below Average-1

Sl. No	USN	Student Name	C211.1	C211.2	C211.3	C211.4	C211.5
1	3VC19EC001	AASHISH ROY	5	5	5	5	5
2	3VC19EC002	ABHISHEK A M	5	5	5	5	5
3	3VC19EC008	BHARATH KUMAR M	5	5	4	4	5
4	3VC19EC010	BINDUSHREE M	5	5	5	5	5
5	3VC19EC012	G P CHOODAMANIKYA	5	4	5	5	4
6	3VC19EC015	H MEGHANA	5	4	5	4	5
7	3VC19EC020	K M SOUNDARYA	4	4	4	4	4
8	3VC19EC022	KARTHIK K					
9	3VC19EC025	KONDA BHARATH KUMAR	4	4	4	4	4
10	3VC19EC026	KOTHINTI JAGADEESHWARA REDDY	4	4	4	4	4
11	3VC19EC033	MANJUNATH S	3	4	3	4	4
12	3VC19EC035	MOHAMMED TOUSIF G P	5	5	5	5	5
13	3VC19EC036	MOHMMEDJUNAID A NAMAJKATTI	5	5	5	5	5
14	3VC19EC039	NIKHITA R	4	4	4	4	4
15	3VC19EC043	RABIYA	4	4	4	4	4
16	3VC19EC044	RAVI SHANKAR B J	5	5	4	4	5
17	3VC19EC046	SANA SAMREEN	5	5	5	5	4
18	3VC19EC049	SATVIKA N	5	5	5	5	5
19	3VC19EC051	SHIFA FARAZ	5	5	5	5	5
20	3VC19EC053	SHREEKANTH H R	5	5	5	5	5
21	3VC19EC054	SHWETA PALLED	5	5	4	4	4
22	3VC19EC056	SREEKAR R	5	4	5	5	4

Faculty: Sharana Basavaraj B	
Course Name: Control Systems	
Course Code: 18EC43	**Sem: 4 B**
Academic Year: 2020-21	

Course Exit Survey

C211.1	Develop the mathematical model of mechanical and electrical systems.
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Sl. NO	USN	Student Name	C211.1	C211.2	C211.3	C211.4	C211.5
23	3VC19EC057	SUDEEP ANGADI	5	4	5	4	5
24	3VC19EC059	TRIVENI M	5	5	4	5	4
25	3VC19EC061	VAISHNAVI D	5	5	5	5	5
26	3VC19EC062	VAMSHI KRISHNA K	5	5	5	4	4
27	3VC19EC065	VIDYA S V	4	3	3	3	3
28	3VC19EC067	YESHASWINI V	5	5	5	5	5
29	3VC19EC068	ZUBER M SOUDAGAR	5	5	5	5	5
30	3VC20EC400	ANIS FATHIMA	4	5	3	4	3
31	3VC20EC401	ANKITHA ARKAL	4	3	4	3	4
32	3VC20EC402	K BASAVARAJ	5	4	5	4	5
33	3VC20EC403	POORNIMA S	5	4	3	5	5
34	3VC20EC404	RAVITEJA B	5	5	5	5	5
35	3VC20EC405	SHAINAZ SULTHANA	5	4	5	3	5
36	3VC20EC406	PRHALAD ACHAR	5	5	5	5	5
37	3VC20EC407	SRIDHARA K M	5	4	4	4	3

Staff incharge: Sharana Basavaraj B

Faculty: Sharana Basavaraj B	
Course Name: Control Systems	
Course Code: 18EC43	**Sem: 4B**
Academic Year: 2020-21	

Self Assesment Report

Q1	Solve Mathematical modelling of Mechanical network for Force Current & Force Voltage Analogy.
Q2	Obtain Transfer function using Block diagram & Signal flow graph approach.
Q3	Apply Time response analysis for second order system to solve problems.
Q4	Apply Routh Hurwitz criterion to Compute range of K for system stabilty & oscillating frequency.
Q5	Sketch Complete root locus using for given transfer function.
Q6	Use Bode Plot & Nyquist plot to find Gain Margin, Phase Margin & range of K for stabilty.
Q7	Use State Variable analysis to different electrical network & differentail equations.

Self Assesment Survey Guidelines: Excellent –5, Very Good – 4, Good – 3, Average – 2, Below Average-1

Sl. No	USN	Student Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7
1	3VC19EC001	AASHISH ROY	5	5	5	5	5	5	5
2	3VC19EC002	ABHISHEK A M	5	5	5	5	5	5	5
3	3VC19EC008	BHARATH KUMAR M	5	5	5	5	5	3	3
4	3VC19EC010	BINDUSHREE M	5	5	5	5	5	4	5
5	3VC19EC012	G P CHOODAMANIKYA	5	4	5	5	5	5	5
6	3VC19EC015	H MEGHANA	5	4	5	4	3	5	4
7	3VC19EC020	K M SOUNDARYA	4	4	4	4	4	4	4
8	3VC19EC022	KARTHIK K							
9	3VC19EC025	KONDA BHARATH KUMAR	5	5	5	5	4	4	4
10	3VC19EC026	KOTHINTI JAGADEESHWARA REDDY	4	4	4	4	4	4	4
11	3VC19EC033	MANJUNATH S	3	4	4	3	4	4	3
12	3VC19EC035	MOHAMMED TOUSIF G P	5	5	5	5	5	5	5
13	3VC19EC036	MOHMMEDJUNAID A NAMAJKATTI	5	5	5	5	5	5	5
14	3VC19EC039	NIKHITA R	4	4	4	4	4	4	4
15	3VC19EC043	RABIYA	4	4	4	4	4	4	4
16	3VC19EC044	RAVI SHANKAR B J	5	5	5	4	4	5	5
17	3VC19EC046	SANA SAMREEN	5	5	5	5	4	5	5
18	3VC19EC049	SATVIKA N	5	5	5	5	5	5	5
19	3VC19EC051	SHIFA FARAZ	5	5	5	5	5	5	5
20	3VC19EC053	SHREEKANTH H R	5	5	5	5	5	5	5
21	3VC19EC054	SHWETA PALLED	5	4	4	5	4	5	5

Faculty: Sharana Basavaraj B	
Course Name: Control Systems	
Course Code: 18EC43	**Sem: 4B**
Academic Year: 2020-21	

Self Assesment Report

Q1	Solve Mathematical modelling of Mechanical network for Force Current & Force Voltage Analogy.
Q2	Obtain Transfer function using Block diagram & Signal flow graph approach.
Q3	Apply Time response analysis for second order system to solve problems.
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Self Assesment Survey Guidelines: Excellent –5, Very Good – 4, Good – 3, Average – 2, Below Average-1

22	3VC19EC056	SREEKAR R	5	4	5	5	5	4	4
23	3VC19EC057	SUDEEP ANGADI	5	5	5	5	4	4	5
24	3VC19EC059	TRIVENI M	5	4	4	5	4	5	5
25	3VC19EC061	VAISHNAVI D	5	5	5	5	5	5	5
26	3VC19EC062	VAMSHI KRISHNA K	5	5	5	5	5	5	5
27	3VC19EC065	VIDYA S V	4	4	4	4	4	4	4
28	3VC19EC067	YESHASWINI V	5	5	5	5	5	5	5
29	3VC19EC068	ZUBER M SOUDAGAR	5	5	5	5	5	5	5
30	3VC20EC400	ANIS FATHIMA	5	4	5	4	3	5	4
31	3VC20EC401	ANKITHA ARKAL	5	4	5	4	5	4	5
32	3VC20EC402	K BASAVARAJ	5	4	5	4	3	5	4
33	3VC20EC403	POORNIMA S	5	4	5	5	5	4	5
34	3VC20EC404	RAVITEJA B	5	5	5	5	5	5	5
35	3VC20EC405	SHAINAZ SULTHANA	5	5	4	4	5	5	5
36	3VC20EC406	PRHALAD ACHAR	5	5	5	5	5	5	5
37	3VC20EC407	SRIDHARA K M	5	5	4	4	4	3	3

Staff incharge: Sharana Basavaraj B

Sb

RAO BAHADUR Y MAHABALESWARAPPA ENGINEERING COLLEGE, BALLARIDEPARTMENT OF ELECTRONICS COMMUNICATION ENGNEERING

DIRECT & INDIRECT ATTAINMENT 2020-21

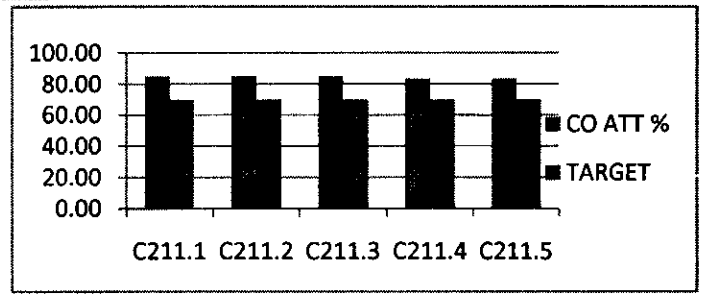
Faculty: Sharana Basavaraj B					
Course Name: Control Systems					
Course Code: 18EC43	**Sem**	**4**	**Sec**	**B**	
C211.1	Develop the mathematical model of mechanical and electrical systems.				
C211.2	Use block diagram reduction techniques & Masons Gain formulae to obtain transfer function.				
C211.3	Analyze time domain specifications for first and second order systems.				
C211.4	Determine the stability of a system in the time domain using Routh Hurwitz criteria and root locus				
C211.5	Use Nyquist plot stability of a system in frequency domain; develop a control system in continuous and				

CO-PO/PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C211.1	3	3	3											
C211.2	3	3	3											
C211.3	3	3	3											
C211.4	3	3	3											
C211.5	3	3	3											
AVG	3	3	3											

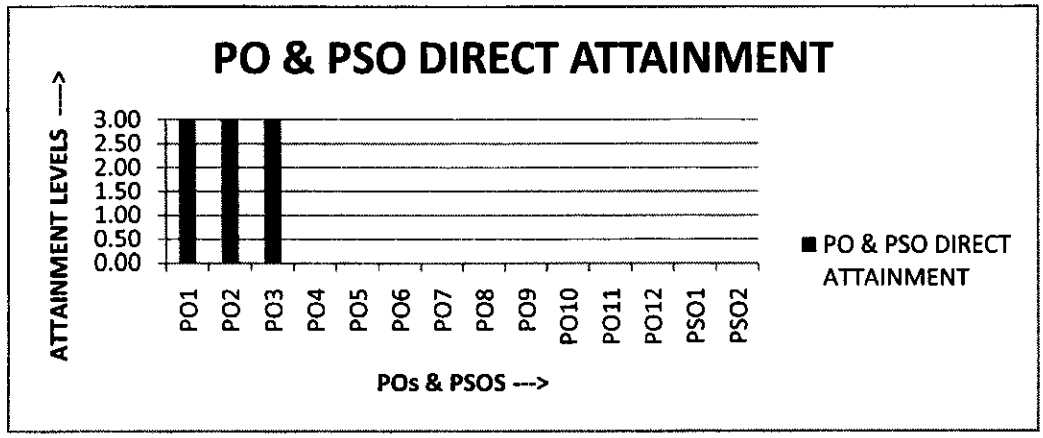
CO DIRECT & INDIRECT ATTAINMENT

	CO AT	TARGET
C211.1	85.28	70
C211.2	85.32	70
C211.3	85.24	70
C211.4	83.60	70
C211.5	83.60	70



	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PO ATT	3.00	3.00	3.00											

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
PO ATT	3.00	3.00	3.00											



[Staff Sign].

CO ATTAINMENT GAP ANALYSIS 2020-21

Course Outcomes	CO Attainment	CO Target	CO Attainment Gap
C211.1	85.28	70	15.28
C211.2	85.32	70	15.32
C211.3	85.24	70	15.24
C211.4	83.60	70	13.60
C211.5	83.60	70	13.60

ACTION REPORT ON GAP ANALYSIS

Course Outcomes	Action proposed to bridge the gap	Modification of target if achieved
C211.1		CO Target can be increased to 72 for next academic year.
C211.2		CO Target can be increased to 72 for next academic year.
C211.3		CO Target can be increased to 72 for next academic year.
C211.4		CO Target can be increased to 72 for next academic year.
C211.5		CO Target can be increased to 72 for next academic year.

INSTRUCTOR REPORT (INNOVATIVE PRACTICES) 2020-21

1. Control Systems subject involves problem solving, classes were engaged in online mode through Google Meet and Zoom with black board teaching and Parallel students participation in problem solving.

2. For few modules screen recording of videos were done and it was shared in telegram channel and made available for students.
   Telegram Link: https://t.me/ControlSystemsSharanB

3. Notes were given for concepts which were covered in the class and assignments of all concepts covered were given.

[Staff Sign]