List of Revised Courses

Department : *Chemical Engineering*

Programme Name : *B.Tech. and M.Tech.*

Academic Year : 2021-22

List of Revised Courses

Sr. No.	Course Code	Name of the Course
01.	CH203TPC01	Material and Energy Balance Calculations
02.	CH203TPC02	Fluid Mechanics
03.	CH203TPC03	Thermodynamics-I
04.	CH204TBS07	Numerical Methods in Chemical Engineering
05.	CH204TPC04	Thermodynamics-II
06.	CH204TPC05	Particle and Fluid Particle Processing
07.	CH204TPC06	Process Instrumentation
08.	CHPATT3	Advanced Fluidization Engineering
09.	CHPATP3	Advanced Chemical Process Modeling
10.	CHPATP4	Advanced Process Control
11.	CHPATP5	Process Intensification
12.	CHPBTP5	Industrial Process Control

Minutes of Meetings (MoM) of Board of Studies (BoS)

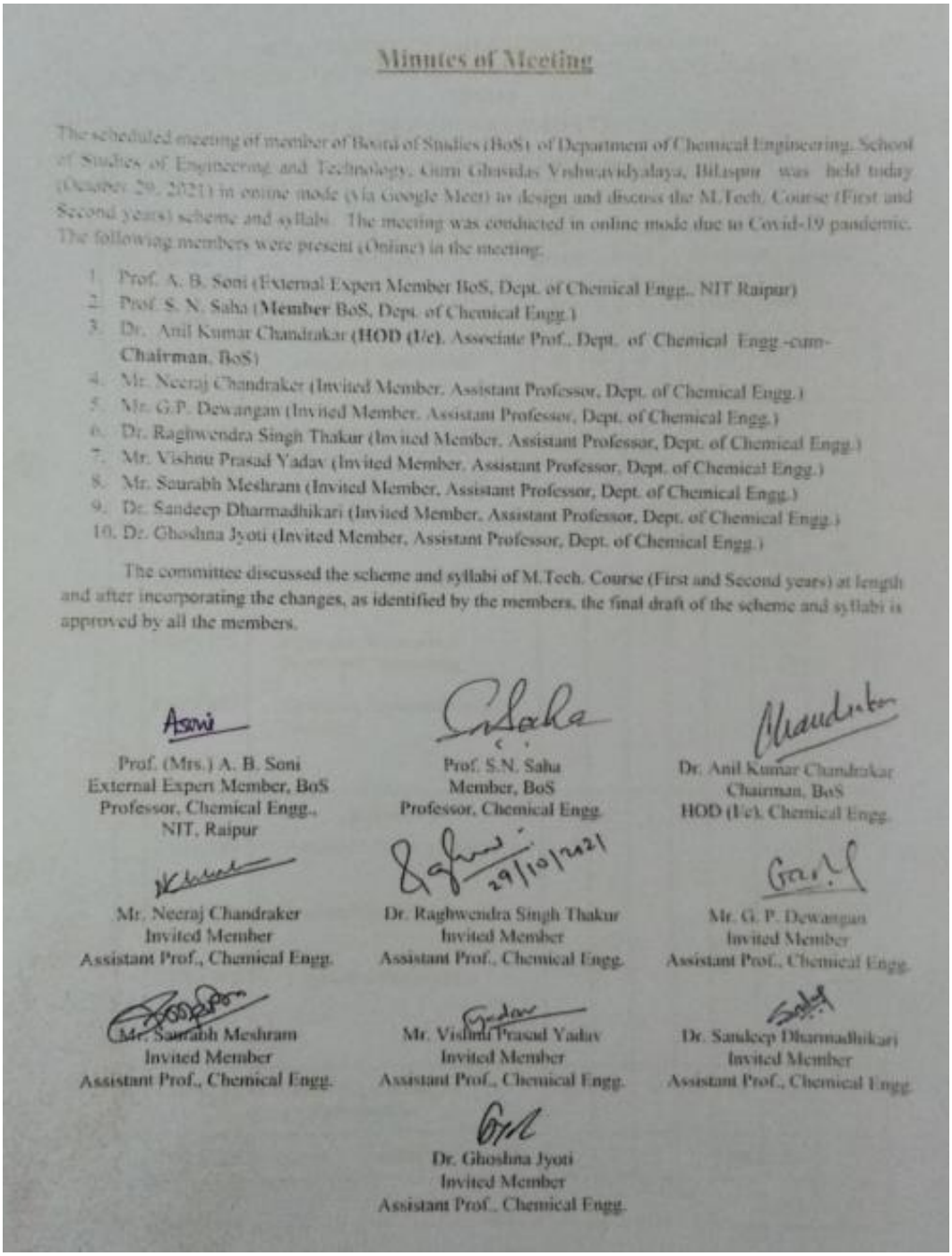
Academic Year : 2021-22

School : *School of Studies of Engineering and Technology*

Department : *Chemical Engineering*

Date and Time : *October 29, 2021 (M.Tech.) & October 1, 2021 (B.Tech.)*

Venue : *Online*



Minutes of Meeting

The scheduled meeting of member of Board of Studies (BoS) of Department of Chemical Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur was held today (October 29, 2021) in online mode (Via Google Meet) to design and discuss the M.Tech. Course (First and Second years) scheme and syllabi. The meeting was conducted in online mode due to Covid-19 pandemic. The following members were present (Online) in the meeting:

1. Prof. A. B. Soni (External Expert Member BoS, Dept. of Chemical Engg., NIT Raipur)
2. Prof. S. N. Saha (**Member** BoS, Dept. of Chemical Engg.)
3. Dr. Anil Kumar Chandrakar (**HOD (I/c)**, Associate Prof., Dept. of Chemical Engg.-cum-**Chairman**, BoS)
4. Mr. Neeraj Chandraker (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
5. Mr. G.P. Dewangan (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
6. Dr. Raghwendra Singh Thakur (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
7. Mr. Vishnu Prasad Yadav (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
8. Mr. Saurabh Meshram (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
9. Dr. Sandeep Dharmadhikari (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
10. Dr. Ghoshna Jyoti (Invited Member, Assistant Professor, Dept. of Chemical Engg.)

The committee discussed the scheme and syllabi of M.Tech. Course (First and Second years) at length and after incorporating the changes, as identified by the members, the final draft of the scheme and syllabi is approved by all the members.

Prof. (Mrs.) A. B. Soni
External Expert Member, BoS
Professor, Chemical Engg.,
NIT, Raipur

Prof. S.N. Saha
Member, BoS
Professor, Chemical Engg.

Dr. Anil Kumar Chandrakar
Chairman, BoS
HOD (I/c), Chemical Engg.

Mr. Neeraj Chandraker
Invited Member
Assistant Prof., Chemical Engg.

Dr. Raghwendra Singh Thakur
Invited Member
Assistant Prof., Chemical Engg.

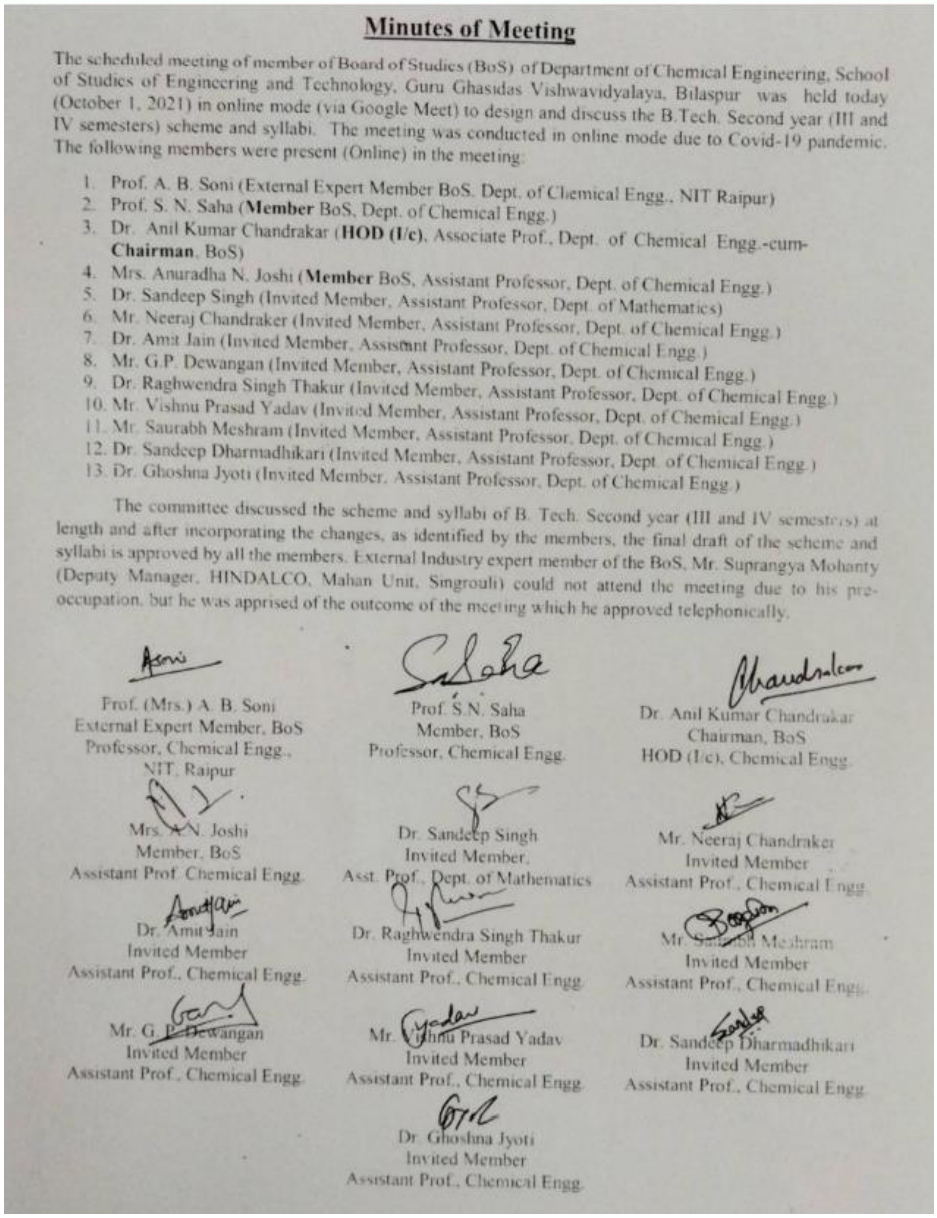
Mr. G. P. Dewangan
Invited Member
Assistant Prof., Chemical Engg.

Mr. Saurabh Meshram
Invited Member
Assistant Prof., Chemical Engg.

Mr. Vishnu Prasad Yadav
Invited Member
Assistant Prof., Chemical Engg.

Dr. Sandeep Dharmadhikari
Invited Member
Assistant Prof., Chemical Engg.

Dr. Ghoshna Jyoti
Invited Member
Assistant Prof., Chemical Engg.



Minutes of Meeting

The scheduled meeting of member of Board of Studies (BoS) of Department of Chemical Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur was held today (October 1, 2021) in online mode (via Google Meet) to design and discuss the B.Tech. Second year (III and IV semesters) scheme and syllabi. The meeting was conducted in online mode due to Covid-19 pandemic. The following members were present (Online) in the meeting:

1. Prof. A. B. Soni (External Expert Member BoS, Dept. of Chemical Engg., NIT Raipur)
2. Prof. S. N. Saha (**Member** BoS, Dept. of Chemical Engg.)
3. Dr. Anil Kumar Chandrakar (**HOD (I/c)**, Associate Prof., Dept. of Chemical Engg.-cum-**Chairman**, BoS)
4. Mrs. Anuradha N. Joshi (**Member** BoS, Assistant Professor, Dept. of Chemical Engg.)
5. Dr. Sandeep Singh (Invited Member, Assistant Professor, Dept. of Mathematics)
6. Mr. Neeraj Chandraker (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
7. Dr. Amit Jain (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
8. Mr. G.P. Dewangan (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
9. Dr. Raghwendra Singh Thakur (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
10. Mr. Vishnu Prasad Yadav (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
11. Mr. Saurabh Meshram (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
12. Dr. Sandeep Dharmadhikari (Invited Member, Assistant Professor, Dept. of Chemical Engg.)
13. Dr. Ghoshna Jyoti (Invited Member, Assistant Professor, Dept. of Chemical Engg.)

The committee discussed the scheme and syllabi of B. Tech. Second year (III and IV semesters) at length and after incorporating the changes, as identified by the members, the final draft of the scheme and syllabi is approved by all the members. External Industry expert member of the BoS, Mr. Suprangya Mohanty (Deputy Manager, HINDALCO, Mahan Unit, Singrouli) could not attend the meeting due to his pre-occupation, but he was apprised of the outcome of the meeting which he approved telephonically.

Prof. (Mrs.) A. B. Soni
External Expert Member, BoS
Professor, Chemical Engg.,
NIT, Raipur

Prof. S.N. Saha
Member, BoS
Professor, Chemical Engg.

Dr. Anil Kumar Chandrakar
Chairman, BoS
HOD (I/c), Chemical Engg.

Mrs. A.N. Joshi
Member, BoS
Assistant Prof. Chemical Engg.

Dr. Sandeep Singh
Invited Member,
Asst. Prof., Dept. of Mathematics

Mr. Neeraj Chandraker
Invited Member
Assistant Prof., Chemical Engg.

Dr. Amit Jain
Invited Member
Assistant Prof., Chemical Engg.

Dr. Raghwendra Singh Thakur
Invited Member
Assistant Prof., Chemical Engg.

Mr. Saurabh Meshram
Invited Member
Assistant Prof., Chemical Engg.

Mr. G. P. Dewangan
Invited Member
Assistant Prof., Chemical Engg.

Mr. Vishnu Prasad Yadav
Invited Member
Assistant Prof., Chemical Engg.

Dr. Sandeep Dharmadhikari
Invited Member
Assistant Prof., Chemical Engg.

Dr. Ghoshna Jyoti
Invited Member
Assistant Prof., Chemical Engg.

The following courses were revised in the of B. Tech. Second year (III and IV Semesters) and M. Tech.:

- Material and Energy Balance Calculations (CH203TPC01)
- Fluid Mechanics (CH203TPC02)
- Thermodynamics-I (CH203TPC03)
- Numerical Methods in Chemical Engineering (CH204TBS07)
- Thermodynamics-II (CH204TPC04)
- Particle and Fluid Particle Processing (CH204TPC05)
- Process Instrumentation (CH204TPC06)
- Advanced Fluidization Engineering (CHPATT3)
- Advanced Chemical Process Modeling (CHPATP3)
- Advanced Process Control (CHPATP4)

- Process Intensification (CHPATP5)
- Industrial Process Control (CHPBTP5)

The following new courses were introduced in the of B. Tech. Second year (III and IV Semesters) and M. Tech.:

Advanced Separation Processes (CHPATT2)

- Bioprocess Engineering (CHPATP6)
- Research Methodology and IPR (CHPATC1)
- Advance Transport Phenomena (CHPBTT1)
- Computational Fluid Dynamics (CHPBTP1)
- Fuell Cell Technology (CHPBTP2)
- Process Plant Design & Flow Sheeting (CHPBTP3)
- Business Analytics (MSPBTO1)
- Industrial Safety (IPPBTO3)
- Cost Management of Engineering Projects (CEPBTO4)
- Composite Materials (MEPBTO5)
- Waste to Energy (CHPBTO7)
- Internet of Things (ECPBTO7)
- Advanced Chemical Engineering Lab (CHPBLT01)
- English for Research Paper Writing (ELPBTX1)
- Stress Management by Yoga (PEPBTX2)
- Disaster Management (CEPBTX3)
- Constitution of India (LAPBTX4)

विभागाध्यक्ष, रासायनिक अभियांत्रिकी
HoD, Chemical Engineering
प्रौद्योगिकी संस्थान/Institute of Technology
गुरु घासीदास विश्वविद्यालय, बिलासपुर (छ.ग.)
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

Signature & Seal of HoD

Scheme and Syllabus

DEPARTMENT OF CHEMICAL ENGINEERING
SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY, GGV, BILASPUR, C.G.
(INDIA)

SCHEME OF EXAMINATION

M.TECH. CHEMICAL ENGINEERING

M.Tech. I-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	CHPATT1	Advanced Heat Transfer	3	0	0	40	60	100	3
2.	CHPATT2	Advanced Separation Processes New Course	3	0	0	40	60	100	3
3.	CHPATT3	Advanced Fluidization Engineering	3	0	0	40	60	100	3
4.		Elective – I	3	0	0	40	60	100	3
	CHPATP1	Advanced Reaction Engineering New Course							
	CHPATP2	Advanced Wastewater Treatment Technology							
	CHPATP3	Advanced Chemical Process Modeling							
5.		Elective – II	3	0	0	40	60	100	3
	CHPATP4	Advanced Process Control							
	CHPATP5	Process Intensification							
	CHPATP6	Bioprocess Engineering New Course							
6.	CHPALT1	Chemical Engineering Computational Lab	0	0	4	30	20	50	2
7.	CHPATC1	Research Methodology and IPR New Course	2	0	0	-	50	50	2
Total								600	19

M.Tech. II-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week L	T	P	Evaluation IA	ESE	Total	Credits
1.	CHPBTT1	Advanced Transport Phenomena New Course	3	0	0	40	60	100	3
2.	CHPBTT2	Chemical Reactor Design	3	0	0	40	60	100	3
3.		Elective – III	3	0	0	40	60	100	3
	CHPBTP1	Computational Fluid Dynamics New Course							
	CHPBTP2	Fuel Cell Technology New Course							
	CHPBTP3	Process Plant Design & Flow Sheeting New Course							
4.		Elective – IV	3	0	0	40	60	100	3
	CHPBTP4	Design & Development of Catalyst							
	CHPBTP5	Industrial Pollution Control							
	CHPBTP6	Safety Hazards & Risk Analysis							
5		Open Elective	3	0	0	40	60	100	3
	MSPBTO1	1. Business Analytics New Course							
	IPPBTO2	2. Industrial Safety New Course							
	IPPBTO3	3. Operations Research							
	CEPBTO4	4. Cost Management of Engineering Projects New COurse							
	MEPBTO5	5. Composite Materials New Course							
	CHPBTO6	6. Waste to Energy New Course							
	ECPBTO7	7. Internet of Things New Course							
	MCPBTO8	8. MOOCs							
6.	CHPBLT1	Advanced Chemical Engineering Lab New Course	0	0	4	30	20	50	2
7.	CHPBPT1	Mini Project	0	0	4	30	20	50	2
8.		Audit Course/Value Added Course	2	0	0	0	0	0	0
	ELPBTX1	English for Research Paper Writing New Course							
	PEPBTX2	Stress Management by Yoga New Course							
	CEPBTX3	Disaster Management New Course							
	LAPBTX4	Constitution of India New Course							
Total								600	19

Note: Under MOOCs the students have to opt any subject other than Chemical Engineering from NPTEL/UGC SWAYAM

M.Tech. III-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week L	T	P	Evaluation IA	ESE	Total	Credits
1.	CHPCPT1	Dissertation Stage–I	0	0	28	100	100	200	14
Total								200	14

M.Tech. IV-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week L	T	P	Evaluation IA	ESE	Total	Credits
1.	CHPDPT1	Dissertation Stage–II	0	0	32	100	200	300	16
Total								300	16

Total Credits for the Program = 19 + 19 +14 +16 = 68

SUBJECT CODE	SUBJECT NAME	L:T:P	CREDIT
CHPATT3	ADVANCED FLUIDIZATION ENGINEERING	3:0:0	3

Course Objective :

- To study the phenomenon of fluidization with industrial processing objective
- To study the various regimes of fluidization and their mapping
- To study the design of equipments based on fluidization technique

70% Change

Course Content:

Introduction to fluidization and applications: Phenomenon of fluidization, behavior of fluidized bed, contacting modes, advantages and disadvantages of fluidization, fluidization quality, selection of contacting mode, Fluidized Beds for Industrial Applications like coal gasification, synthesis reactions, physical operations, cracking of hydrocarbons. Mapping of fluidization regimes: Characterization of particles, mechanics of flow around single particles, minimum fluidization velocity, pressure drop versus velocity diagram, The Geldart classification of solids, fluidization with carryover of particles, terminal velocity of particles, distributor types, gas entry region of bed, pressure drop requirements, various distributor plates, design of distributor plate. Bubbling fluidized beds: Davidson model for gas flow at bubbles in a fluidized bed, the wake region and movement of solids at bubbles, coalescence and splitting of bubbles, bubble formation above a distributor, slug flow, Turbulent and fast fluidization - mechanics, flow regimes and design equations, Emulsion movement, estimation of bed properties, bubble rise velocity, scale up aspects, flow models, two phase model, K-L model. Solids movement and Gas dispersion: Vertical and horizontal movement of solids, Dispersion model, large solids in beds of smaller particles, staging of fluidized beds Gas dispersion in beds, gas interchange between bubble and emulsion, estimation of gas interchange coefficient, Heat and mass transfer *in fluidized systems*, Mixing in fluidized systems - measurements and models. Entrainment or Elutriation of Fluidized Beds , Reactors : Entrainment and elutriation, Freeboard behavior, gas outlet, entrainment from tall vessel, freeboard entrainment model, high velocity fluidization, pressure drop in turbulent and fast fluidization, Slugging, Spouted beds, Circulating Fluidized Beds. Mathematical model of a homogeneous fluidized bed, Design of catalytic reactors, pilot plant reactors, information for design, bench scale reactors, design decisions, deactivating catalysts, Design of no catalytic reactors, kinetic models for conversion of solids, models for shrinking particles, conversion of solids of unchanging size

Course Outcomes :

At the end of the course, the student will be able to:

- Performing and understanding the behavior fluidization in fluidized bed
- Evaluate the characterization of particles and power consumption in fluidization regimes
- Understanding the applicability of the fluidized beds in chemical industries

SUBJECT CODE	SUBJECT NAME	L:T:P	CREDIT
CHPATP3	ADVANCED CHEMICAL PROCESS MODELLING	3:0:0	3

Course Objective :

90% Change

- To understand the systematic approaches for the development of modelling
- To understand the mathematical modelling of chemical processes

Course Contents :

Introduction to Modelling: a systematic approach to model building, classification of models. Development of steady state and dynamic, lumped and distributed parameter models based on conservation principles. Models based on Transport Phenomenon Principles: molecular description, microscopic and macroscopic description, multiple and maximum gradient description, boundary conditions. Classification of transport phenomena models: Terminology of mathematical models, alternate classification of mathematical models, integral representation of models. Population balance models: Description of flow pattern of flow pattern vessels, Age distribution functions, general population balance models, combined models.

Course Outcome :

After learning the course, the students will be able to:

- To apply the suitable modelling approach for given problem
- Analyze the terminology of mathematical models
- Develop a mathematical model based on transport phenomenon and population balance for chemical processes

Texts Books :

1. Process Plant Simulation by B. V. Babu, Oxford University Press, 2004.
2. Process Analysis and Simulation deterministic system, David M. Himmelblau, John Wiley & Sons,

Reference Books :

- Denn M. M., Process Modelling, John Wiley
- Rutherford Aris, Mathematical Modelling, A Chemical Engineer's Perspective (Process Systems Engineering), Academic Press
- M. Chidambaram, Mathematical Modelling and Simulation in Chemical Engineering, Cambridge University Press
- Verma Ashok Kumar, Process Modelling and Simulation in Chemical, Biochemical and Environmental Engineering, CRC Press
- Elnashaie S.E.H., Garhyan Parag, Conservation Equations and Modelling of Chemical and Biochemical Processes, , Marcel Dekker Publishers
- Hangos K.M. and Cameron I.T., Process Modelling and Model Analysis, Academic Press

SUBJECT CODE	SUBJECT NAME	L:T:P	CREDIT
CHPATP4	ADVANCED PROCESS CONTROL	3:0:0	3

90%

Course Objective :

- Expose the students to the advanced control methods used in industries and research
- To analyze the system to adapt a control strategy
- Analyze the functioning of different control strategy and tuning of controllers
- To introduce to the concept of advanced control strategy for process

Course Content :

Review of Systems: Review of first and higher order systems, closed and open loop response. Response to step, impulse and sinusoidal disturbances. Transient response. Block diagrams. Stability Analysis: Frequency response, design of control system, controller tuning and process identification. Zigler-Nichols and Cohen-Coon tuning methods, Bode and Nyquist stability criterion. Process identification.Advanced Control Strategies: Special Control Techniques: Advanced control techniques, cascade, ratio, feed forward, adaptive control, Smith predictor, internal model control automatic tuning and gain scheduling. Multivariable Control Analysis: Introduction to state-space methods, , Control degrees of freedom analysis and analysis, Interaction, Bristol arrays, Niederlinski index - design of controllers, Tuning of multivariable controllers. Sample Data Controllers: Basic review of Z transforms, Response of discrete systems to various inputs. Open and closed loop response to step, impulse and sinusoidal inputs, closed loop response of discrete systems. Design of digital controllers. Introduction to PLC and DCS.

Course Outcomes :

At the end of the course, the student will be able to:

- Controller tuning
- Type of controller that can be used for specific problems in chemical industry
- Design of controllers for interacting multivariable systems
- Design of digital control systems

Texts Books :

- Bequette B.W., Process Control: Modelling, Design and Simulation, PHI
- Seborg D.E., Edger T.F., and Millichamp D.A., Process Dynamics and Control, John Wiley and Sons

Reference Books :

- Ogunnaike B.A. and Ray W.H., Process Dynamics, Modelling and Control, Oxford Press
- Luyben W.L., Process Modelling Simulation and Control for Chemical Engineers, McGraw Hill
- Bhanot S., Process Control: Principles and Applications, Oxford University Press
- Coughanour D.R., Process Systems analysis and Control, McGraw-Hill

SUBJECT CODE	SUBJECT NAME	L:T:P	CREDIT
CHPATP5	PROCESS INTENSIFICATION	3:0:0	3

Course Objective :

- Understand the concept of Process Intensification
- Know the limitations of intensification of the chemical processes
- Apply the techniques of intensification to a range of chemical processes
- Develop various process equipment used for intensifying the processes
- Infer alternative solutions keeping in view point, the environmental protection, economic viability and social acceptance

80% Change

Course Content :

Introduction of Process Intensification (PI), Process Intensifying Equipment, Process intensification toolbox, Techniques for PI application, Process Intensification through Micro Reaction Technology, Inherent Process Restrictions in Miniaturized Devices and Their Potential, Scales of Mixing, Flow Patterns in Reactors, Mixing in Stirred Tanks, Mixing in intensified equipment, Chemical Processing in High-Gravity Fields Atomizer Ultrasound Atomization, Nebulizers, High intensity inline MIXERS reactors Static mixers, Rotor stator mixers, Design Principles of static Mixers, Classification of compact heat exchangers, Plate heat exchangers, Spiral heat exchangers, Flow pattern, Heat transfer and pressure drop, Flat tube-and-fin heat exchangers, Microchannel heat exchangers, Phase-change heat transfer, Selection of heat exchanger technology, Feed/effluent heat exchangers, Integrated heat exchangers in separation processes, Design of compact heat exchanger – example, Energy based intensifications, Sono-chemistry, Basics of cavitation, Cavitation *Reactors*, Cavitation reactor design, Nusselt-flow model and mass transfer, The Rotating Electrolytic Cell, Microwaves, Electrostatic fields, Reactive separations, Supercritical fluids.

Course Outcomes :

At the end of the course, the student will be able to:

- Assess the values and limitations of process intensification, cleaner technologies and waste minimization options
- Measure and monitor the usage of raw materials and wastes generating from production and frame the strategies for reduction, reuse and recycle
- Obtain alternative solutions ensuring a more sustainable future based on environmental protection, economic viability and social acceptance
- Analyze data, observe trends and relate this to other variables
- Plan for research in new energy systems, materials and process intensification

Department of Chemical Engineering, GGV — M.Tech-2021-22

SUBJECT CODE	SUBJECT NAME	L:T:P	CREDIT
CHPBTP5	INDUSTRIAL POLLUTION CONTROL	3:0:0	3

Course Objective :

- To understand the importance of industrial pollution and its abatement
- To study the underlying principles of industrial pollution control
- To acquaint the students with case studies
- Student should be able to design complete treatment system

70% Change

Course Content :

Air pollution Sources and Effects, Air pollution laws and standards; Air pollution sampling and measurement from point, non-point, line and area sources, analysis of air pollutants; Air pollution control methods and equipment, Design details of Particulate emission control equipments like Gravitational settling Chamber, Cyclone Separator, Fabric Filter, Electrostatic Precipitator, Wet scrubber; Case studies of a few industrial pollution control system. Sources, effects and laws of water pollution; BOD, COD; Waste water treatment, Design details of Primary Treatment methods like Pretreatment, Sedimentation, Floatation, Design aspects of Secondary Treatment methods like Activated Sludge Process, Trickling Filter. Design aspects of Advanced waste water treatment including Ion Exchanger, Reverse Osmosis, Electrodialysis, Advanced Biological Systems. Solid Waste Management, design calculation of disposal methods, Incineration, Hazardous Waste Management strategy and treatment methods, landfill closure and underground disposal.

Course Outcome :

After learning the course, the students will be able to:

1. Recognize the causes and effects of environmental pollution
2. Analyze the mechanism of proliferation of pollution
3. Develop methods for pollution abatement and waste minimization
4. Design treatment methods for gas, liquid and solid wastes

Texts Books :

- Schnelle K.B. and Brown C.A., Air Pollution Control Technology Handbook, CRC Press
- Peavy H.S., Rowe D.R. and Tchobanoglous G., Environment Engineering, McGraw-Hill

Reference Books :

- Trivedy R.K. and Goel P.K., An Introduction to Air Pollution, Technoscience Pub.
- Sengar D.S., Environmental Law, PHI
- B. Chawla, Jain A.K., Jain A.K., Waste Water Engineering

29/12/21

total 44% change

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

SCHEME FOR EXAMINATION (Effective from Session 2021-22)
B.TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING
SECOND YEAR, THIRD SEMESTER (AICTE-NEW)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
	THEORY					Sessional			
			L	T	P	IA	ESE	TOTAL	
01.	CH203TBS05	Biology	3	0	0	30	70	100	3
02.	CH203TBS06	Mathematics-III	3	1	0	30	70	100	4
03.	CH203TPC01	Material and Energy Balance Calculations	3	1	0	30	70	100	4
04.	CH203TPC02	Fluid Mechanics	3	1	0	30	70	100	4
05.	CH203TPC03	Thermodynamics-I	3	0	0	30	70	100	3
	PRACTICAL	one subject removed-Engg and Solid Mechanics							
01.	CH203PPC01	Chemical Engineering Lab-I	0	0	3	30	20	50	1.5
02.	CH203PPC02	Fluid Mechanics Lab	0	0	3	30	20	50	1.5
		Total	15	3	6			600	21

IA – Internal Assessment | ESE - End Semester Examination | Total Credits: 21
Total Marks – 600 | Total Periods / week - 24

BoS held on 01.10.2021 | B. Tech. (Chemical Engg.)- II Year | w.e.f : Session 2021-22

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

SCHEME FOR EXAMINATION (Effective from Session 2021-22)
B.TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING
SECOND YEAR, FOURTH SEMESTER (AICTE-NEW)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
	THEORY					Sessional			
			L	T	P	IA	ESE	TOTAL	
01.	CH204THS02	Business Communication and Presentation Skill	3	0	0	30	70	100	3
02.	CH204TBS07	Numerical Methods in Chemical Engineering	3	1	0	30	70	100	4
03.	CH204TPC04	Thermodynamics-II	3	0	0	30	70	100	3
04.	CH204TPC05	Particle and Fluid Particle Processing	3	1	0	30	70	100	4
05.	CH204TPC06	Process Instrumentation	3	1	0	30	70	100	4
	PRACTICAL								
01.	CH204PBS03	Numerical Methods in Chemical Engineering lab	0	0	2	30	20	50	1
02.	CH204PPC03	Particle and Fluid Particle Processing lab	0	0	3	30	20	50	1.5
03.	CH204PPC04	Process Instrumentation Lab	0	0	3	30	20	50	1.5
		Total	15	3	8			650	22

IA – Internal Assessment | ESE - End Semester Examination | Total Credits : 22
Total Marks – 650 | Total Periods / week - 26

BoS held on 01.10.2021 | B. Tech. (Chemical Engg.)- II Year | w.e.f : Session 2021-22

Department of Chemical Engineering 1%

CH203TPC01 Material and Energy Balance Calculations [L:3, T:1, P:0]

Objectives:

The course will serve as a basis for all further chemical engineering courses that are part of the curriculum.

Unit I : Introductory concepts of units, physical quantities in chemical engineering, Dimensionless groups, "basis" of calculations Gases, Vapours and Liquids: Equations of state, Vapour pressure, Clausius Clapeyron equation, Cox chart, Duhring's plot, Raoult's law.

Unit II : Humidity and saturation, humid heat, humid volume, dew point, humidity chart and its use.

Unit III : Material Balance: Introduction, solving material balance problems without chemical reaction, material balances with recycle, bypass and purge, material balance with chemical reaction, concept of stoichiometry and mole balances, examples, including combustion.

Unit IV : Energy Balance: open and closed system, heat capacity, calculation of enthalpy changes.

Unit V : Energy balances with chemical reaction, heat of reaction, heat of combustion.

Suggested Text Books:

1. S. N. Saha, "Chemical Process Engineering Calculation", Dhanpat Rai Publication Co. (Pvt.) Ltd., New Delhi
2. B. I. Bhatt & S. M. Vora, "Stoichiometry", Tata McGraw Hill Publishing Co. Ltd.

Suggested References Books:

1. R. M. Felder & R. W. Rousseau, "Elementary Principles of Chemical Processes", John Wiley & Sons.
2. O. A. Hougen, K. M. Watson & R. A. Ragatz, "Chemical Process Principles, Part I Material & Energy Balances", CBS Publishers & Distributors.
3. D. M. Himmelblau & J. B. Riggs, "Basic Principles and Calculations in Chemical Engineering", Pearson India Education Services.
4. V. Venkataramani, N. Anantharaman, K. M. Begum & S. Meera, "Process Calculations", Prentice Hall of India.
5. D. C. Sikdar, "Chemical Process Calculations", Prentice Hall of India.

Outcomes:

Students completing the course will

- Develop mastery over process calculations relevant to Chemical Engineering Processes
- Be able to handle elementary flow-sheeting, material and energy balance calculations
- Be able to solve problems based on without and with chemical reactions, and involving concepts like recycle, bypass and purge.
- Be familiar with equations of state and properties of gases and liquids, including phase transition.

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70% Change

CH203TPC02 **Fluid Mechanics** **[L:3, T:1, P:0]**

Objectives:

The objective of this course is to introduce the mechanics of fluids (fluid statics and fluid dynamics), relevant to Chemical Engineering operations. The course will impart the knowledge of basic concepts of kinematics of flow, different forces on fluids, flow visualization, flow measurement, flow transportation and types of flow.

Unit I : Fluid Static & Applications: Hydrostatic equilibrium, hydrostatic equilibrium in centrifugal field and its applications in chemical engineering like manometers decanters. Fluid Flow Process: velocity gradient and shear, types of fluids, concept of viscosity, kinematic viscosity, nature of flow- laminar, turbulent, Reynolds number, boundary layer formation and separation.

Unit II : Basic Equations for Fluid Flow: Mass balance & momentum balance equations, Bernoulli's equation without and with corrections for solid boundaries, kinetic energy, friction factor, pump work.

Unit III : Incompressible Fluids : Flow through pipes, flow characteristics- shear stress, friction factor, laminar flow for newtonian fluids, Hagen Poiseuille equation, laminar flow for non-newtonian liquids, turbulent flow through pipes and close channels and its characteristic equations, friction factor and its dependence on roughness, Reynolds number, friction factor for flow through channels of non-circular cross section – concept of equivalent diameter, frictional losses due to sudden change in velocity or direction of flow; expansion, contraction, effect of fittings, flow of liquids in thin layers.

Unit IV : Transportation of Fluids: pipe fitting like bends, elbows, flanges, tee and different types of valves, seals for moving parts, pumps, NPSH, power requirement, types of pumps – centrifugal & positive displacement, trouble shooting in operation – priming & cavitation, characteristic curves – head / capacity / power / efficiency, capacity- head flow and head work relationship, metering of fluids: variable head meters- venturi meter & orifice meter, variable area meter – rotameter, insertion meters – pitot tube.

Unit V : Differential analysis: mass and momentum balances, Navier-Stokes equation, unidirectional flow, viscous flow, Stokes law, skin drag and pressure drag, potential flow, potential function, solution of Laplace equation.

Suggested Text Books :

1. M. White, Fluid Mechanics, Tata-McGraw Hill.
2. V. Gupta & S. K. Gupta, Fundamentals of Fluid Mechanics, New Age International.
3. W. L. McCabe, J. C. Smith & P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill International Edition.

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80% Change

CH203TPC03 **Thermodynamics –I** **[L:3, T:0, P:0]**

Objectives:

Principles and application of first and second law of thermodynamics, and phase equilibria.

UNIT I : Basic Concepts, Definitions & P-V-T Relations: Approaches of thermodynamics, system & its types, types of processes, work, heat, energy. P-V-T relations of fluids: graphical representation of P-V-T behavior, mathematical representation of P-V-T behavior (Ideal gas law, van der Waals, Beattie-Bridgeman, Benedict-Webb-Rubin, Redlich-Kwong, Virial equation of state), generalized compressibility factor correlation, equations of state (Redlich-Kwong, Soave-Redlich-Kwong, Peng-Robinson, Lee-Kesler, Virial coefficient correlation)

UNIT II : First Law of Thermodynamics: First law, calculation of internal energy, enthalpy, heat capacities, application of first law for open and closed systems, Throttling process, Joule – Thompson effect.

UNIT III : Second law of thermodynamics, heat engine, heat pump, refrigerator, Kelvin and Clausious statement, criteria of irreversibility, Carnot theorem, Carnot cycle, Clausious inequality, entropy and its principle, third law of thermodynamics : definition and applications.

UNIT IV : Thermochemistry: Enthalpy, heat of reaction at constant pressure and volume, Hess's law of constant heat summation, effect of temperature on heat of reaction at constant pressure (Kirchoff's equation), heat of dilution, heat of hydrogenation, heat of formation, heat of neutralization and heat of combustion, adiabatic flame temperature.

UNIT V : Equation of state, VLE/LLE equilibrium: Le Chatlier's principle, kinetic theory, vapour-liquid equilibrium in ideal solution, liquid-liquid equilibrium diagrams, equation of state of real gas, principles of corresponding states.

Suggested Text Books :

1. J. M. Smith, H. C. Van Ness & M. M. Abbott, Introduction to Chemical Engineering Thermodynamics, McGraw-Hill International Edition.
2. Y. V. C. Rao, Chemical Engineering Thermodynamics, University Press.
3. K. V. Narayanan, A Textbook of Chemical Engineering Thermodynamics, Prentice Hall of India.

Suggested References Books :

1. R.C. Srivastava, Thermodynamics a core course, PHI publication, India.

Outcomes :

Course outcomes students would be able to :

- Apply mass and energy balances to closed and open systems.
- Evaluate the properties of non-ideal gases.
- Solve problems involving liquefaction, refrigeration and different power cycles.
- Evaluate the enthalpy of reactions of chemical processes.
- Analyse the system of VLE and LLE.

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Students should be able to :
- Communicate properly, write technical letters and reports. 15% Change
- Present reports and seminars in an attractive way.

CH204TBS07 Numerical Methods in Chemical Engineering [L:3, T:1, P:0]

Objectives:

The objective of this subject is to introduce students to numerical methods used to solve engineering problems, in particular chemical engineering problems, using numerical methods and computer programming.

Unit I : Introduction of errors and their analysis, types of errors, numerical problems on error analysis, curve fitting: method of least squares, fittings of straight line and parabola and by method of moments.

Unit II : Numerical Solution of Algebraic and Transcendental Equations: Secant method, Regula-falsi Method, Newton Raphson method, solution of a system of simultaneous linear algebraic equations direct method: Gauss elimination method, iterative methods, Gauss Seidel iterative method.

Unit III : The Calculus of Finite Differences: Finite differences, difference formula, operators and relation between operators, inverse operator, interpolation with equal intervals: - Newton's forward and backward interpolation formula, interpolation with unequal intervals: - Lagrange's interpolation.

Unit IV : Numerical Differentiation and Integration: Numerical differentiation Newton's forward and backward difference interpolation formula. Numerical Integration: Trapezoidol rule, simpson's $1/3^{rd}$ and $3/8^{th}$ rule, Boole's rule, Weddle rule.

Unit V: Numerical solution of ordinary differential equation: Taylor series method, Euler's method, Modified Euler method Range's method Runge-Kutta method.

Books Recommended:

1. Jain & Iyngar, Numerical Methods for Scientific and Engineering Computations.
2. G. S. Rao, Numerical Analysis.
3. B. S. Grewal, Numerical Methods in Engineering and Science.
4. H. K. Das, Advance Engineering Methods.
5. V. Rajaraman, Computer Oriented Numerical Methods

Outcomes:

After successful completion of this course students will be able to solve chemical engineering problems involving linear and non-linear equations and solve ordinary differential equations.

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80% Change

CH204TPC04 **Thermodynamics –II** **[L:3, T:0, P:0]**

Objectives:

To introduce the concepts of fugacity, activity coefficient, vapour-liquid equilibrium and reaction equilibrium.

Unit I : Thermodynamic Potentials : Postulates, intensive properties, criteria of equilibrium, free energy functions and their significances in phase and chemical equilibria, Euler relation, Gibbs-Helmholtz equation, Gibbs free energy minimum principle. Maxwell relations, Various TDS equations, Cp and Cv relations.

Unit II : Thermodynamic Properties of Gases and Liquids : Joule-Thomson coefficient, Clausisus – Clapeyron equations and some important correlations for estimation of vapour pressures, estimation of thermodynamic properties by using equations, graphs and tables.

Unit III : Multicomponent Mixtures : Partial molar properties, partial molar Gibbs free energy, chemical potential and its dependence on temperature and pressure, fugacity and its calculation, dependence of fugacity on temperature & pressure, Gibbs phase rule and its significance.

Unit IV : Properties of Solutions : Ideal solutions (Lewis Randall Rule) phase equilibrium in ideal solutions, phase equilibrium problems, excess properties, Gibbs-Duhem relation, activity & activity coefficient, dependence of activity coefficient on temperature and composition, excess Gibbs free energy models : UNIQUAC and UNIFAC methods, Margules, Van laar, Wilson and NRTL equations, Henry's Law.

Unit V : Chemical Equilibrium : Equilibrium constants in terms of measurable properties, variation of equilibrium constants with temperature and pressure, adiabatic reactions, equilibrium in homogeneous & heterogeneous reactions.

Suggested Text Books

1. J. M. Smith, H. C. Van Ness & M. M. Abbott, Introduction to Chemical Engineering Thermodynamics, McGraw-Hill International Edition.
2. Y. V. C. Rao, Chemical Engineering Thermodynamics, University Press.
3. K. V. Narayanan, A Textbook of Chemical Engineering Thermodynamics, PHI.

Suggested References Books

1. R.C. Srivastava, "Thermodynamics a core course", PHI.
2. P. K. Nag, Engineering Thermodynamics, Tata McGraw Hill.

Outcomes:

Students should be able to understand

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- Application of various equation of state. 5% Change
- Evaluate the equilibrium constant for chemical reactions.

CH204TPC05 Particle and Fluid Particle Processing [L:3, T:1, P:0]

Objectives :

Objective of this course is to introduce students to the numerous industrial operations dealing with the particulate solids, their handling in various unit operations, and those in which particle fluid interactions are important. The course addresses fundamentals of fluid-particle mechanics, such as the notion of drag, and builds on those fundamentals to develop design concepts for various industrial processes like packed bed operation, fluidized operations, sedimentation, filtration, separation of solids and fluids, etc. Industrial applications are discussed. The course is concluded with an introduction to colloidal systems, soft materials and nanoparticles. Applications of these novel systems are discussed.

Unit I: Solids Properties, Handling, Mixing : Introduction: Relevance of fluid and particle mechanics, and mechanical operations, in chemical engineering processes. Solid particle characterization: Particle size, shape and their distribution, Screen analysis, standard screens; Relationship among shape factors and particle dimensions; Specific surface area; Measurement of surface area. Mixing and storage of Solids: Types of important mixers like kneaders, dispersers, masticaters, roll mills, muller mixer, pug mixer, blender, screw mixer etc., mixing index.

Unit II: Storage and Transportation, Size Reduction : Types of storage equipments, Bin, Silo, Hoper, etc. Transport of fluid-solid systems: mechanical conveying, pneumatic and hydraulic conveying. Major equipment's- Crushers, grinders, ultrafine grinders, laws of communition, Close circuit and open circuit grinding.

Unit III: Fluid Solid Separation : Sedimentation: Elutraition, Classification and sedimentation, Free Settling, hindered settling, flow of solids through fluid, Stoke's law, Richardson-Zaki equation, design of settling tanks. Centrifugal separation, design of cyclones and hydro cyclones, filter bags, venturi scrubber, electrostatic precipitator.

Unit IV: Mechanical Separation and Filtration : Industrial screen; their capacity and effectiveness. Types of filtration, principle of filtration, plate and frame filter, leaf filter, rotary drum filter, etc.

Unit V: Fluidization : Fluidization: Fluidized bed, minimum fluidization velocity, pressure drop etc. Types of fluidization: Particulate fluidization, Bubbling fluidization, Applications of fluidization. Packed bed: Void fraction, superficial velocity, channelling, Ergun equation and its derivation, Kozeny Carman equation, Darcy's law and permeability, Blaine's apparatus.

Suggested Text Books :

1. W. McCabe, J. Smith, J. & P. Harriott, Unit Operations of Chemical Engineering,

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CH204TPC06 **Process Instrumentation** **[L:3, T:1, P:0]**

60% CHange

Objectives:

This course is to introduce students to learn the basics of instrumentation and handling the process variables, course address fundamentals & amp; operation of different measuring devices such as temperature, level, pressure, flow, pH, humidity and compositions. Course introduced to impart basic knowledge of transmitters, transducers, control valves, digital and analog components related to PLC, DCS.

Unit I : Instruments Characteristics: Introduction to process variables, static and dynamic characteristics of instruments, and their general classification, elements of measuring system and their functions.

Unit II: Transmitters & amp; Transducers: Signal transmission, transmitters, electronic, pneumatic, transducers.

Unit III: Measuring Instruments : Principles, construction and operations of instruments for the measurement of various process variables such as temperature, pressure, flow, liquid level, humidity, viscosity and composition.

Unit IV: Controllers & amp; Regulators : Principles and construction of electro- pneumatic controllers, multiplexers, final control elements such as pneumatic control vale, stepper motor.

Unit V: Data Acquisition & amp; Analysis : Introduction to data acquisition system and intelligent instruments, instrumentation of process equipment such as distillation column, heat exchanger etc.

Text Books:

1. S. K. Singh, Industrial Instrumentation and Control, McGraw-Hill.
2. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, McGrawHill.

References Books:

1. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw-Hill Publishing Co. Ltd.
2. T. G. Beckwith, R. D. Marangoni & J. H. Lienhard, Mechanical Measurements, Addison Wesley.
3. R. K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi
4. C. D. Johnson, Process Control Instrumentation Technology, Pearson Education, Inc.

Outcomes :

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