6.1 QUALITY CONTROL AND TESTING OF COATINGS

L	T	P
5	-	4

RATIONALE

This subject converses the student with quality control and performance/testing of end use applications.

DETAILED CONTENTS

1. Objectives of paint testing, quality control procedures, Standard specifications and test methods , classification of paint tests and evaluation tests,. Test on liquid paints density, dispersion, viscosity and consistency, wet opacity and dry hiding, spreading capacity and spreading rim wet and dry rim thickness, drying time etc. (24 hrs)

2 Tests of dried coatings, colour and colour fastness, light fastness, gloss, flexibility, adhesion impact test, hardness mar resistance, abrasion resistance water and moisture resistance, water vapour transmission, PAC and salt spray test, resistance to chemicals, resistance to lubricating oils and solvents, resistance to heat and fire air permeability etc., evaluation of water based paints, biological effects on paint films. (20 hrs)

3 Analysis of paints and varnishes, volatile and nonvolatile matter pigment content, binder or solid vehicle content, water content, ash content, pigment binder and solvent analysis. (18 hrs)

4 Ageing properties of coatings, weatherometery, natural outdoor durability test accelerated outdoor weathering, artificial weathering test in a weatherometer defects observed in paint film on exposure, concept of quality circles, introduction to ISO (18 hrs)

INSTRUCTIONAL STRATEGY

Visit to paint R& D laboratories/ industry may be undertaken

PRACTICALS

1. To check the gloss and drying of paints
2. To prepare copal varnish and check the gloss
3. To check the drying time and gloss varnish
4. To prepare bitumen varnish and check the hardness
5. To check the glass, drying time, hardness and flexibility of paints
6. To prepare dry distemper and check the adhesion
7. To prepare cement paint and check the adhesion
8. To prepare cement colour and check the stability
9. To prepare ready mixed paints and test the drying time, glass and resistance properties
10. To prepare emulsion paint and test the gloss and drying time.

RECOMMENDED BOOKS

1. Organic Coating Technology Vol.I and II by H.F. Payne
2. Surface coatings vol. I and II 0CCA, Australia
3. Testing of Organic Costing by Norman I Gaynes

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	24	30
2	20	30
3	18	20
4	18	20
Total	**80**	**100**

6.2. CORROSION ENGINEERING

L T P

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 and solid solutions, crystal imperfection, macroscopic defects etc. (14 hrs.)

2 Electro-chemistry, electrolysis, emf,, and emf series, galvanic cells , concentration cells electrolytic cells, passivation, characteristic parameter, 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 bieallic 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

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. PRINTING TECHNOLOGY

L	T	P
4	-	-

RATIONALE

This subject has been designed to give students an overview about various printing technologies and machinery used for printing. This subject also deals with testing and evaluation of raw materials used for printing.

DETAILED CONTENTS

1. Major printing systems, principles of printing, description and schematic diagram e.g. Typographic, Poiano graphic Gravurs and screen process, Classification of printing inks, Mechanism of ink drying, colour matching and process printing. (12 hrs.)

2 Testing and Evaluation of raw materials for their use in ink manufacturing. (12 hrs)

3. Principles of ink formulations and characteristics of various types of process ink e.g. letterpress, offset, lithographic, gravure, flexographic, and screen inks, inks for various sub-strates e.g. paper, plastic, fabric leather, glass and metal (14 hrs)

4 Inks for newspaper, publication work, posters, labels and packaging materials, heat set and quick set inks for multicolour printing, Metal decorating inks, overprint varnishes and lacquers, magnetic inks, ceramic inks, inks for printed circuit boards and other miscellaneous inks, water based inks. (14 hrs)

5 Printing ink manufacture, different methods and machinery used laboratory equipments and ink testing. Factory layout, hazards and precautions, various ink troubles and remedial measures. (12 hrs)

INSTRUCTIONAL STRATEGY

Field visits to textile industry and newspaper printing industry can be arranged so that student can have first hand experience of the machines in printing industry.

RECOMMENDED BOOKS

1. Printing Inks Manual by R.H. Leach & R.J. Pierce

SUGGESTED DISTRIBUTION OF MARKS

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

6.4 PROCESS EQUIPMENT DESIGN

L	T	P
5	-	-

RATIONALE

The topic included in the subject process equipment design are design of machine elements, storage, vessels, pressure vessels with the consideration of stress involved in materials and their protective coating. The students are expected to solve the elementary problems of different equipment used in process industry.

DETAILED CONTENTS

1. Basic Considerations in Process Equipment Design (08 periods)

   Introduction, general design procedures, fabrication techniques, equipment Classification, power for rotational motion.

2. Design Considerations (08 periods)

   Introduction, materials selections, corrosion prevention, stresses created due to static & dynamic loads, elastic instability, combined stresses and theories of failure, fatigue, brittle, fracture, creep, temperature effect, radiation effects, effects of fabrication methods, economic consideration.

3. Power Requirement of Pumps (10 periods)

   Definition of pumps, types of pumps (centrifugal and reciprocating pumps), manometric head of centrifugal pump, efficiency of the centrifugal pumps (manometric efficiency, mechanical efficiency and overall efficiency), problems relating calculations of horse power (H.P.), N.P.S.H., for flow of incompressible fluid, characteristics curves for pumps, specification sheet for pumps.

4. Pressure Vessels (17 periods)

   Selection of type of vessels, causes of failure of vessels, methods of fabrication, types of formed heads, stress in thin shells subjected to internal pressure, longitudinal and circumferential stress, joint efficiency and corrosion allowance, crown and knuckle radius, Problems relating calculation of shell thickness of cylindrical and spherical shells under internal and external pressure, thickness of torispherical heads subjected to internal pressure as per I.S. code.

5. Distillation Column (17 periods)

   Preparation of equilibrium diagram, problems relating calculation of theoretical plates at a given reflux ratio and total reflux, minimum reflux ratio, feed plate location, by McCabe-thiele methods for separation of ideal binary mixtures, shell diameter calculations.

6. Heat Exchanger and Condensers (12 periods)

   Problems relating calculation of L.M.T.D., individual and overall heat-transfer coefficients, number of tubes, number of passes, Heat-transfer coefficient for condensing vapors by Wilson's plot.

7. Evaporators (08 periods)

   Problems relating calculation of heating area, steam requirement, steam economy for single and double effect evaporators. Methods of feeding evaporators and effect of Boiling Point Rise (B.P.R) and Hydrostatic Head.

INSTRUCTIONAL STRATEGY

The emphasis should be laid on numerical aspects for the design of distillation columns and process vessels. Field visits may help the students to know more about latest types of trays and packings used in distillation absorption columns. Emphasis should also be laid on material selection aspects for the equipment.

RECOMMENDED BOOKS

1. Process Equipment Design by Mane and Rushtom
2. Process Equipment Design by Bronwnell and Young
3. Process Equipment Design by MV Joshi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	10
2	08	10
3	10	20
4	17	20
5	17	20
6	12	10
7	08	10
Total	**80**	**100**

6.5 Pollution Control & Industrial Safety

L T P
4 - 4

RATIONALE

This course is related with the cleaning of environment. This subject provides the knowledge of how to keep our environment free from any type of pollution, what are laws related to environment. In this subject, study of industrial safety and fire are also included.

DETAILED CONTENTS

1- **Introduction**: - What is environment? Environment keeps changing, component of the environment, factors affecting environment & types of environment. What is pollution? Classification of pollution & types of pollution, classification of pollutants.

(5 Periods)

2- **Air Pollution** :- Definition of air pollution, types of air pollutants, properties of air pollutants, various sources of air pollution like SPM, SO_X , NH_3 , F, CL, CFC, CO_2 , and their effects, Acid rain, Green house effects, Ozone layer**.** **(10 Periods)**

Air pollution control equipment's:-

(I) Settling chambers
(II) Cyclones
(III) Scrubber (dry & wet)
(IV) Cyclones & multi-clones
(V) Electrostatics properties
(VI) Bag filters.

- Ambient air quality measurement & their standards.

3- **Water pollution**:- origin of waste water, different types of water pollutants, their sources & effects. Water pollution, standards for drinking water, domestic waste water & industrial waste water. Methods of measurement of various parameters like BOD, SS, P^H, COD, TDS etc. methods of treatment of industrial waste water like.

(10 Periods)

I) Chemical treatment
II) Physio - chemical treatment
III) Bio- chemical treatment
IV) Any other advanced treatment

4- **Pollution and factory acts**: - water pollution control act 1974, air pollution act 1981, environment protection act 1986, hazardous chemical manufacturing, storage and impact rule 1989 and hazardous waste management and handling rule 1989, elementary knowledge of factory act 1948 and payment of wage act 1936.

(10 Periods)

5. Fire & prevention: - Fire triangle, classification of fires, flammable and Inflammable liquids, various types of fire extinguishers and their applications. Fire hazards and their prevention. **(6 Periods)**

6. Industrial safety: - Receiving, storing, transportation of flammable liquids, gases and toxic Materials and wastes, Safety in chemical reaction, pipelines in chemical factories, Precautions in the case of processes in operations involving explosives and inflammable Dusts, gases, vapours etc. codes of practice and specification for safety equipment/ Alarms/signals (reference should be made from I.S. Codes). **(10 Periods)**

7. Elements of safety- safety aspects related to site, plant layout, process development And design stages, identification of hazards and its estimation risk, risk analysis and Assessment methods, fault free method, event free method, scope of risk assessment, Controlling toxic chemicals and flammable materials **(7 Periods)**

8. Toxic substances and degree of toxicity- its estimation, their entry routes into human System, their doses and responses, control techniques for toxic substances exposure,
Use of respirators, ventilation systems.
(6 Periods)

LIST OF PRACTICALS

1. Estimation of TS, TDS
2. Estimation of BOD
3. Estimation of COD by titration methods
4. Estimation of PH valve, carbonate, bicarbonate and hydroxide alkalinity of waste water sample
5. To determine the turbidity of waste water sample
6. To determine the hardness of water
7. Demonstration of various types of fire extinguishers

INSTRUCTIONAL STRATEGY

In this subject, it is essential to instruct to students about the environment and pollution due to industry and how it may be minimized It must be essential to students to visit industry for pollution related problems.

RECOMMENDED BOOKS

1. Safety and Accident Prevention in Chemical Operation byFawelt and w'ood, Inter Science Publication
2. Chemical Engineering, Vol. 1, II, III and IV by Coulson and Richardson, Pergamme on Press Publication
3. Air Pollution by Perkins, McGraw Hill Publication
4. Fundamentals of Air Pollution by Williamson, Addison Wesley Publication
5. Liquid Wastes of Industries by Nemerow, Addison Wesley Publication
6. Waste Water Engineering by Metcalf and Eddy, McGraw Hill Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	05	10
2	10	15
3	10	15
4	10	15
5	06	10
6	10	15
7	07	10
8	06	10
Total	**64**	**100**

6.6. MAJOR PROJECT WORK

L	T	P
-	-	10

RATIONALE

Every diploma holder has to do a project work before going to the world of work so that he may have sufficient knowledge to face the various problems involved in solving the project. Chemical Technology (Paint) technician must be well aware of these too.

Project work aims at developing skills in the students whereby they apply the knowledge and skills gained through the course in totality to solve a 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. The project assignments may consist of:

- Preparation of Powder Coating
- Preparation of High Performance Coating
- CED & AED Coatings preparation
- Prototype of Ball mill
- Development of prototypes
- Study of the process of manufacturing of paints, detergents etc.

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

Sr. No.	Performance criteria	Max. 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.

6.7 EMPLOYABLE SKILLS

	L	T	P
Periods per week	-	-	4

RATIONALE

Diploma holders are required to not only possess subject related knowledge but also soft skills to get good jobs and to rise steadily at their workplace. This subject is included to develop employability skills amongst the students.

DETAILED CONTENTS

1. Industrial Scenario Engineering Education and expectations of competences from an engineer by employer (04 period)

2. Personality types, characteristic and features for a successful engineer (04 period)

3. Professional Engineer desirable values and ethics and their development. Relation between engineering profession, society and environment (04 period)

4. Managing project (16 period)
   - Leadership
   - Motivation
   - Time management
   - Resource management
   - Computer Software
   - Interpersonal relationship
   - Engineer economics and fundamentals

5. Effective Communication (08 period)
   - Listening
   - Speaking
   - Writing
   - Presentation Technique/Seminar
   - Group discussion

6. Preparing for Employment (08 period)
   - Searching for job/job hunting
   - Resume Writing
   - Interview technique in personal interview telephonic interview, panel interview, group interview, video conference

7. Managing Self (06 period)
   - Managers body, mind, emotion and spirit
   - Stress Management
   - Conflict resolution

8. Continuing professional development (04 period)
   - Organising learning and knowledge
   - Use of computer for organising knowledge resource

9. Creativity, Innovation and Intellectual property right (06 period)

- Concept and need in present time for an engineer

10. Basic rules, laws and norms to be adhered by engineers during their working (04 period)