6.1 PROCESS PLANT UTILITIES

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RATIONALE

This subject is introduced to give the student a thorough knowledge of process utilities such as demineralization of water, steam generation, steam distribution and cooling water, which is essentially required for working in any chemical or related industry.

DETAILED CONTENTS

1. Water (18 hrs)

Sources of water, Impurities in water, Define Hardness and its cause, types of hardness (1) Temporary Hardness (2) Permanent Hardness, Units of Hardness and their interrelation. Estimation of hardness by EDTA methods, Conditions for boilers feed, water boiler problems. Scale and sludge, Priming, Foaming, Carryover, Boiler Corrosion, Caustic Embrittlement, Water Softening, Internal Treatment, External Treatment, Colloidal Conditioning, Carbonate Conditioning, Phosphate Conditioning, Calgon Conditioning, External Treatment, Zeolite Process, Lime Soda Process, Ion Exchange Process, Mixed Bed Deionizer Process, Concept of soft, hard, de-ionized water and distilled water Resins used. Regeneration (Ion Exchange and Mixed Bed Deionizer).

2. Steam, Steam Generation and Steam Distribution (24 hrs)

Brief introduction of steam, Formation of steam at a constant pressure from water.

Temperature vs total heat graph during steam formation, important terms for steam (wet steam, dry saturated steam, superheated steam, dryness fraction or quality of wet steam, sensible heat of water, latent heat of vaporization, enthalpy or total heat of steam, specific volume of steam. Steam tables and simple numerical problems on them.

Enthalpy – Entropy (h-s) diagram for water and steam or Mollier Chart and simple numerical problems on them, specification of steam pipes, layout of piping, steam trap (Expansion and Bucket), Steam ejectors.

Boilers: Different types of boilers viz. Babcock Wilcox, Nestler, Cochran boilers, boilers accessories like Economizer, ID fan, FD fans, heaters, subeheaters, oil burness, soot blowers.

3. Refractories (08 hrs)

Definition, classification (acid, basis, neutral, insulating, special, cermets refractoriness), properties, characteristics, general method of manufacturing of refractories, selection of refractories, some important refractories (fire clay, silica, high alumina, bauxite, carbon/graphite). Failure of refractories.

4. Insulation (04 hrs)

Characteristics, properties, classification: cold insulation, low temperature insulation (high vacuum, multiple layer powder, rigid foam).

5. Refrigerants and Cooling Water (10 hrs)

Introduction, classification of refrigerants (primary, secondary) properties (thermodynamic, physical and safe working,), important refrigerants (ammonia, carbon dioxide, cryogeme, antifreeze). Selection of refrigerants. Construction and working of cooling towers (natural and forced draft).

INSTRUCTIONAL STRATEGY

Field visit is must to give idea about the various boilers and cooling towers. Students should be encouraged to make flow sheets for various processes.

RECOMMENDED BOOKS

1. Industrial Chemistry by Shashi Chawla, Dhanpat Rai and Sons Publication
2. Plant Utilities by Dr. Mujawar, Nirali Prakashan Publication
3. Plant Economics by Peter Timmerhans, McGraw Hill
4. Heat Transfer by D.S. Kumar
5. Plant Utilities by D.B. Dhone, Nirali Prakshan Publication
6. Fuel Furances and Refractories by O.P. Gupta, Khanna Publishers

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted Hrs
1	18	30
2	24	35
3	8	15
4	4	5
5	10	15
Total	**64**	**100**

6.2 CORROSION ENGINEERING

L	T	P
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RATIONALE

The basic purpose of coating is to protect the surface from environmental stresses. This subject deals with various types and mechanism of corrosion from which the substrate needs to be protected.

DETAILED CONTENTS

1. Definition, corrosion damage, functional and economic aspects of corrosion, relevance of corrosion studies, classification of corrosion process, General chemistry of corrosion with metals alloys, solid solutions, crystal imperfection, macroscopic defects etc. (14 hrs)

2 Electro-chemistry, electrolysis, emf and emf series, galvanic cells , concentration cells, electrolytic cells, passivation – characteristics, parameters, mechanism of passivation, oxidizing and non-oxidizing anodic inhibitors, Theories of passivtion like film theory, adsorption theory (14 hrs)

3. Different form of corrosion: chemical, uniform, bi-metallic, galvanic, crevice, under film, pitting corrosion, intergranular, Selective erosion, stress corrosion cracking, corrosion fatigue- their mechanism and remedial measures, Hydrogen and radiation damages (12 hrs)

4 Corrosion under various conditions – Atmosphere, underground, immersion, marine and liquid metal corrosion, mechanism and dependence parameters of metal oxidation, catastrophic oxidation, internal oxidation and oxidation of alloys etc. (12 hrs)

5 Corrosion in various industries: Boiler plant, chemical industries, petroleum industries, building industry, fertilizer industry, paint industry etc., Corrosion testing: physico-chemical methods, electro-chemical methods, corrosion inspection and monitoring, corrosion rate measurements. Advantages and defects of corrosion testing methods,. Corrosion control: Practical and fundamental approach, selection of materials, modification of metals, change in design and corrosive environment, corrosion inhibitor, surface coating and Electro chemical corrosion protection methods such as cathodic and anodic protections (12 hrs)

INSTRUCTIONAL STRATEGY

Few field visits should be made to different chemical industries so that students can see the various types of corrosion effecting equipment and pipelines. Simple experiment like putting coatings, isolation, passivation can be designed for better understanding of corrosion preventon.

RECOMMENDED BOOKS

1. Corrosion Engineering by MARS-G, FONTANA – Tata McGraw Hill, 1986
2. Handbook of Corrosion Engineering by Pierce Roberge- Tata McGraw Hill, 1999
3. Principles of Corrosion Engineering and Corrosion Control by Zaki Ahmad, Published by Butterworth – Heinemann, 2006

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	15
2	14	20
3	12	20
4	12	20
5	12	25
Total	**64**	**100**

6.3 ADHESIVES AND SURFACE COATINGS - II

L	T	P
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RATIONALE

This course is designed to impart knowledge relating to adhesive and coatings to the students. Study of this course will enable them to learn about the types, raw materials, defects and testing of adhesive and coatings.

DETAILED CONTENTS

Adhesives

1. Introduction to Adhesives – Definition and classification of adhesives, components of adhesives, various terms like glue line, setting time, solvent cementing etc. Effect of various factors on bond strength like pressure, temperature, surface energy, surface preparation, time given for adhesion (10 hrs)

2. Hot Melt adhesives (06 hrs)

   Definition, applications, preparation, advantages and disadvantages

3. Types of Adhesives (08 hrs)

   Adhesives for wood, adhesives for metals, adhesives for polymers etc.

Coating Technology

4. Water Soluble Coatings: Raw materials, manufacturing, properties and applications (10 hrs)
5. Solvent Based Coatings (08 hrs)

   Raw material, manufacturing, properties of varnishes and applications of epoxy coatings, polyurethane, silicone, polyester coatings

6. Varnishes (06 hrs)

   Raw materials, resin used in varnishes, properties and applications

7. Industrial Coating: Automotive component coating, furniture finishes, fabric coating, aircraft, buildings (10 hrs)

8. Defects in Coating (06 hrs)

   Cratering, alligatoring, moisture inherent, peel off, fading, yellowing etc.

INSTRUCTIONAL STRATEGY

Actual application should be shown by visits to sites.

RECOMMENDED BOOKS

1. Organic Coating Technology, Vol. II by H.F. Payne Published by (John Wiley), 1960.
2. Surface Coating, Science and Technology, Ed. 2, Swarj Paul (John Wiley), 1997.
3. Outlines of Paint Technology by W.M. Morgans, Publishers Griffin, 1969.
4. Organic Coatings, Wicks W; Jones FN.; Pappas S.P.; & Wicks D.A. (John Wiley 3rd Edn. 2007).

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	15
2	06	10
3	08	13
4	10	15
5	08	12
6	06	10
7	10	15
8	06	10
Total	**64**	**100**

6.4 PROCESS INSTRUMENTATION AND CONTROL

L	T	P
4	-	3

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. Measurement Systems or Elements of Measurement Instruments (8 hrs)

   Measurement and its aim, primary and secondary element, manipulating and functioning elements, static characteristics, calibration, Accuracy, Precision, repeatability, drift, sensitivity, resolution, Dead Zone, Static Error.

2. Temperature Measurement (10 hrs)

   Temperature scales, methods of temperature Measurement: Expansion thermometers, filled system thermometer, electric temperature instruments, pyrometers.

3. Pressure Measurement (10 hrs)

   Units of pressure, methods of pressure measurement, manometers, elastic pressure transducers, force balance pressure gaugers, electrical pressure transducer, measurement of vacuum.

4. Level Measurement (10 hrs)

   Methods of Liquid level measurement, Direct Methods: Sight Glass, Float, Displacer, Indirect Methods: Pressure Gauge, Air Trap, Diaphragm box, Air Purge, Radioactive, Ultrasonic, Capacitive Solid level Measurement, Solid level Measurement.

5. Analyzers and Recorders (10 hrs)

   pH meter, viscosity measurement, various types of analyzers. Oxygen analyzer, Infrared Analyzer, Orsat Analyzer. Circular charts and strip chart recorders.

6. Introduction to Process Control (6 hrs)

   Definition and example of process control system. Block diagram representation of process control system, component of a process control system, Transfer function of a control system, types of process control system – open loop control system, closed loop control system, feed forward and feed backward control system, cascade control system (in brief). System Input-Step, Ramp, Sinusoidal, Pulse.

7. Control Valve (6 hrs)

Valve Characteristics, Valve Types, Valve Actuator and Valve Positioning.

LIST OF PRACTICALS

1. To calibrate pressure gauge with the help of dead weight pressure gauge
2. To calibrate bimetallic thermometer, resistance thermometer, thermocouple, energy meter and watt meter.
3. To measure pressure with the help of different types of manometers.
4. To determine the characteristics of a flapper nozzle system.
5. To study on-off controller for temperature control.
6. To study constructional details of strip chart recorder.
7. To study measurement of relative humidity and to compare the value with psychometric chart.
8. To study constructional details of circular chart recorder.
9. To plot the curve between flow rate and percent opening of control valve with the help of DCS (Distributed Control System)

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 publications.
2. Process System Analysis and Control by Cughnour, McGraw Hill publications.
3. Industrial Instrumentation by SK Singh, Tata McGraw Hill Publicaions.
4. Principles of Industrial Instrumentation by D. Patro Nalis, Tata McGraw Hill Publications

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	8	15
2	10	15
3	10	15
4	10	15
5	10	15
6	10	15
7	6	10
Total	**64**	**100**

6.5 EMPLOYABILITY SKILLS – II

L	T	P
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RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. Our diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject to prepare students for employability in job market and survive in cut throat competition among professionals.

DETAILED CONTENTS

1. Oral Practice

i)	Mock interview	(05 hrs)
ii)	Preparing for meeting	(05 hrs)
iii)	Group discussion	(05 hrs)
iv)	Seminar presentation	(05 hrs)
v)	Making a presentation	(12 hrs)

a) Elements of good presentation
b) Structure and tools of presentation
c) Paper reading
d) Power point presentation

6.6 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

L	T	P
3	-	-

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

DETAILED CONTENTS

SECTION – A ENTREPRENEURSHIP

1. Introduction (14 hrs)

- Concept /Meaning and its need
- Qualities and functions of entrepreneur and barriers in entrepreneurship
- Sole proprietorship and partnership forms of business organisations
- Schemes of assistance by entrepreneurial support agencies at National, State, District level: NSIC, NRDC, DC:MSME, SIDBI, NABARD, Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubator (TBI) and Science and Technology Entrepreneur Parks (STEP).

2. Market Survey and Opportunity Identification (10 hrs)

- Scanning of business environment
- Salient features of National and State industrial policies and resultant business opportunities
- Types and conduct of market survey
- Assessment of demand and supply in potential areas of growth
- Identifying business opportunity
- Considerations in product selection

3. Project report Preparation (08 hrs)

- Preliminary project report
- Detailed project report including technical, economic and market feasibility
- Common errors in project report preparations
- Exercises on preparation of project report

SECTION –B MANAGEMENT

4. Introduction to Management (04 hrs)

- Definitions and importance of management
- Functions of management: Importance and Process of planning, organising, staffing, directing and controlling
- Principles of management (Henri Fayol, F.W. Taylor)
- Concept and structure of an organisation
- Types of industrial organisations
    a) Line organisation
    b) Line and staff organisation
    c) Functional Organisation

5. Leadership and Motivation (03 hrs)

a) Leadership

- Definition and Need
- Qualities and functions of a leader
- Manager Vs leader
- Types of leadership

b) Motivation

- Definitions and characteristics
- Factors affecting motivation
- Theories of motivation (Maslow, Herzberg, McGregor)

6. Management Scope in Different Areas (06 hrs)

a) Human Resource Management

- Introduction and objective
- Introduction to Man power planning, recruitment and selection
- Introduction to performance appraisal methods

b) Material and Store Management

- Introduction functions, and objectives
- ABC Analysis and EOQ

c) Marketing and sales

- Introduction, importance, and its functions
- Physical distribution
- Introduction to promotion mix
- Sales promotion

d) Financial Management

- Introductions, importance and its functions
- Elementary knowledge of income tax, sales tax, excise duty, custom duty and VAT

7. Miscellaneous Topics (03 hrs)

a) Customer Relation Management (CRM)

- Definition and need
- Types of CRM

b) Total Quality Management (TQM)

- Statistical process control
- Total employees Involvement
- Just in time (JIT)

c) Intellectual Property Right (IPR)

- Introductions, definition and its importance
- Infringement related to patents, copy right, trade mark

Note: In addition, different activities like conduct of entrepreneurship awareness camp extension lecturers by outside experts, interactions sessions with entrepreneurs and industrial visits may also be organised.

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment or seminar method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. Approach extracted reading and handouts may be provided.

RECOMMENDED BOOKS

1. A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. Entrepreneurship Development published by Tata McGraw Hill Publishing Company Ltd., New Delhi
3. Entrepreneurship Development in India by CB Gupta and P Srinivasan; Sultan Chand and Sons, New Delhi
4. Entrepreneurship Development - Small Business Enterprises by Poornima M Charantimath; Pearson Education, New Delhi

5. Entrepreneurship : New Venture Creation by David H Holt; Prentice Hall of India Pvt. Ltd., New Delhi
6. Handbook of Small Scale Industry by PM Bhandari
7. Principles and Practice of Management by L M Prasad; Sultan Chand & Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	28
2	10	20
3	08	16
4	04	10
5	03	06
6	06	14
7	03	06
Total	**48**	**100**

6.7 PROJECT WORK

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Project work aims at developing skills in the students whereby they apply the totality of knowledge and skills gained through the course in the solution of particular problem or undertaking a project. The students have various aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given for a group. The students should identify or given project assignment at least two to three months in advance. The project work identified in collaboration with industry may be preferred.

Each teacher is expected to guide the project work of 5-6 students.

- Projects related to increasing productivity
- Projects related to quality assurance
- Projects related to estimation and economics of production
- Projects connected with repair and maintenance of plant and equipment
- Projects related to identification of raw material thereby reducing the wastage
- Any other related problems of interest of host industry

A suggestive criteria for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

	Performance criteria	% marks	Rating Scale				
			excellent	Very good	good	fair	poor
1.	Selection of project assignment	10	10	8	6	4	2
2.	Planning and execution of considerations	10	10	8	6	4	2
3.	Quality of performance	20	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20	20	16	12	8	4
5.	Sense of responsibility	10	10	8	6	4	2
6.	Self expression/ communication skills	5	5	4	3	2	1
7.	Interpersonal skills/human relations	5	5	4	3	2	1
8.	Report writing skills	10	10	8	6	4	2
9.	Viva voce	10	10	8	6	4	2
	Total Marks	100	100	80	60	40	20

The overall grading of the practical training shall be made as per following table

	Range of maximum marks	**Overall grade**
i)	More than 80	Excellent
ii)	79 <> 65	Very good
iii)	64 <> 50	Good
iv)	49 <> 40	Fair
v)	Less than 40	Poor

In order to qualify for the diploma, students must get "Overall Good grade" failing which the students may be given one more chance of undergoing 8 -10 weeks of project oriented professional training in the same industry and re-evaluated before being disqualified and declared "not eligible to receive diploma ". It is also important to note that the students must get more than six "goods" or above "good" grade in different performance criteria items in order to get "Overall Good" grade.

Important Notes

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.

2. The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.

3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.

4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve another criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organisations in such an exhibition. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific industries are approached for instituting such awards.