SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of Chemical Engineering			LP: CH18603
~~B.E~~/B.Tech/~~M.E/M.Tech~~ :Chemical Engineering		Regulation:2018A	Rev. No: 00
PG Specialisation	: NA		Date:
Sub. Code / Sub. Name	: CH18603 Process Instrumentation, Dynamics and Control		02/01//2024
Unit	: I		

Unit Syllabus: INSTRUMENTATION

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

Objective: To introduce the field measuring instruments and their Principles.

Session No *	Topics to be covered	Ref	Teaching Aids
1	Introduction of control systems and applications in process industries	R1-ch.1; pg. 1	PPT/ BB
2	Components of control system and role of each component	R1-Ch.1; pg. 1-3	PPT/ BB
3	Principles of measurements and classification of process instruments	T1-ch.1; pg. 1	PPT/ BB
4	Principles and classification of Temperature measurement Devices.	T1-Ch.1; pg. 1-3	PPT/ BB
5	Principles and classification of Pressure measurement Devices	T1-Ch.2; pg.4-13	PPT/ BB
6	Principles and classification of Fluid flow measurement devices	T1-Ch.3; pg.1-07	PPT/ BB
7	Principles and classification of liquid weight and weight flow rate measurement Devices.	T1-Ch.3; pg.1-07	PPT/ BB
8	Viscosity, pH	R3-Ch10, Pg 316,	PPT/ BB
9	concentration measurements	R3- Ch6, Pg 180,	PPT/ BB
10	Electrical and Thermal Conductivity measurement	R3-Ch6, Pg 168	PPT/ BB
11	Measurement of Humidity of gases	R3-Ch6, Pg 171	PPT/ BB
12	Composition measurements by physical properties and spectroscopy methods for online measurement	-	PPT/ BB
Content beyond syllabus covered (if any): Composition measurements by physical properties and spectroscopy methods			

* Session duration: 50 minutes

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Sub. Code / Sub. Name: : CH18603 – PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL

Unit : II

Unit Syllabus: OPEN LOOP SYSTEMS

Laplace transformation and its application in process control. First order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

Objective: To analysis the static and dynamic behavior of chemical processing system and models employed through the use of Laplace transforms.

Session No *	Topics to be covered	Ref	Teaching Aids
13	Introduction to Chemical Process control and Instrumentation	T2-Ch.1; pg.1-11	PPT/ BB
14	Theorems in Laplace transformation, Derivatives, Integrals and Inversion of standard functions	T2-Ch.2; Pg18-25	PPT/ BB
15	Open loop systems, physical examples of first Order systems	T2-Ch.5; pg.69 & 99	PPT/ BB
16	Transient behavior of standard input functions	T2-Ch.4; pg.69-87	PPT/ BB
17	First Order systems in Series-Interacting types	T2-Ch.6; pg.123-125	PPT/ BB
18	First Order systems in Non-Interacting types	T2-Ch.6; pg.126-128	PPT/ BB
19	Problems on Interacting type and Non-Interacting types first order systems	T2-Ch.6; pg.123-128	PPT/ BB
20	Linearization and its application in process control	T2-Ch.5; pg.109	PPT/ BB
21	Case studies and problems on linearization	T2-Ch.5; pg.109-112	PPT/ BB
22	Second order systems and their dynamics with an example and its response to standard forcing functions	T2-Ch.7; pg.137-152	PPT/ BB
23	Transportation lag	T2-Ch.7; pg.153	PPT/ BB
24	Development of transfer functions for chemical reactors and its Transient behavior of standard input function		PPT/ BB

Content beyond syllabus covered (if any): Development of transfer functions for chemical reactors and its Transient behavior of standard input function

* Session duration: 50 mins

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Sub. Code / Sub. Name: : CH18603 – PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL

Unit : III

Unit Syllabus: CLOSED LOOP SYSTEMS

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers.

Objective: To develop block diagram using transfer functions for closed loop systems and stability analysis

Session No *	Topics to be covered	Ref	Teaching Aids
25	Introduction to closed loop control systems	T2-Ch.11; pg.218-219	PPT/ BB
26	Development of block diagram for feed-back control systems- servo problems	T2-Ch.12; pg.228-229	PPT/ BB
27	Development of block diagram for feed-back control systems – regulator problems	T2-Ch.12; pg.229-234	PPT/ BB
28	Servo and regulatory problems in closed systems	T2-Ch.12; pg.236-241	PPT/ BB
29	Development of transfer function for ON-OFF, P controller	T2-Ch.10; pg.211-212	PPT/ BB
30	Development of transfer function for PI , PD and PID Controllers	T2-Ch.10; pg.212-213	PPT/ BB
31	Problems on development and simplification of transfer functions with controller	T2-Ch.10; pg.211-213	PPT/ BB
32	Development of transfer function for final control element	T2-Ch.10; pg.209	PPT/ BB
33	Problems on development and simplification of transfer functions with FCE	T2-Ch.10; pg.209	PPT/ BB
34	Principles of pneumatic controllers	T2-Ch.9; pg.186	PPT/ BB
35	Principles of electronic controllers	T2-Ch.7; pg.187	PPT/ BB
36	Analytical method stability analysis by Routh test	-	PPT/ BB

Content beyond syllabus covered (if any): Analytical method stability analysis by Routh test

* Session duration: 50 mins

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Sub. Code / Sub. Name: : CH18603 – PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL

Unit : IV

Unit Syllabus: **FREQUENCY RESPONSE** - Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controllers Z-N tuning rules, C-C tuning rules.

Objective: Emphasis on Frequency Response Analysis and its application in feedback controller settings

Session No *	Topics to be covered	Ref	Teaching Aids
37	Introduction to frequency response of closed-loop systems	T2-Ch.15; pg.285-287	PPT/ BB
38	Control system design by frequency response method	T2-Ch.15; pg.285-287	PPT/ BB
39	Stability analysis using bode diagram	T2-Ch.15; pg.300-311	PPT/ BB
40	Bode diagram for first order system.	T2-Ch.15; pg.300-310	PPT/ BB
41	Bode diagram for second order system.	T2-Ch.15; pg.310-316	PPT/ BB
42	Bode diagram for PI and PD Controllers	T2-Ch.15; pg.312-315	PPT/ BB
43	Bode diagram for PID Controllers	T2-Ch.15; pg.312-315	PPT/ BB
44	Problems in stability criterion of bode diagram	T2-Ch.16; pg.326-327	PPT/ BB
45	Tuning of controller settings using Ziegler-Nichols rules	T2-Ch.18; pg.394-396	PPT/ BB
46	Tuning of controller settings using Cohen-Coon method	T2-Ch.18; pg.397-401	PPT/ BB
47	Problems in stability and controller tuning	T2-Ch.18; pg.404-409	PPT/ BB
48	Stability analysis using Nyquist diagram		PPT/ BB

Content beyond syllabus covered (if any): Stability analysis using Nyquist diagram

* Session duration: 50 mins

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Sub. Code / Sub. Name: : CH18603 – PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL

Unit : V

Unit Syllabus: **ADVANCED CONTROL SYSTEMS**
Introduction to advanced control systems, cascade control, feed forward control, Smith predictor, control of distillation towers and heat exchangers, introduction to computer control of chemical processes.

Objective: Analysis and Design of advanced control systems, cascade control of chemical processes

Session No *	Topics to be covered	Ref	Teaching Aids
49	Controller mechanism, introduction to advanced control systems	T2-Ch.17; pg.353	PPT/ BB
50	Cascade control with an example and development of block diagram for servo problems	T2-Ch.17; pg.353	PPT/ BB
51	Cascade control with an example and development of block diagram for regulator problems	T2-Ch.17; pg.353	PPT/ BB
52	Feed forward control with an example development of block diagram for servo problem	T2-Ch.17; pg.354-357	PPT/ BB
53	Feed forward control with an example development of block diagram for regulator problem	T2-Ch.17; pg.358-360	PPT/ BB
54	Smith predictor with an example development of block diagram for servo and regulator problem	T2-Ch.17; pg.373-376	PPT/ BB
55	Control of distillation towers	R1-Ch.17; pg.01-52	PPT/ BB
56	Different control techniques used in distillation control	R1Ch.17; pg.01-52	PPT/ BB
57	Control of heat exchangers	R1-Ch.17; pg.01-52	PPT/ BB
58	Control systems and strategies used in process industries	R1-Ch.17; pg.01-52	PPT/ BB
59	Introduction to computer control of chemical processes.	T2-Ch.26; pg.581-595	PPT/ BB
60	Advance control systems based on machine learning &Importance of microprocessors in control system studies	-	PPT/ BB

Content beyond syllabus covered (if any): Importance of microprocessors in control system studies

* Session duration: 50 mins

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Sub Code / Sub Name: : CH18603 – PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL

TEXT BOOKS:

1. Singh S K, Industrial Instrumentation and control, 3rd Ed., Tata McGraw-Hill Publishing Co.,2006.

2. Donald R. Coughanowr, "Process Systems Analysis and Control", 3rd Ed, McGraw Hill, New York, 2008.

REFERENCES:

1. George Stephanopoulos, "Chemical Process Control ",2nd Ed., Prentice Hall of (I) Ltd., New Delhi, 2003.

2. Bequette, B. W., "Process Control: Modeling, Design, and Simulation", Prentice Hall, 2003

3. Donald.P. Eckman, "Industrial Instrumentation", CBS Publishers & Distributors, New Delhi, 2006

* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD

	Prepared by	Approved by
Signature	SRJ	N. Meyyappan 2/1/24
Name	Dr.S.Rajasekar	Dr.N.Meyyappan
Designation	Assistant Professor	Professor and Head / CHE
Date	02/01/2024	02/01/2024
Remarks *:		