5.1 PROCESS INSTRUMENTATION AND CONTROL

L	P
4	4

RATIONALE

This subject gives the knowledge of various instruments used to measure various process parameters. This course will impart knowledge on working principle, construction, repair and use of these instruments

DETAILED CONTENTS

1. Introduction (32 hrs)

   Importance of instruments in chemical process industry, general classification of instruments, indicating and recording type instruments, static and dynamic characteristics of instruments. (4 hrs)

   Description and construction details, working principle, range and application of following instruments:

   a) Pressure and vacuum gauge: manometers, bourdon tube gauge, mcleod gauge, pirani gauge (6 hrs)

   b) Thermometer and Pyrometer: liquid expansion thermometer, bimetallic thermometer, thermocouple, resistance thermometer, optical and radiation pyrometer (8 hrs)

   c) Liquid level meter: visual indicator, float actuated level meter, bubbler system, diaphragm box system (5 hrs)

   d) Flow meters: Orifice meter, Venturimeter, Pitot tube, Rota meter (4 hrs)

   e) Analyzers: pH meter, chemical composition analyzer, various types of analyzers i.e. oxygen analyzer, infra red analyzer, orsat analyzer (5 hrs)

2. Transmission (06 hrs)

   Pneumatic and electrical transmission (Induction Transmission only) and their fields of application

3. Process Instrumentation (06 hrs)

   Control centre, instrument diagrams, instrumentation in modern chemical plant

4. Basic concept of automatic process control, advantages of automatic control (06 hrs)

5. Types of feedback controllers: Proportional, Integral, Derivative and their combination and their applications in chemical industry (10 hrs)

6. Types of control valves-pneumatic: air to open, air to close, electronic, hydraulic (04 hrs)

LIST OF PRACTICALS

1. Calibration of a pressure gauge
2. Calibration of a resistance thermometer
3. Calibration of a thermocouple
4. Study of on-off controller for temperature control
5. Study the characteristics of pneumatic control valve
6. Characteristics of a flapper nozzle system
7. Study of constructional detail of chart recorder
8. Study of constructional details of strip chart recorder

INSTRUCTIONAL STRATEGY

The subject gives the knowledge of various process, instruments and controls to measure process parameters. So the theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with examples.

RECOMMENDED BOOKS

1. Industrial Instrumentation by Donald P Eckman, Wiley Eastern Publication
2. Principles of Industrial Instrumentation by D Patranabis, Tata McGraw Hill Publication, 2nd Edition, 1999
3. Process System Analysis and Control by Coughnour, McGraw Hill Publication, 2nd Edition, 1991
4. Industrial Instrumentation by SK Singh, Tata McGraw Hill Publication, 2nd Edition, 2007
5. Process Instruments and Controls Handboook by Considine, 2nd Edition, McGraw Hill , 1974
6. Process Instrumentation and Control by A.P. Kulkarni, Nirali Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	32	50
2	06	10
3	06	10
4	06	10
5	10	15
6	04	05
Total	**64**	**100**

5.2 HEAT TRANSFER - II

L	P
4	4

RATIONALE

This subject enables the students to apply the understanding of heat transfer mechanisms such as conduction, convection and radiation for understanding the performances of various heat transfer equipment such as heat exchangers, condensers, boilers, evaporators etc used in almost all chemical and related industries

DETAILED CONTENTS

1. Condensation, Boiling and Evaporation (10 hrs)

   Concept of Condensation, Types of Condensation i.e. Dropwise condensation and filmwise condensation, Concept of boiling, boiling curve, heat transfer medium i.e. diphenyl, dowthern, Concept of evaporation, Boiling point elevation

2. Heat Exchangers (28 hrs)

   - Introduction, LMTD for co-current and counter current, Overall heat-transfer co-efficient, construction and description of (i) double pipe (ii) shell and tube heat exchanger. Simple numerical problems concerning single pass 1 – 1 exchanger, 1 – 2 parallel counter flow heat exchangers. Condensers and Reboilers, Plate and Frame Heat Exchanger.

   - Fouling factors, roughness of surfaces and their effect, overall heat transfer coefficient.

   - Extended surface equipment (fins) and their efficiency and effectiveness. Effectiveness and capacity Ratio, LMTD correction factor.

3. Evaporators (16hrs)

   Introduction, types of evaporators; open pan, standard type, long tube evaporator, falling films, forced circulation

4. Furnaces (10 hrs)

   Classification based on fuel used (oil fired, coal fired, gaseous fuel fired), working & constructional details of cupola furnace, reverberatory furnace, muffle furnace

LIST OF PRACTICALS

1. To determine the heat transfer coefficient with the help of double pipe heat exchanger using parallel flow
2. To determine the H.T coefficient with the help of double pipe heat exchanger using counter flow
3. To determine heat transfer coefficient in shell and tube heat exchanger using counter flow
4. To determine heat transfer coefficient in shell and tube heat exchanger using parallel flow
5. To determine the rate of evaporation in a jacketed bottle (open pan evaporation)
6. Experiment on a single effect evaporator and determination of steam economy
7. To determine heat transfer rate in finned tube heat exchanger

INSTRUCTIONAL STRATEGY

A field visit may be conducted to expose the students to various types of heat transfer equipment. Practicals should be conducted to give an idea about modes of heat transfer, effect of insulation on heat transfer.

RECOMMENDED BOOKS

1. Process Heat Transfer by Kern DQ, McGraw Hill Book, New York
2. Heat Transfer 7th Ed. By Holman JP; McGraw Hill, New York
3. Applied Process Design for Chemical and Petrochemical Plants, Volume III by Ludwig, E; Gulf Publishing Co., Houston, Texas
4. Heat Transfer Principles and Applications by Binary K Dutta; Prentice Hall, India.
5. Heat Transfer by K.A. Gauhane, Nirali Publications

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	15
2	28	45
3	16	25
4	10	15
Total	**64**	**100**

5.3 MASS TRANSFER - II

L	P
4	4

RATIONALE

In this subject the basic concepts of mass transfer are covered to enable the students to understand working of various mass transfer equipments like distillation columns, absorption columns, crystallizers and driers which are used in industries for purification of products

DETAILED CONTENTS

1. Distillation (24 hrs)

   Relative volatility, vapour liquid equilibrium, various distillation methods, flash distillation, batch destination, continuous, fractionating column with details and identification of different parts, vacuum flash distillation, steam distillation, introduction to azeotropic, extractive distillation, different types of distillation columns.

   Perforated plate or sieve plate, bubble cap, packed column, calculation of number of stages by McCabe Thiele Method.

2. Adsorption (10 hrs)

   Concept of adsorption, operation and its types, absorption isotherms, effect of temperature and industrial applications

3. Crystallization (12 hrs)

   Study of various factors affecting crystallization, nucleation, crystal growth, size and shape, variation of different materials during crystallization, types of crystallizers – continuous crystallizer, DTB crystallizer

4. Drying (18 hrs)

   Definition, industrial application, moisture content, wet and dry basis, equilibrium moisture, bound, unbound, free moisture

   Batch drying; direct driers, tray driers, two track driers, rate of drying curve

   Continuous drying, turbo type drier, rotary driers

LIST OF PRACTICALS

1. To study the bubble cap distillation column and determine its efficiency
2. To determine the rate of distillation by steam distillation
3. To determine the number of transfer units (NTU) and height equivalent to theoretical plate (HETP) of packed distillation column
4. To determine the absorption isotherm of acetic acid by activated charcoal.
5. Experiment on batch distillation
6. Experiment on crystallizer
7. To determine the drying characteristics of a given substance (drying rate measurement)
8. To perform an experiment on a rotary dryer and find rate of drying
9. To perform an experiment on a tray drier and find rate of drying

INSTRUCTIONAL STRATEGY

Field visit will make the students familiar with different types of column (packed/tray) and different types of packings/trays used in the column. This will also make the students aware of auxiliary equipment/models/supports used for the columns. Along with the theoretical part, emphasis should be given to problem solving and practices especially for distillation column, absorption and humidification.

RECOMMENDED BOOKS

1. Mass Transfer Operations by Treybal, Kogakusha Publication
2. Introduction to Chemical Engineering by badger and Banchero; McGraw Hill Publication
3. Unit Operations of Chemical Engineering by Mc Cabe and Smith; McGraw Hill Publication
4. Mass Transfer by Sherwood Pigtord and Wilke; McGraw Hill Publication
5. Chemical Engineers Hand book by Perry and Chilton; McGraw Hill Publication
6. Mass Transfer by K.A. Gavhane, Nirali Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	24	45
2	10	15
3	12	15
4	18	25
Total	64	100

5.4 REACTION ENGINEERING

L	P
4	-

RATIONALE

It is a core subject of Chemical Engineering and is essential for understanding the kinetics of various reactions, types of reaction vessels and the performance of reactive systems used in industry.

DETAILED CONTENTS

1. Kinetics of Homogeneous Reactions (08 hrs)

   Introduction to chemical reaction and different types of reactions like single reaction, multiple reactions-parallel reaction, series reaction, series-parallel reaction, irreversible and reversible reactions, exothermic and endothermic reactions.

2 - Order of reaction- zero, first, second and fractional order (12 hrs)
- Molecularity of reaction and difference between order and molecularity
- Elementary and non-elementary reactions, introduction to kinetic models for non-elementary reactions

3 Rate of reaction, special rate of reaction (12 hrs)
Threshold energy, Energy barrier, Activation energy and temperature dependence of specific reaction rate.
Various affecting rate of reaction

4 Reversible Reactions (08 hrs)
Concept of chemical reaction equilibrium, equilibrium constant, effect of T and P on equilibrium constant, equilibrium conversion

5 Reactions Vessels for homogenous reactions (24 hrs)
- Concept of residence time, space time and space velocity.
- Different types of reactors for homogenous reactions - batch, semi-batch, ideal reactors – CSTR, PFR
- Steady state CSTR/MFR and PFR, their space time and residence time, simple numericals
- factors influencing the selection of reactors.

.

INSTRUCTIONAL STRATEGY

Emphasis should be laid on problem-solving using some simple numericals.

RECOMMENDED BOOKS

1. Chemical Reaction Engineering by Levenspeil, John Wiley Publication
2. Chemical Engineering Kinetics by Smith, McGraw Hill Publication
3. Elements of Chemical Reaction Engineering by Fogler, Prentice Hall of India
4. Reaction Kinetics for Chemical Engineering by Wales, McGraw Hill Publication
5. Chemical Reaction Theory-An Introduction by Denbigh and Turner, Cambridge University Press Publication
6. Chemical Reaction Engineering by K.A. Gavhane, Nirali Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	08	10
2	12	20
3	12	20
4	08	10
5	24	40
Total	**64**	**100**

5.5 (a) ALTERNATE ENERGY SOURCES

L	P
4	-

RATIONALE

This specialized subject will make the students aware of energy crisis and will impart detailed knowledge of alternate sources of energy as remedial and preventive measures.

DETAILED CONTENTS

I. Introduction (06 hrs)
Non-conventional/renewable energy sources, their importance for sustainable development and environmental protection.

2. Solar Energy (16 hrs)

- Introduction to solar radiation and evaluation of radiation incident on a solar collector
- Applications of solar thermal energy such as solar water heater, solar cooker, solar furnaces, solar stills, solar concentrators and solar thermal power generation, Types of solar photovoltaic systems and applications

3. Hydro Energy (8 hrs)

Hydro-electric power plants

4. Bio-Energy (12 hrs)

Photosynthesis and biomass conversion system, bio-gas plant, Power generation by using gasifiers

5. Wind Energy (8 hrs)

Wind mills, Electricity generation from wind.

6. Geothermal and Tidal Energy (8 hrs)

Steam generation and electricity generation

7. Introduction to Ocean and wave energy (2 hrs)

8. Smokeless Chulhas (4 hrs)

INSTRUCTIONAL STARTEGY

Small and simple models can be made to explain the various types of energy. This will help the students to understand the subject in a better way.

RECOMMENDED BOOKS

1. Solar Energy - Principles of Thermal Collection and Storage by S P Sukhatme, 2nd Edition, Tata McGraw Hill Publication, New Delhi,2006
2. Solar Energy Utilization by G D Rai, Khanna Publishers, New Delhi
3. Reviews of Renewable Energy Sources, Vol. 3, edited by M S Sodha, S S Mathur, MAS Malik, T C Kandpal, Wiley Eastern Limited, New Delhi
4. Energy Today and Tomorrow by Maheshwar Dayal, Pubications Division, Ministry of Information and Broadcasting, Govt. of India, New Delhi.
5 Energy Technology – Non-Conventional, Renewable and Conventional by Rao, S and Parulekar, BB, 3rd Edition, Khanna Publishers, 2007

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	10
2	16	25
3	08	10
4	12	15
5	08	15
6	08	15
7	02	05
8	04	05
Total	**64**	**100**

5.5 (b) TEXTILE TECHNOLOGY

L	P
4	-

RATIONALE

The students are supposed to have introductory knowledge of skills related to various fibers, yarn, and fabrics. The students will learn various manufacturing techniques, machines related to textiles.

DETAILED CONTENTS

1. Definition of fiber, yarn, fabric, classification of textile fibres and physical and chemical and identifications of textile fibers. (04 hrs)

2. Definition of moisture content, moisture region, absolute, relative humidity and their relation with properties of fibers. (04 hrs)

3. Classification of fibers, natural and synthetic fibers, natural fibers source and products of cotton, wool, jute, silk, fibers and their end uses and properties. Synthetic fibers: viscose, rayon, nylon, polyester, acrylic, polypropylene fibers, their structure, synthetics, uses and properties. (14 hrs)

4. Introduction to standard yarns, bulk yarn, case yarn, high tenacity yarn, hosiery yarn, twist-of-twist yarn, carpet yarn. (10 hrs)

5. Preparation of yarn for weaving sizing, winding, wrapping, drafting, lifting and denting plans. (04 hrs)

6. Introduction to various machines used for yarn fiber manufacture like (20 hrs)

   (i) Power Looms (part of looms, their function and motions)

   (ii) Types of shedders their advantages and limitations

   (iii) Types of spinner

   (iv) Mixing, Blending and Blow room

7. Chemical processing of textiles. (04 hrs)

8. Dyeing of Textile fibres, treatment of dyeing effluent. (04 hrs)

INSTRUCTIONAL STRATEGY

The students may be exposed to different types of textile manufacturing process through textile mill visit so that they are able to understand the subject properly. Different fibers should be shown to students so that they can be analyzed for their properties.

RECOMMENDED BOOKS

1. Textile science by Gohl and Vilensky

2. Introduction to Textile by HH Willege

3. Yarn to Fabric by BP Corbman

4. Textile Fibers and their processing by KP Heas.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	04	10
2	04	10
3	14	20
4	10	10
5	04	10
6	20	20
7	04	10
8	04	10
Total	64	100

5.5 (c) POLYMER TECHNOLOGY

L	P
4	-

RATIONALE

This specialized subject is taught in view of the growing employment potential in the field of polymers. This subject deals with polymer processing techniques and important Industrial polymers which will make the diploma holder in chemical engineering confident to join polymer industry.

DETAILED CONTENTS

1. Introduction (12 hrs)

- Introduction to polymers.
- Classification of polymers.
- Polymer structure: Tacticity, Geometric isomerism, stereo isomerism.
- Concept of molecular weight (weight average, molecular, number average, molecular weight effect of molecular wt. on properties of polymers.)

2. Polymer Synthesis (18 hrs)

- Step Polymerization.
- Chain Polymerization.
- Brief Introduction to Copolymers.

3. Polymerization Techniques (08 hrs)

- Bulk Polymerization
- Solution Polymerization.
- Suspension Polymerization.
- Emulsion Polymerization.

4. Introduction to some Industrial Polymers (18 hrs)

Structure, properties & uses of following polymers

- Polyester
- Polyethylene

- Polystyrene
- Polypropylene
- Polyvinyl chloride (PVC)
- Nylon (6-6, 6)

5. Polymer Processing Techniques (08 hrs)

Introduction to Extrusion, Injection moulding, Blow moulding, Calendaring.

INSTRUCTIONAL STRATEGY

Theoretical knowledge of this subject should be properly imparted to the students. Extension lectures by experts from polymer industries can enrich the students with better inputs regarding the various processes involved for improving the quality of polymer products. Various types of techniques and latest development in polymer industry is essential for complete knowledge of the subject.

RECOMMENDED BOOKS

1. Polymer Science by Gwarikar
2. Polymer Science and technology by Joel R. Fried, Prentice Hall of India, Publication
3. Polymer Science and Technology by P. Gosh, Tata McGraw Hill Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	20
2	18	20
3	08	20
4	18	20
5	08	20
Total	64	100

5.5 (d) FERTILIZER TECHNOLOGY

L	P
4	-

RATIONALE

Fertilizer plants have large employment potential, therefore, this subject is being offered as an elective. Students will be imparted detailed knowledge of fertilizers.

DETAILED OF CONTENTS

1. Introduction (10 hrs)

   Demand and supply in India, Important fertilizer plants in India, Grading of NPK fertilizers, Importance of fertilizers

2. Nitrogenous Fertilizers (20 hrs)

   Manufacture of ammonia, nitric acid, manufacture of urea, ammonium nitrate, ammonium sulphate, major engineering problems like corrosion, safety.

3. Phosphatic Fertilizers (16 hrs)

   Manufacturing process of superphosphate, triple superphosphate, manufacture of ammonium phosphates like MAP and DAP.

4. Potassic fertilizers:- Mutriate of potash, sulphate of potash. (06 hrs)

5. Complex and Compound Fertilizers: Introduction and definition (04 hrs)

6. Micronutrients: Different micronutrients and their effects (8 hrs)

INSTRUCTIONAL STRATGY

Visit to fertilizer industries will provide the students with latest techniques used in manufacture of fertilizer

RECOMMENDED BOOKS

1. Handbook of Fertilizer Technology, published by Fertilizer Association of India
2 Fertilizer Industry in India, Part I and II by Pritam Singh & VS Awasthi, 1992
3 Agriculture in India, vol. I by Kumar, Aggarwal & Others, Asia Publishing House, Mumbai
4. Nitrogen Fertilizers Chemical Processes, Christopher J, Pratt, Noyes Development Corpn.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	15
2	20	30
3	16	20
4	06	10
5	04	10
6	08	15
Total	**64**	**100**

5.6. MINOR PROJECT WORK

L	P
-	4

Minor project work aims at exposing the students to field practices, size and scale of operation. For this purpose, students are required to undertake preferably an industrial problem as their minor project work. Some of the good industries as suggested by the expert group are as follows:

List of Industries

1. Max GB. Ropar
2. Ranbaxy, Ropar
3. Shreyans Paper Mill, Ropar
4. NFL, Nangal
5. PCPL Derabassi
6. SIEL Complex, Rajpura
7. PACL Nangal
8. JIL, Hamira
9. Rana Sugar Mill, Bulter
10. Trident, Barnala
11. IAL, Sangrur
12. Barnala Paper Mill
13. Paper Mill Mukeriyan
14. NFL, Bathinda
15. Thermal Plant, Bathinda
16. Sukhjit Starch and Chemicals, Phagwara
17. JCT, Hissar
18. Horlicks, Nabha
19. NESTLE, Ferozpur Road, Moga
20. K.B.R.L., Dhrui-Malerkotla Road, Bhasaur, Dist Sarangrur
21. Oswald Oils and Fats, Raikot
22. A.P Solvex Ltd. Dhuri
23. Shreyans paper mills, Ahmedgarh

24. Ind Swift- Barwala road, Chandigarh
25. Panecea BioTech – Lalroo
26. Morpen Pharmaceuticals, Parwanoo
27. Sanchez Pharmaceuticals, Tohana, Tricrossing Tohana, Distt. Fatehabad
28. M/S Cure Quick Pharma, Karnal 20/3, HSIDC, Karnal
29. Wochert, Ambala-Chandigarh. Road, Lalroo
30. Amrit Vanaspati, Rajpura
31. NFL, Nangal
32. Diplast Industries, Mohali
33. Mount Shivalik Brewries, Derabassi
34. PCPL chemicals, Derabassi

The teacher along with field supervisors will conduct performance assessment of students. This minor project work will carry 200 marks. 100 marks will be given by Industrial/field supervisors and 100 marks by the teacher supervising this training. The components of evaluation will include the following:

a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with peers	15%
d)	Project report	55%

PERSONALITY DEVELOPMENT CAMP

This is to be organized at a stretch for two to three days during fifth or sixth semester. Extension Lectures by experts or teachers from the polytechnic will be delivered on the following broad topics. There will be no examination for this subject.

1. Communication Skills
2. Correspondence and job finding/applying/thanks and follow-up
3. Resume Writing
4. Interview Techniques: In-Person Interviews; Telephonic Interview' Panel interviews; Group interviews and Video Conferencing etc.
5. Presentation Techniques
6. Group Discussions Techniques
7. Aspects of Personality Development
8. Motivation
9. Leadership
10. Stress Management
11. Time Management
12. Interpersonal Relationship
13. Health and Hygiene