Revised - Academic Calendar of VTU, Belagavi for EVEN Semester of 2017-2018 (Feb 2018 – July 2018)

	II,IV & VI Sem B.E/B.Tech II , IV, VI, VIII Sem B.Arch	VIII Sem BE / B.Tech & X Sem B.Arch	IV Sem MCA	VI Sem MCA	IV Sem MBA	IV Sem M.Tech	IV Sem M.Arch	II Sem MCA	II Sem MBA	II Sem M.Tech	II Sem M.Arch
Commencement of EVEN Semester	05.02.2018	05.02.2018	05.02.2018	05.02.2018	26.03.2018	08.01.2018	05.02.2018	17.02.2018	10.02.2018	17.02.2018	23.02.2018
Last Working day of EVEN Semester	26.05.2018	26.05.2018	26.05.2018	26.05.2018	13.07.2018	28.04.2018	09.06.2018	08.06.2018	31.05.2018	08.06.2018	28.06.2018
Practical Examination	28.05.2018 To 07.06.2018	-	28.05.2018 To 02.06.2018	-	-	-	-	11.06.2018 To 16.06.2018	-	11.06.2018 To 16.06.2018	-
Theory Examinations	11.06.2018 To 14.07.2018	28.05.2018 To 08.06.2018	04.06.2018 To 20.06.2018	-	16.07.2018 To 08.08.2018	28.05.2018 To 02.06.2018	-	18.06.2018 To 30.06.2018	04.06.2018 To 18.06.2018	18.06.2018 To 30.06.2018	02.07.2018 To 12.07.2018
Viva Voce	-	11.06.2018 To 16.06.2018	-	-	-	-	-	-	-	-	-
Summer Project / Professional Training	-	-	-	28.05.2018 To 08.06.2018 [Submission of Report to VTU]	15.05.2018 To 30.05.2018 [Submission of Report to VTU]	02.05.2018 To 19.05.2018 [Submission of Report to VTU]	-	-	-	-	-
Commencement of ODD Semester	01.08.2018	-	01.08.2018	-	-	-	-	01.08.2018	01.08.2018	01.08.2018 [Internship of 16 Weeks]	01.08.2018

1. College Time Table shall be arranged for five and a half week days and planned to accommodate EDUSAT transmission slots, the schedule of which will be notified separately.
2. The faculty/staff shall be available to undertake any work assigned by the university.
3. If any of the above date is declared to be a holiday then the corresponding event will come into effect on the next working day.
4. Notification regarding Calendar of Events relating to the conduct of University Examination will be issued by the Registrar (Evaluation) from time to time

REGISTRAR

Revised

||JAI SRI GURUDEV||

AIT	College Calendar of Events			Format No.	ACD01
				Issue No.	01
				Rev. No.	00
Academic Year	2017-18	Semester	EVEN	Date :10-02-2018	

Sl No	Date	Events	Remark
1	08.01.2018	Commencement of 4th Semesters of M.Tech Classes	
2	29-01-2018	After availing the vacation all the faculty members reported back to the duty	
3	31.01.2018	One day work shop on Application of Mathematics in Engineering for all the branches	
4	05-02-2018	Commencement of 2nd, 4th ,6th and 8th Semesters of B.E. Classes	
5	01.02.2018	BARC Students Empowerment Programme by Sri Ramachandra Aital	
6	08.02.2018 to 10.02.2018	Three Days Faculty Development Programme on "ARM Cortex M3 Microcotroller" organized by E&C Department.	
7	10.02.2018	Commencement of 2nd semester MBA classes	
8	10.02.2018	One day national work shop on "Chemistry of Nanomaterials and their Engineering Applications"	
9	17-02-2018	Commencement of 2nd , Semesters of M.Tech Classes	
10	10-03-2018 to 12-03-2018	Commencement of First Test Cycle for 2nd, 4th, 6th and 8th semester B.E Students	
11	16-03-2018	Announcement of 1st Test I.A Marks for 2nd, 4th, 6th and 8th semester B.E Students	
12	26-03-2018	Commencement of 4th semester MBA classes	
13	14-04-2018 to 16-04-2018	Commencement of Second Test Cycle for 2nd, 4th, 6th and 8th semester B.E Students	
14	19-04-2018	Announcement of 2nd Test I.A Marks for 2nd, 4th, 6th and 8th semester B.E Students	
15	26-04-2018	Graduation Day for outgoing B.E. M.Tech. and AIBM students.	
16	27-04-2018 & 28-04-2018	"CHUNCHANA" - Cultural Fest - 2018	
17	28-04-2018	Last working day for 4th semester M.Tech Students	

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18	*12.05.2018*	Conduction of National conference in all departments	
19	18-05-2018 to 20-05-2018	Commencement of Improvement Test Cycle for 2nd, 4th,6th and 8th semester B.E Students	
20	22-05-2018	Announcement of Improvement Test I.A Marks for 2nd, 4th, 6th and 8th semester B.E Students	
21	26-05-2018	Last working day for 2nd, 4th 6th and 8th semester B.E Students	
22	28.05-2018 to 07-06-2018	Practical Examination for 2nd, 4th,6th semester B.E Students	
23	08.06.2018	Last working day for 2nd semester M.Tech Students	
24	11-06-2018 to 16-06-2018	Practical Examination for 2nd semester M.Tech Students	
25	28-05-2018 to 02-06-2018	Theory Examination for 4th semester M.Tech, students	
26	28.05.2018 to 08.06.2018	Theory Examination for 8th semester B.E., students	
27	04-06-2018 to 18-06-2018	Theory examinations for 2nd Semesters of MBA Students	
28	18.06.2018 to 30.06.2018	Theory examinations for 2nd Semesters of M.Tech Students	
29	11-06-2018 to 16-06-2018	External project Viva-voce for 8th semester students	
30	11-06-2018 to 14-07-2018	Theory examinations for 2nd, 4th,6th semester B.E Students	
31	16-07-2018 to 08-08-2018	Theory examinations for 4th Semesters of M B A Students	
32	13.07.2018	Last working day for 4th semester MBA Students	
33	04.06.2018 to18.06.2018	Theory examinations for 2nd Semesters of MBA Students	
34	01-08-2018	Commencement of ODD semester tentatively	

Note : Add all the activities done by individual department and highlight the Non-Work ing days, Guest Lecturers, Seminars, Test Cycles etc

Copy to

1. All HOD'S
2. Placement Officier
3. Establishment Section
4. vijayalakshmi.a@spaneos.com

PRINCIPAL
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Principal
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||JAI SRI GURUDEV||

AIT	Department of Mechanical Engineering Calendar of Events	Format No.	ACD01
		Issue No.	01
		Rev. No.	00

Academic Year	2017-18	Semester	EVEN	Date :15-01-2018

Sl No	Date	Events	Remark
1	29-01-2018	After availing the vacation all the faculty members reported back to the duty	
2	31-01-2018	One day workshop on Application of Mathematics in Engineering for all the branches	
3	01-02-2018	Commencement of 2nd, 4th, 6th and 8th semesters B.E.Classes	
4	01-02-2018	BARC students Empowerment Programme by Sri Ramachandra Aital	
5	08-02-2018	Dept Meeting & discussion about 6th sem syllabus & spaneos	
6	22-02-2018	Dept Meeting of 1st test portion	
7	26-02-2018, 27-02-2018, 28-02-2018.	Project 1st phase.	
8	~~03~~-03-2018 to ~~05~~-03-2018	Commencement of First Test Cycle for 2nd, 4th, 6th and 8th semester B.E Students	
9	08-03-2018	Announcement of First Test I.A Marks for 2nd, 4th, 6th and 8th semester B.E Students	
10	08-03-2018	Last date for submission of subject seminar topics	
11	10-03-2018	Technical talk	
12	26-03-2018 to 28-03-2018	Project Second phase.	
13	02-04-2018	Dept Meeting of Second test portion	
14	14 ~~07~~-04-2018 to 16 ~~09~~-04-2018	Commencement of Second Test Cycle for 2nd, 4th, 6th and 8th semester B.E Students	
15	11-04-2018	Announcement of second Test I.A Marks for 2nd, 4th, 6th and 8th semester B.E Students	
16	20-04-2018 21-04-2018	National Conference by Mechanical Engineering Department	
17	26-04-2018	Graduation Day for outgoing B.E. M.Tech. and AIBM students.	
18	27-04-2018 28-04-2018	CHUNCHANA 2018	
19	03-05-2018 to 05-05-2018	Project final phase	
20	09-05-2018 to 12-05-2018	Subject seminar	
21	10-05-2018	Dept Meeting of Third test portion	
22	18-05-2018 to 20-05-2018	Commencement of Improvement Test Cycle for 2nd, 4th,6th and 8th semester B.E Students	
23	22-05-2018	Announcement of Improvement Test I.A Marks for 2nd, 4th, 6th and 8th semester B.E Students	
24	23-05-2018	Last working day for 2nd, 4th 6th and 8th semester B.E and 2nd sem M.Tech., and MBA Students	
25	28-05-2018 to 06-06-2018	Practical Examination for 2nd, 4th,6th semester B.E Students	
26	28-05-2018 to 08-06-2018	Theory Examination for 8th semester B.E., students	
27	11-06-2018 to 16-06-2018	External project Viva-voce for 8th semester students	
28	11-06-2018 to 14-06-2018	Theory examinations for 2nd, 4th,6th semester B.E Students	
29	01-08-2018	Commencement of ODD semester tentatively	

8/2/18

HOD's Signature

Professor & Head
Department of Mechanical Engineering
Adichunchanagiri Institute of Technology

AIT	Class Time Table	Format No	ACD06
		Issue No	01
		Rev. No	00

Department	Mechanical Engineering	Semester	7	Section	A
Academic year	2018-19	**Room No**	E-307		
Class Coordinator	Ullas G S / Prashanth N				

Period ▶ / Day ▼ / Time ▶	1	2	3	4	5	6	7	8
	9:10	10:11	11.15:12.15	12.15:1.15	2.30:3.20	3.20:4.10	4.10:5.0	Total Hours
Monday		Tribology	FPS	EE	Design Lab (A1) / CIM Lab (A2)			
Tuesday	EE	Mechatronics	CE	CE				
Wednesday	FPS	CE	Mechatronics	FPS	Design Lab (A2) / CIM Lab (A3)			
Thursday	Mechatronics	Tribology	Design Lab (A3) / CIM Lab (A1)					
Friday	CE	EE	FPS	Tribology				
Saturday	Mechatronics	Tribology	EE					

Other Special activities (if any)

Theory

Subject Code	Title	Faculty Name	Faculty Code
15ME71	Energy Engineering	Ullas G S	
15ME72	Fluid Power Systems	Praveen D	
15ME73	Control Engineering	Basavarajappa M P	
15ME742	Tribology	Prashanth N	
15ME753	Mechatronics	Koushik G C	
15MEP78	Project Phase – I		

Practical

Subject Code	Title	Faculty Name	Faculty Code
15MEL76	Design Lab		
15MEL77	CIM Lab		

Timetable- Coordinator

Head of the Department

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6 . Course Information

6 . 1 Course Content

Title of the Course : CONTROL ENGINEERING
Semester : 7

Academic Year : 2018-19

Subject Code : 15ME73	IA Marks : 20
Hours/week : 4	Total Hours : 54
Exam Hours : 3	Exam Marks : 80
Course Plan Author : Basavarajappa M P	Planned Date : -
Approved by : Satyanarayana G M	Approved Date : -

Objectives:

1 . Modeling of mechanical, hydraulic, pneumatic and electrical systems,

2 . Representation of system elements by blocks and its reduction

3 . Transient and steady state response analysis of a system.

4 . Frequency response analysis using polar plot.

5 . Frequency response analysis using bode plot.

6 . Analysis of system using root locus plots.

7 . Different system compensators and variable characteristics of linear systems.

Course Outcomes (COs) :

1 . Recognize control system and its types , control actions

2 . Determine the system governing equations for physical models(Electrical, Thermal, Mechanical, Electro Mechanical)

3 . Calculate the gain of the system using block diagram and signal flow graph

4 . Illustrate the response of 1st and 2nd order systems

5 . Determine the stability of transfer functions in complex domain and frequency domain

6 . Employ state equations to study the controllability and observability

6 . Course Information

6 . 1 . 1 Course Syllabus

Objectives:
Title of the Course : CONTROL ENGINEERING
Subject Code : 15ME73

Module 1

Introduction :

Concept of automatic controls, Open loop and closed loop systems, Concepts of feedback, requirements of an ideal control system, Types of controllers-Proportional, Integral, Differential, Proportional & Integral, Proportional Differential and Proportional Integral, Differential controllers.

Module 2

Modeling of Physical Systems :

Mathematical Models of Mechanical, Electrical, Thermal, Hydraulic and Pneumatic Systems.

Analogous Systems :

Direct and inverse analogs for mechanical, thermal and fluid systems.

Block diagram Algebra :

General representation of a feedback control system, transfer functions, rules of block diagram algebra, reduction of block dia, to obtain closed loop transfer function, Signal flow graphs -Mason's gain formula .

Module 3

Steady state operation-Steady state analysis for general block dia, for a control system, steady state characteristics, equilibrium in a system.

Transient Response: Transient response and steady state analysis of unit, step input, general operational representation for a differential equation of control system, distinct, repeated and complex conjugate zeros, general form of transient response, Routh's stability criterion for a control system.

Root Locus Plots -Root locus method: Significance of Root locus, angle and magnitude conditions, breakaway points, angles of departure and arrival, construction of Root locus using general rules and steps, Lead and Lag compensation.

Module 4

Frequency Domain Analysis :

Relationship between time and frequency response, Polar plot, Bode's Plot, Nyquist plot and Nyquist stability criterion, Relative Stability, Phase and Gain Margins .

Module 5

System Compensation and State Variable Characteristics of Linear Systems :

Series and feedback compensation, Introduction to state concepts, state equation of linear continuous data system, Matrix representation of state equations, controllability and observability, Kalmanand Gilberts test .

6 . Course Information

6 . 2

Semester : 7 **Section :** A **Course :** CONTROL ENGINEERING

Period	Planned			Execution		
	Date	Topic	Source material to be referred	Date	Topic	Source material to be referred
			1			
1	2018-08-01	Concept of automatic controls		2018-08-21	Concept of automatic controls	
2	2018-08-03	Open loop and closed loop systems		2018-08-21	Open loop and closed loop systems	
3	2018-08-07	Concepts of feedback		2018-08-28	Concepts of feedback	
4	2018-08-07	requirements of an ideal control system		2018-08-28	requirements of an ideal control system	
5	2018-08-08	Types of controllers-Proportional		2018-08-29	Types of controllers-Proportional	
6	2018-08-10	Integral		2018-08-31	Integral	
7	2018-08-14	Differential		2018-09-04	Differential, Differential, Proportional & Integral, Proportional Differential and Proportional Integral, Differential controllers.	
8	2018-08-14	Proportional & Integral		2018-09-04	Proportional & Integral	
9	2018-08-17	Proportional Differential and Proportional Integral		2018-09-05	Proportional Differential and Proportional Integral	
10	2018-08-21	Differential controllers.		2018-09-07	Differential controllers.	
			2			
11	2018-08-21	Mathematical Models of Mechanical, Electrical		2018-09-07	Mathematical Models of Mechanical, Electrical, Mathematical Models of Mechanical	
12	2018-08-24	Hydraulic and Pneumatic Systems.		2018-09-11	Hydraulic and Pneumatic Systems.	
13	2018-08-28	Mathematical Models of Mechanical		2018-09-11	Mathematical Models of Mechanical	
14	2018-08-28	Thermal		2018-09-25	Thermal	
15	2018-08-29	Direct and inverse analogs for mechanical		2018-09-25	Direct and inverse analogs for mechanical	
16	2018-08-31	thermal and fluid systems.		2018-09-25	thermal and fluid systems.	
17	2018-09-04	thermal and fluid systems.		2018-09-26	thermal and fluid systems.	
18	2018-09-04	General representation of		2018-09-28	General representation of	

19	2018-09-05	rules of block diagram algebra, reduction of block dia		2018-09-28	rules of block diagram algebra, reduction of block dia	
20	2018-09-07	to obtain closed loop transfer function, Signal flow graphs -Mason's gain formula .		2018-10-02	to obtain closed loop transfer function, Signal flow graphs -Mason's gain formula .	
			3			
21	2018-09-11	Steady state operation- Steady state analysis for general block dia		2018-10-02	Steady state operation- Steady state analysis for general block dia	
22	2018-09-11	Steady state operation- Steady state analysis for general block dia, for a control system		2018-10-03	Steady state operation- Steady state analysis for general block dia, for a control system	
23	2018-09-12	steadystate characteristics, equilibrium in a system.		2018-10-05	steadystate characteristics, equilibrium in a system.	
24	2018-09-14	Transient Response: Transient response and steady state analysis of unit, step input		2018-10-05	Transient Response: Transient response and steady state analysis of unit, step input	
25	2018-09-18	general operational representation for a differential equation of control system, distinct, repeated and complex conjugate zeros		2018-10-09	general operational representation for a differential equation of control system, distinct, repeated and complex conjugate zeros	
26	2018-09-18	general form of transient response, Routh's stability criterion for a control system.		2018-10-10	general form of transient response, Routh's stability criterion for a control system.	
27	2018-09-19	Root Locus Plots -Root locus method: Significance of Root locus, angle and magnitude conditions		2018-10-12	Root Locus Plots -Root locus method: Significance of Root locus, angle and magnitude conditions	
28	2018-09-25	breakaway points, angles of departure and arrival		2018-10-16	breakaway points, angles of departure and arrival	
29	2018-09-25	breakaway points, angles of departure and arrival		2018-10-16	breakaway points, angles of departure and arrival	
30	2018-09-26	construction of Root locus using general rules and steps		2018-10-23	construction of Root locus using general rules and steps	
31	2018-09-28	Lead and Lag compensation.		2018-10-23	Lead and Lag compensation.	
			4			
32	2018-10-03	Relationship between time and frequency response		2018-10-30	Relationship between time and frequency response	

35	2018-10-09	Bode's Plot		2018-10-31	Bode's Plot	
36	2018-10-10	Bode's Plot		2018-10-31	Bode's Plot	
37	2018-10-12	Nyquist plot and Nyquist stability criterion		2018-11-02	Nyquist plot and Nyquist stability criterion	
38	2018-10-16	Nyquist plot and Nyquist stability criterion		2018-11-13	Nyquist plot and Nyquist stability criterion	
39	2018-10-16	Relative Stability		2018-11-13	Relative Stability	
40	2018-10-17	Phase and Gain Margins .		2018-11-14	Phase and Gain Margins .	
			5			
41	2018-10-23	Series and feedback compensation		2018-11-14	Series and feedback compensation	
42	2018-10-23	Series and feedback compensation		2018-11-16	Series and feedback compensation	
43	2018-10-26	Introduction to state concepts		2018-11-16	Introduction to state concepts	
44	2018-10-30	Introduction to state concepts		2018-11-20	Introduction to state concepts	
45	2018-10-30	state equation of linear continuous datasystem		2018-11-20	state equation of linear continuous datasystem	
46	2018-10-31	state equation of linear continuous datasystem		2018-11-21	state equation of linear continuous datasystem	
47	2018-11-02	Matrix representation of state equations		2018-11-23	Matrix representation of state equations	
48	2018-11-07	Matrix representation of state equations		2018-11-27	Matrix representation of state equations	
49	2018-11-09	controllability and observability		2018-11-27	controllability and observability	
50	2018-11-13	Kalmanand Gilberts test .		2018-11-28	Kalmanand Gilberts test .	

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USN : ____________________

Adichunchanagiri Institute of Technology
DEPARTMENT OF MECHANICAL ENGINEERING
I - INTERNAL ASSESSMENT

Semester: 7-CBCS
Subject: CONTROL ENGINEERING (15ME73)
Faculty: Prof Basavarajappa M P

Date: 18 Sep 2018
Time: 10:30 AM - 11:30 AM
Max Marks: 30

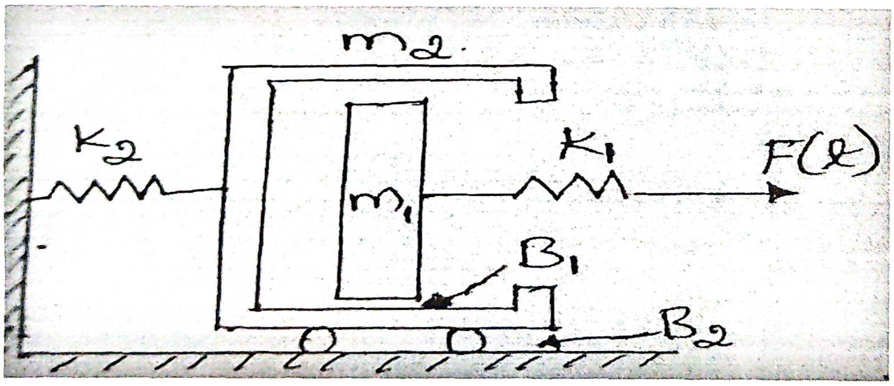
Answer any 2 Question(s)

Marks CO BT/CL

1a. What are the difference between open loop and closed loop control system.

[3.0] [1] [1]

1b. Determine the transfer function for the given mechanical system shown in figure

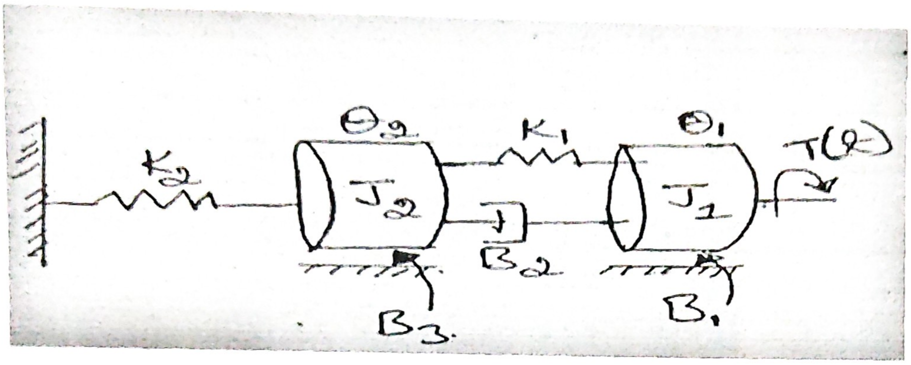


[12.0] [1] [1]

2a. What are the requirements of an ideal control system

[5.0] [1] [1]

2b. Determine the transfer function for the system shown in figure

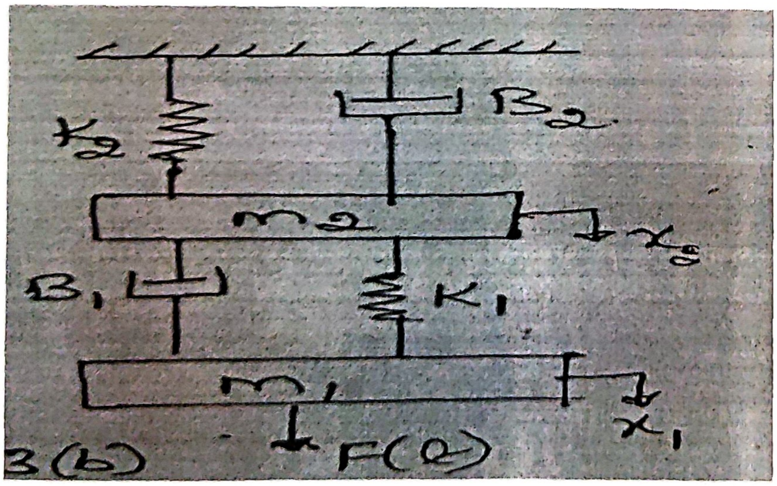


[10.0] [1] [1]

3a. Explain open loop and closed loop control system with an example

[5.0] [1] [1]

3b. Write the Force-voltage and Force-current analogous circuit for the mechanical system shown in figure



[10.0] [1] [1]

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USN : ____________________

Adichunchanagiri Institute of Technology
DEPARTMENT OF MECHANICAL ENGINEERING

II - INTERNAL ASSESSMENT

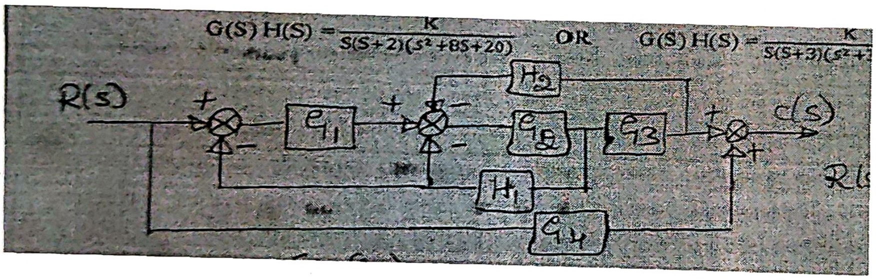
Semester: 7-CBCS
Subject: CONTROL ENGINEERING (15ME73)
Faculty: Prof Basavarajappa M P

Date: 26 Oct 2018
Time: 10:30 AM - 11:30 AM
Max Marks: 30

Answer any 2 Question(s)

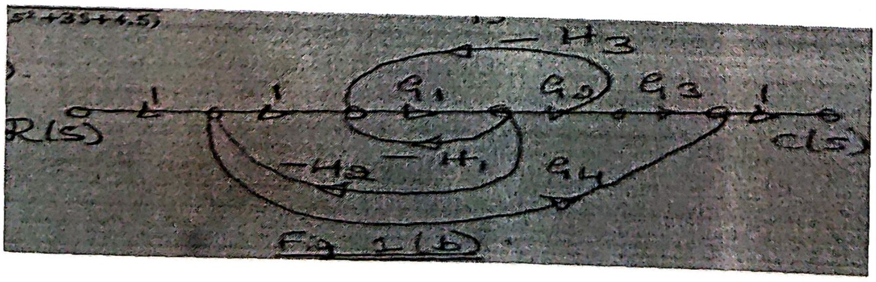
Marks CO BT/CL

1a. Reduce the block diagram shown in fig and find CLTF.



[8.0] [3] [4]

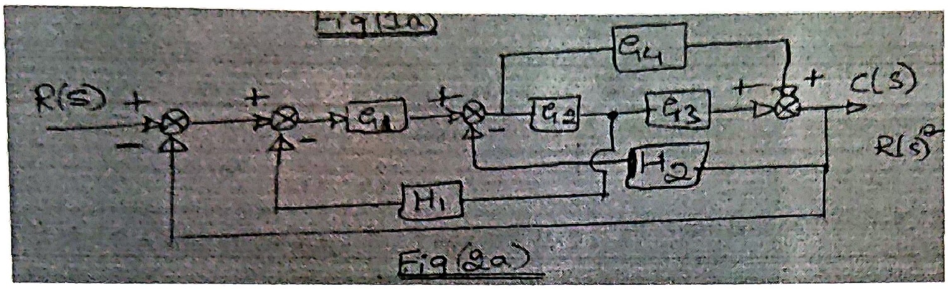
1b. For the SFG shown infig,determine CLTF using masons gain formula



[7.0] [3] [4]

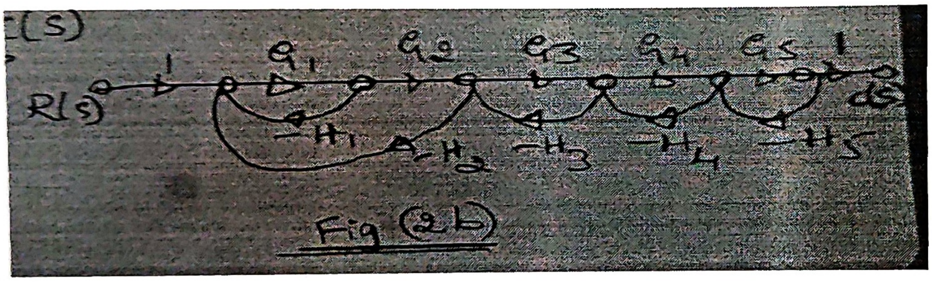
OR

2a. Reduce the block diagram shown in fig and find CLTF.



[8.0] [3] [4]

2b. For the SFG shown infig,determine CLTF using masons gain formula



[7.0] [3] [4]

3. Draw the root locus plot for the given OLTF

$G(S)H(S)=K/S(S+3)(S^2+3S+4.5)$

[15.0] [3] [4]

OR

4. Draw the root locus plot for the given OLTF

$G(S)H(S)=K/S(S+2)(S^2+8S+20)$

[15.0] [3] [4]

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Adichunchanagiri Institute of Technology
DEPARTMENT OF MECHANICAL ENGINEERING
III - INTERNAL ASSESSMENT

Semester: 7-CBCS
Subject: CONTROL ENGINEERING (15ME73)
Faculty: Prof Basavarajappa M P

Date: 28 Nov 2018
Time: 10:30 AM - 11:30 AM
Max Marks: 30

Answer all questions

Marks CO BT/CL

1. Draw the root locus plot for the given OLTF and find the value of K for which system is stable and unstable

G(S)H(S)=K /S(S+2)(S+4)(S+6)

[15.0] [3] [3]

2. Sketch the bode plot for given OLTF also determine the value of K for the gain margin of 20 db

G(S)H(S)= $Ke^{-0.1S}$/ S(1+0.1S)(1+S)

[15.0] [4] [3]

3. Sketch the bode plot for given OLTF also determine the value of K for the gain margin of 10 db and phase margin of 40^0

G(S)H(S)= K / S(1+0.2S)(1+0.05S)

[15.0] [4] [3]

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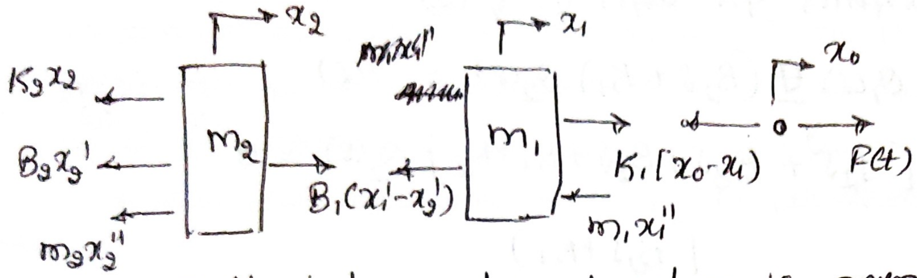
Control Engineering [15ME73]

Date: 18.09.18 "SCHEME AND SOLUTION"

1a) Difference b/w open Loop and Closed loop Control Systems — (03)

b) F.B.D of System is shown below



— (03)

Differential equation of motion is given by

$K_1[x_0-x_1] = F(t)$ — ①

$m_1 x_1'' + B_1[x_1'-x_2'] - K_1[x_0-x_1] = 0$ — ②

$m_2 x_2'' + B_2 x_2' + K_2 x_2 - B_1[x_1'-x_2'] = 0$ — ③

— (03)

Apllying Laplace transform. For equation 1, 2 and 3.

$K_1 X_0(s) - K_1 X_1(s) = F(s)$ — ④

$-K_1 X_0(s) + [m_1 s^2 + B_1 s + K_1] X_1(s) - B_1 s X_2(s) = 0$ — ⑤

$-B_1 s X_1(s) + [m_2 s^2 + B_2 s + B_1 s + K_2] X_2(s) = 0$ — ⑥

— (03)

Aplying Cramers rule.

$$X_2(s) = \frac{\begin{vmatrix} K_1 & -K_1 & F(s) \\ -K_1 & (m_1 s^2+B_1 s+K_1) & 0 \\ 0 & -B_1 s & 0 \end{vmatrix}}{\begin{vmatrix} K_1 & -K_1 & 0 \\ -K_1 & (m_1 s^2+B_1 s+K_1) & -B_1 s \\ 0 & -B_1 s & (m_2 s^2+B_2 s+B_1 s+K_2) \end{vmatrix}}$$

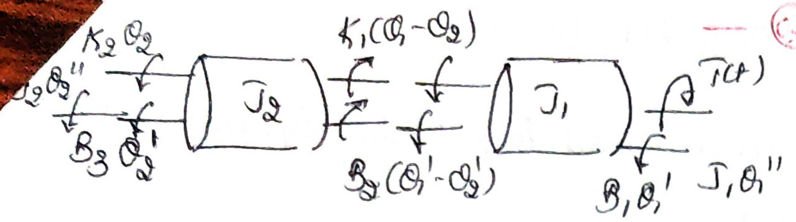
$$\therefore TF = \frac{X_2(s)}{F(s)} = \frac{K_1 B_1 s}{K_1\left[(m_1 s^2+B_1 s+K_1)(m_2 s^2+B_2 s+B_1 s+K_2) - (B_1 s)^2\right] - K_1^2 (m_2 s^2+B_2 s+B_1 s+K_2)}$$

— (03)

2a) Requirements of Ideal Control System are. — (05)

Stability. Accuracy. Speed of response. Bandwidth. Disturbance.

F.B.D is shown in fig.



— (2)

$\therefore J_1\theta_1'' + B_1\theta_1' + B_2[\theta_1'-\theta_2'] + K_1(\theta_1-\theta_2) = T(t)$ — (1)

$J_2\theta_2'' + B_3\theta_2' + K_2\theta_2 - B_2[\theta_1'-\theta_2'] - K_1[\theta_1-\theta_2] = 0$ — (2) (2)

Aplying laplace transform for eqn (1) & (2)

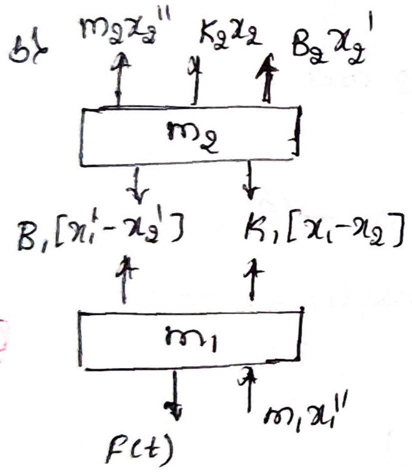
$[J_1s^2 + B_1s + B_2s + K_1]\,\theta_1(s) - (B_2s + K_1)\,\theta_2(s) = T(s)$

$-[B_2s + K_1]\,\theta_1(s) + [J_2s^2 + B_3s + B_2s + K_1 + K_2]\,\theta_2(s) = 0$ (3)

$\therefore TF = \dfrac{\theta_2(s)}{T(s)} = \dfrac{[B_2s+K_1)}{(J_1s^2+B_1s+B_2s+K_1)(J_2s^2+B_2s+B_3s+K_1+K_2) - [B_2s+K_1]^2}$ — (1)

8 a) Open loop and closed loop Control System with example — (05)

b)



(2)

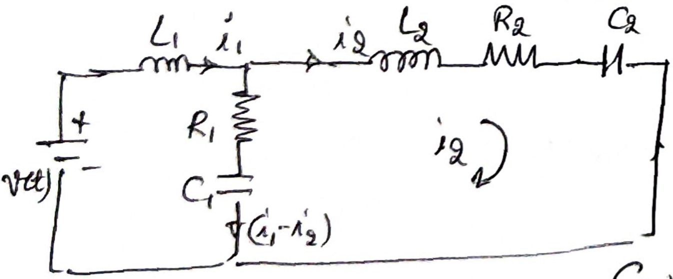
$m_1x_1'' + B_1[x_1'-x_2'] + K_1[x_1-x_2] = F(t)$ — (1)

$m_2x_2'' + B_2x_2' + K_2x_2 - B_1[x_1'-x_2'] - K_1[x_1-x_2] = 0$ — (2) (2)

F-V analogy:

$L_1 \times di_1/dt + R_1[i_1-i_2] + \frac{1}{C_1}\int(i_1-i_2)dt = v(t)$ (3)

$L_2 \times di_2/dt + R_2 i_2 + \frac{1}{C_2}\int i_2 dt - R_1[i_1-i_2] - \frac{1}{C_1}\int(i_1-i_2)dt = 0$ — (4) (2)



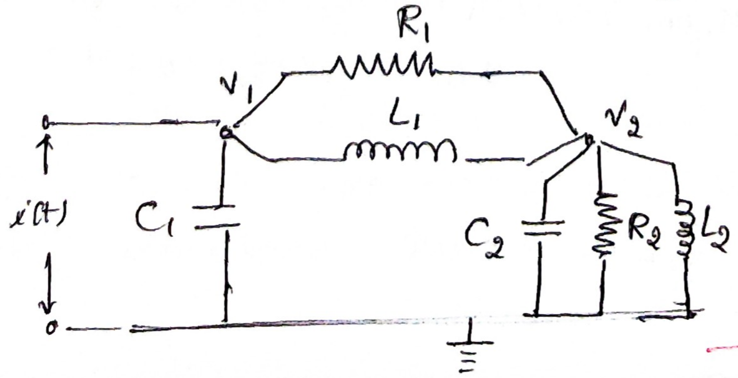
(1)

F-I Analogy

$C_1 \times dv_1/dt + \frac{1}{R_1}[v_1-v_2] + \frac{1}{L_1}\int(v_1-v_2)dt = i(t)$ — (5)

$C_2 \times dv_2/dt + \frac{1}{R_2}v_2 + \frac{1}{L_2}\int v_2 dt - \frac{1}{R_1}[v_1-v_2] - \frac{1}{L_1}\int(v_1-v_2) = 0$ — (6)

(2)

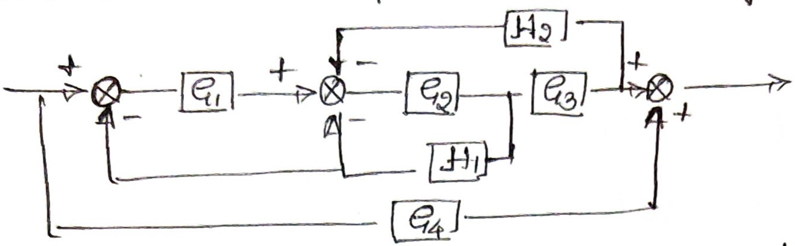


— (1).

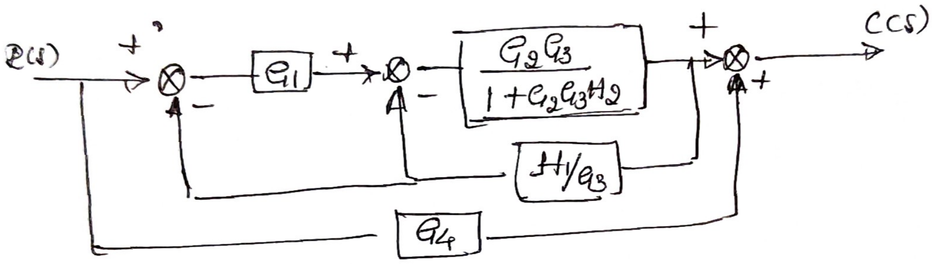
"Control Engg" [15ME73] "Test-2"

"Scheme and Solutions"

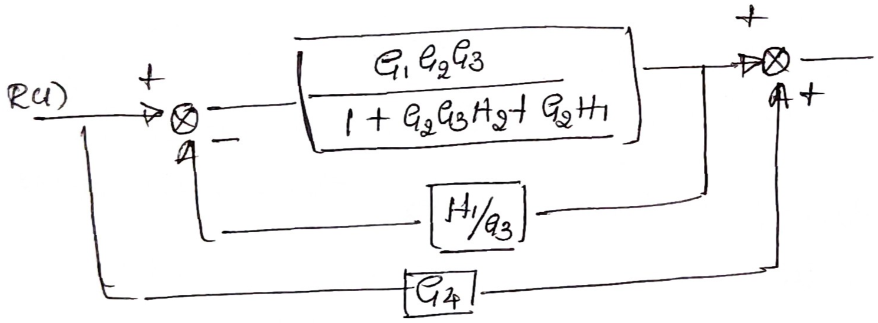
1. a) Reduce the Block diagram shown in Fig and Find CLTF



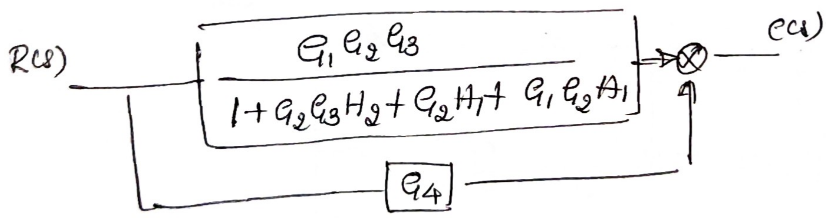
Shift the take off point behind G3 Combine the blocks in series & eliminate the FB loop



— (02)



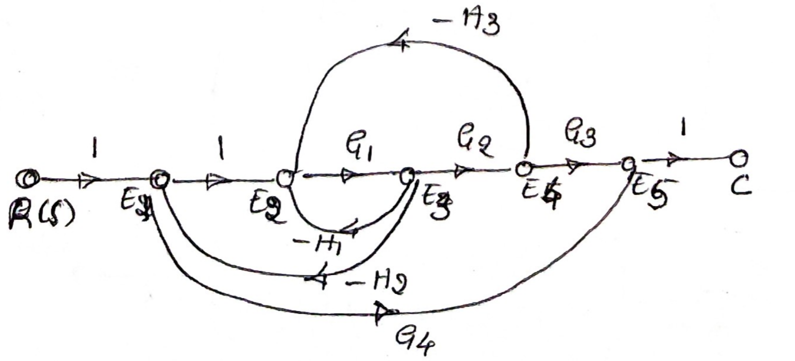
— (02)



— (02)

$$\therefore \frac{C(s)}{R(s)} = G_4 + \frac{G_1G_2G_3}{1+G_2G_3H_2+G_2H_1+G_1G_2H_1}$$ — (01)

b)



SFG. Following data were obtained.

1) Forward path. — (02)

FP1 $R E_1 E_2 E_3 E_4 E_5 C$ $P_1 = G_1 G_2 G_3$

FP2. $R E_1 E_5 C$ $P_2 = G_4$

2) Individual loops: — (02)

Loop 1 $E_1 E_2 E_3 E_1$ $L_1 = -G_1 H_2$

Loop 2 $E_2 E_3 E_2$ $L_2 = -G_1 H_1$

Loop 3 $E_2 E_3 E_4 E_2$ $L_3 = -G_1 G_2 H_3$

3) Non Touching Loops There are no N.T.L — (01)

4) 'Δ' of SFG. — (01)

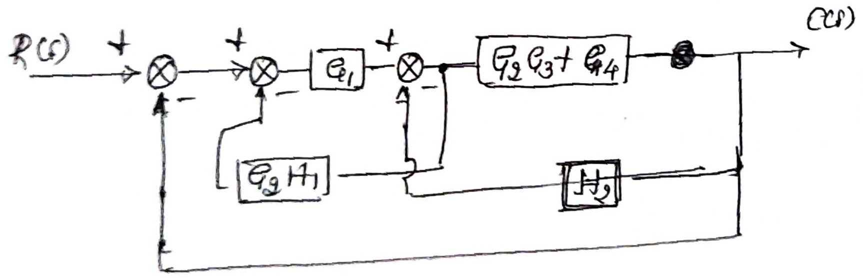
$$\Delta = 1 + G_1 H_1 + G_1 H_2 + G_1 G_2 H_3.$$

5) 'Δ' of Forward path. — (01)

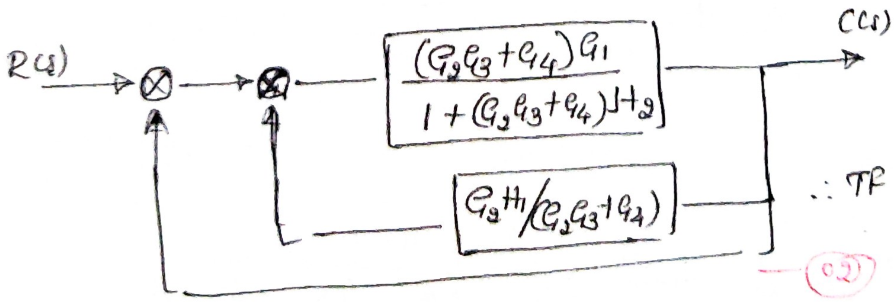
$\Delta_1 = 1$ $\Delta_2 = 1 + G_1 H_1 + G_1 G_2 H_3$

6) $$T.F = \frac{P_1 \Delta_1 + P_2 \Delta_2}{\Delta} = \frac{G_1 G_2 G_3 + G_4 [1 + G_1 H_1 + G_1 G_2 G_3]}{\Delta}.$$ — (01)

2 a) Shift the take off point ahead of G_2. Combine the blocks in series and in parallel

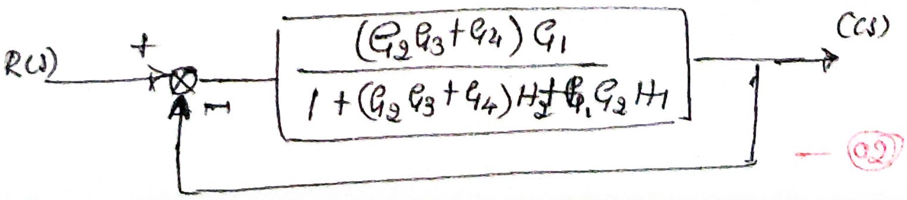


— (02)



— (02)

$$\therefore TF = \frac{(G_2 G_3 + G_4) G_1}{1 + (G_2 G_3 + G_4) H_2 + G_1 G_2 H_1 + G_1 [G_2 G_3 + G_4]}$$ — (02)



— (02)

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$dK/ds = 4s^3 + 30s^2 + 72s + 40 = 0$

$\therefore$ $s = -0.785$

Critical freq & gain — C.E is given by — (02)

$s^4 + 10s^3 + 36s^2 + 40s + K = 0$ — Put ($s = j\omega$)

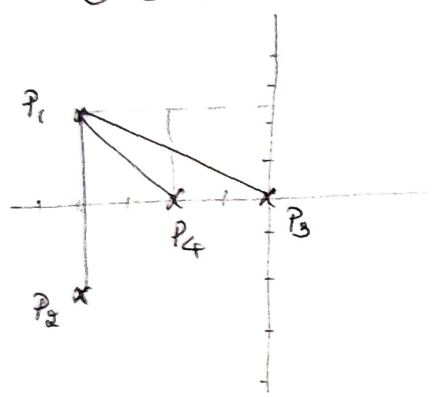
$\omega^4 - j10\omega^3 - 36\omega^2 + j40\omega + K = 0$

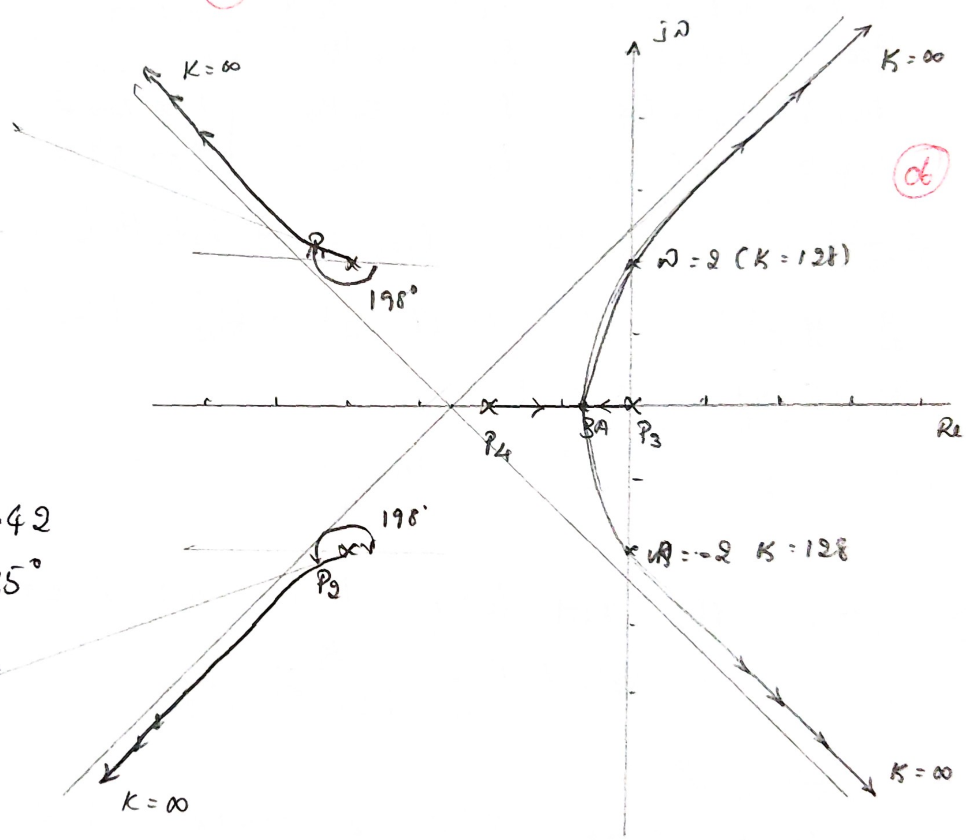
$\therefore [\omega^4 - 36\omega^2 + K] + j[-10\omega^3 + 40\omega] = 0$

$\therefore -10\omega^3 + 40\omega = 0$ $\quad \omega^2 = 4.$ $\quad \therefore \omega = \pm 2 \text{ rad/s}$

$K = -\omega^4 + 36\omega^2$ $\quad K = 128$

Angle of departure:- — (02)





$\theta_{P_2} = 90°$

$\theta_{P_3} = 90 + \tan^{-1}(4/2) = 153.42$

$\theta_{P_4} = 90 + \tan^{-1}(2/2) = 135°$

$\therefore \theta_{d_1} = 180 - \Sigma\theta_p + \Sigma\theta_z$

$= -198.42$

$\therefore \theta_{d_2} = 198.42.$

4) Root locus plot for $G(s)H(s) = \dfrac{K}{s(s+3)(s^2+3s+4.5)}$

Poles & Zeros — $P = 4$ at $s = 0, -3, -1.5+1.5i, -1.5-1.5i$ — (01)

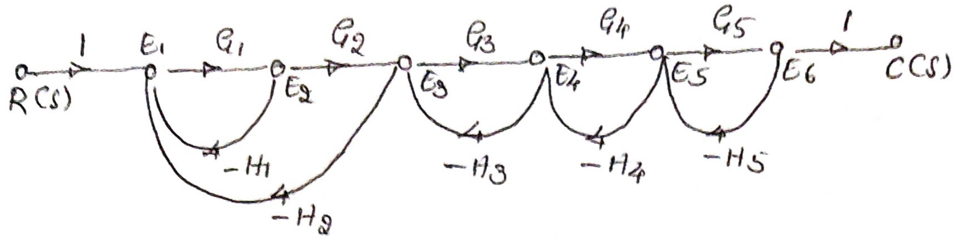
$Z = 0$

Assymptodes: — $N = P - Z = 4$ — (02)

Angle $= \dfrac{(2n+1)180}{P-Z} = 45.\ 135.\ 225.\ 315.$

$\sigma = \dfrac{\Sigma P - \Sigma Z}{P - Z} = -1.5.$

2) b)



1) Forward path — (1)

$R E_1 E_2 E_3 E_4 E_5 E_6 C$ $\quad P_1 = G_1 G_2 G_3 G_4 G_5$

2) Indiv. Loops — (02)

Loop 1 $\quad E_1 E_2 E_1$ $\quad L_1 = -G_1 H_1$

Loop 2 $\quad E_1 E_2 E_3 E_1$ $\quad L_2 = -G_1 G_2 H_2$

Loop 3 $\quad E_3 E_4 E_3$ $\quad L_3 = -G_3 H_3$

Loop 4 $\quad E_4 E_5 E_4$ $\quad L_4 = -G_4 H_4$

Loop 5 $\quad E_5 E_6 E_5$ $\quad L_5 = -G_5 H_5$

Non Touching Loops — (02)

Loop 1 & 3 $\quad \therefore L_{13} = G_1 G_3 H_1 H_3$

Loop 1 & 4 $\quad L_{14} = G_1 G_4 H_1 H_4$

Loop 1 & 5 $\quad L_{15} = G_1 G_5 H_1 H_5$

Loop 2 & 4 $\quad L_{24} = G_1 G_2 G_4 H_2 H_4$

Loop 2 & 5 $\quad L_{25} = G_1 G_2 G_5 H_2 H_5$

Loop 3 & 5 $\quad L_{35} = G_3 G_5 H_3 H_5$

3NTL $\quad$ loop 1, 3, & 5 $\quad L_{135} = -G_1 G_3 G_5 H_1 H_3 H_5$ — (01)

Δ of SFG $\quad \Delta = 1 - [L_1 + L_2 + \dots L_5] + [L_{13} + L_{14} + \dots L_{35}] - [L_{135}]$ — (01)

Δ of FP $\quad \Delta_1 = 1$

$$\therefore TF = \frac{P_1 \Delta_1}{\Delta} = \frac{G_1 G_2 G_3 G_4 G_5}{\Delta}.$$ — (01)

3. Draw the root locus plot for System with OLTF

$$G(s)H(s) = \frac{K}{S(S+2)(S^2+8S+20)}$$

Poles & Zeros

$P = 4.$ $\quad$ at $\quad S = 0, -2, -4+2i, -4-2i$ — (01)

$Z = 0.$

Assymptodes $\quad$ No. of Assymptodes $= P - Z = 4$ — (02)

$$\text{Angle} = \frac{(2n+1)180}{P-Z} = 45, 135, 225, 315^\circ.$$

$$\text{Centroid } \sigma = \frac{\Sigma P - \Sigma Z}{P-Z} = -2.5$$

Break away point: $\quad$ The C.E eqn is given by $1 + G(s)H(s) = 0$ — (02)

$$\therefore 1 + \frac{K}{(S^2+2S)(S^2+8S+20)} = 0$$

$$\therefore K = -[S^4 + 10S^3 + 36S^2 + 40S]$$

Break away point: C.E is given by. $1+G(s)H(s)=0$ — (02)

$$\therefore 1+\frac{K}{(s^2+3s)(s^2+3s+4.5)}=0$$

$$\therefore K=-[s^4+6s^3+13.5s^2+13.5s]$$

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

$$\therefore \boxed{s=-1.5}$$

Critical frequency and gain C.E is given by — (02)

$$s^4+6s^3+13.5s^2+13.5s+K=0 \quad \text{put } s=j\omega$$

$$\omega^4-j6\omega^3-13.5\omega^2+j13.5\omega+K=0$$

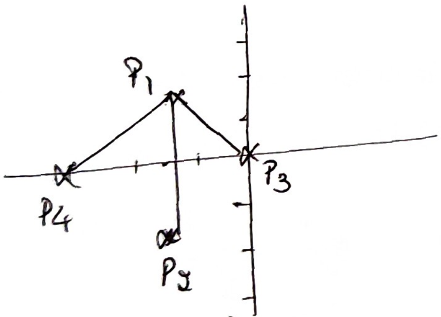
$$\therefore (\omega^4-13.5\omega^2+K)+j[-6\omega^3+13.5\omega]=0$$

$$\therefore -6\omega^3+13.5\omega=0 \quad \therefore \omega^2=2.25 \quad \therefore \omega=\pm 1.5\ \text{rad/s}$$

$$K=-\omega^4+13.5\omega^2=25.31.$$

Angle of departure:- — (02)

$$\theta_{P_2}=90^\circ \quad \theta_{P_3}=135 \quad \theta_{P_4}=45^\circ$$

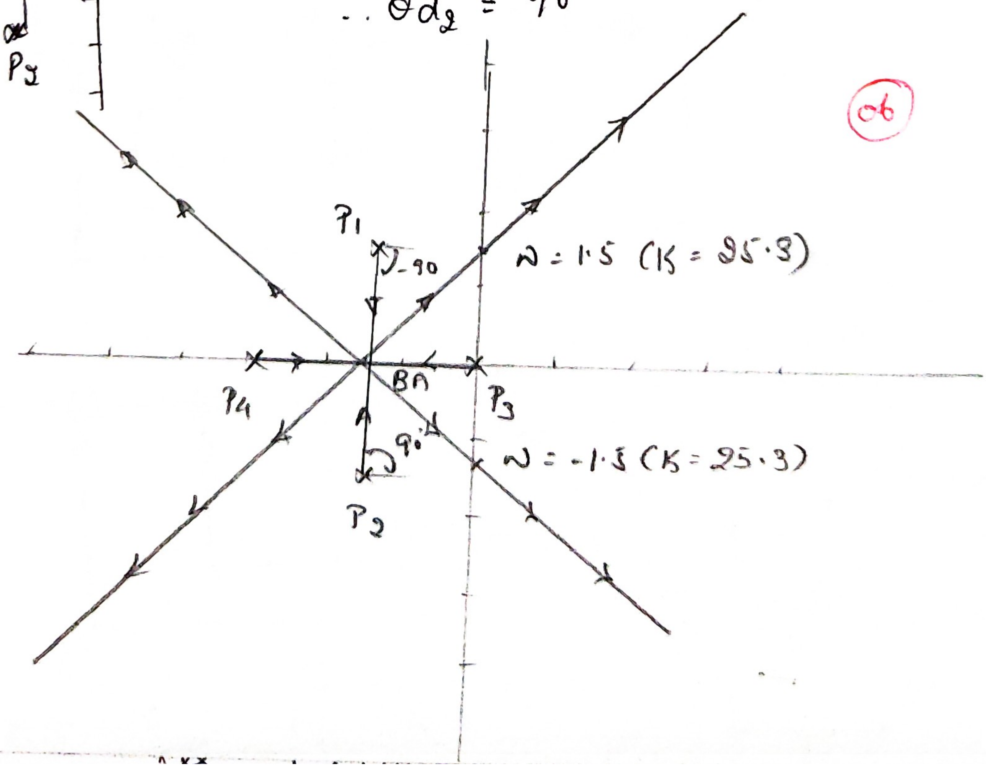


$$\therefore \theta_{d_1}=180-\Sigma\theta_p+\Sigma\theta_z$$

$$=-90^\circ$$

$$\therefore \theta_{d_2}=90^\circ.$$

(06)



"Control Engineering" [Test-3]

1.

$$G(s)H(s) = \frac{K}{s(s+2)(s+4)(s+6)}$$

Poles & Zeros $P = 4$ at $s = 0, -2, -4, -6$.

$Z = 0$

Assymptodes: No. of Assymptodes $= P - Z = 4$

$$\text{Angle} = \frac{(2n+1)180}{P-Z} = 45°, 135°, 225, 315°$$

$$\text{Centroid} \quad \sigma = \frac{\Sigma P - \Sigma Z}{P - Z} = \frac{-12}{4} = -3$$

Break away point . CE is given by. $1 + G(s)H(s) = 0$

$$\therefore (s^2+2s)(s^2+10s+24) + K = 0$$

$$s^4 + 12s^3 + 44s^2 + 48s + K = 0$$

$$\therefore \frac{dK}{ds} = -[4s^3 + 36s^2 + 88s + 48] = 0$$

$$s = \boxed{-5.23, \; -0.764}, \; -3.$$

Critical freq and gain C.E is given by

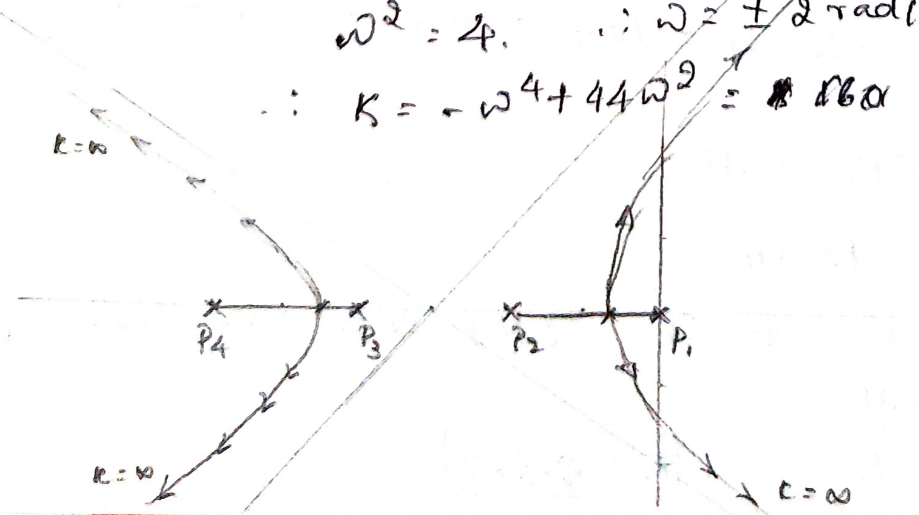
$$s^4 + 12s^3 + 44s^2 + 48s + K = 0 \qquad \text{Put } s = j\omega$$

$$\therefore \omega^4 - j12\omega^3 - 44\omega^2 + j48\omega + K = 0$$

$$[\omega^4 - 44\omega^2 + K] + j[-12\omega^3 + 48\omega] = 0$$

$$\omega^2 = 4. \quad \therefore \omega = \pm 2 \text{ rad/s}$$

$$\therefore K = -\omega^4 + 44\omega^2 = 160 \qquad \boxed{K = 160}$$



2) $G(s)H(s) = \frac{K e^{-0.1s}}{s(1+0.1s)(1+s)}$

log magnitude plot

Factor	Corner freq.	Ind. slope	Cum. slope
$\frac{1}{s}$	—	-20	-20
$\frac{1}{1+s}$	1	-20	-40
$\frac{1}{(1+0.1s)}$	10	-20	-60

$\therefore \omega_s = 0.1 \qquad S = 20\log(1/0.1) = 20\,db$

Phase angle plot Put $s = j\omega$

$$G(j\omega) = \frac{K e^{-j0.1\omega}}{(0+j\omega)(1+j0.1\omega)(1+j\omega)}$$

Consider $e^{-j0.1\omega} = \cos 0.1\omega - j\sin(0.1\omega)$

$$\therefore \phi = \tan^{-1}\left(-\frac{\sin 0.1\omega}{\cos 0.1\omega}\right) = -0.1\omega = -0.1\omega \times \frac{180}{\pi}$$

$$= -5.73\omega$$

$$\therefore \phi(\omega) = -5.73\omega - 90 - \tan^{-1}(0.1\omega) - \tan^{-1}(\omega)$$

ω	0.1	0.2	0.5	1	2	5	3
$\phi(\omega)$	-96.8	-103.6	-122.29	-146.4	-176.2	-223.9	-195.4

Ans: K = ? for GM = 20db

for K = 1 GM = 15 db

for GM to be 20 db. LMS should move down by 5db

$\therefore 20\log K = -5 \qquad \therefore \boxed{K = 0.562}$

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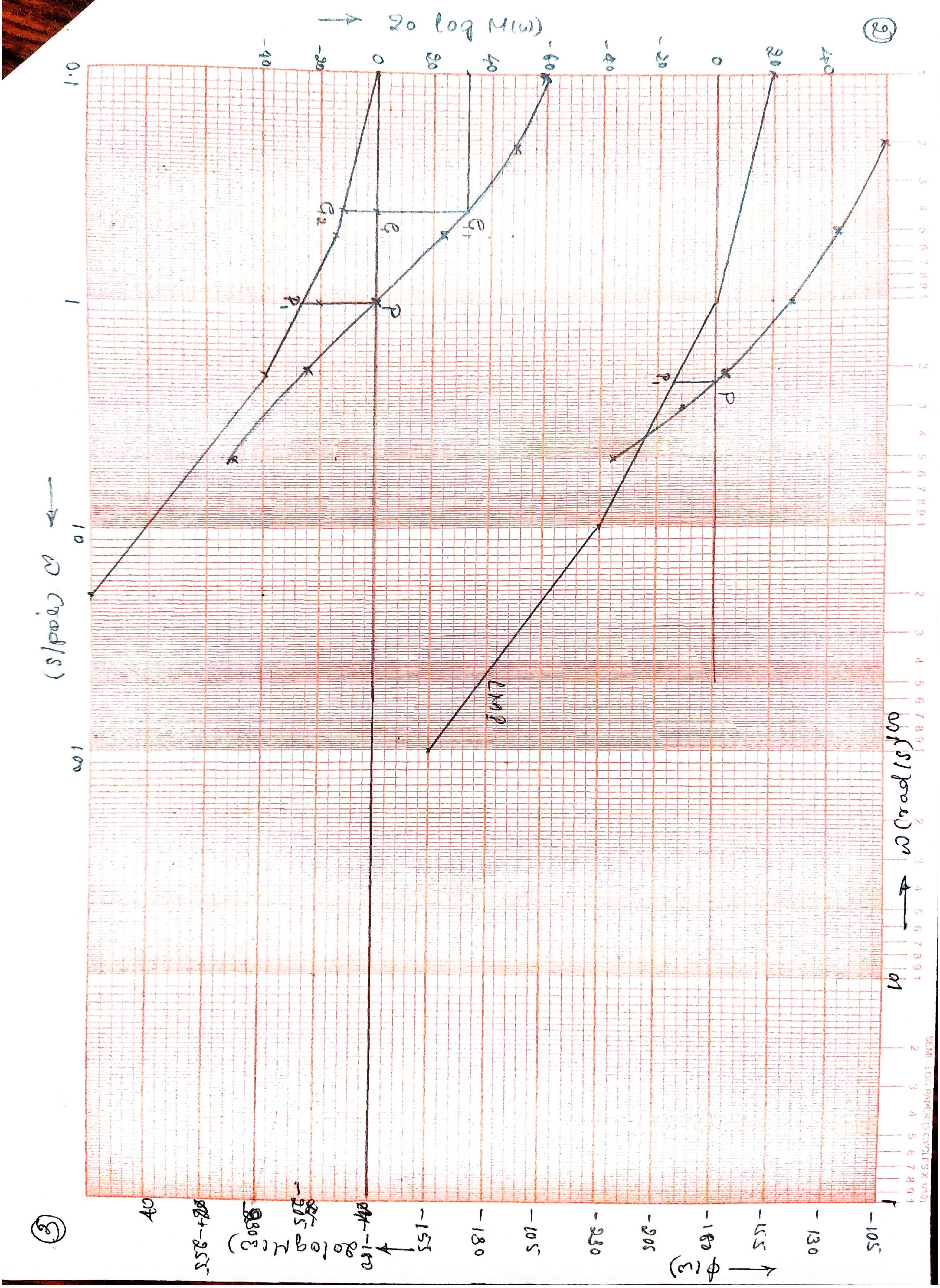

20 log M(ω)
ω (rad/s)
φ(ω)
LMP