

Diploma in Chemical Production Technology

(A Self Supporting Two Year Interdisciplinary Course leading to Diploma in Chemical Production Technology)

Aims and Objectives:

- This diploma program is designed for students while they pursue graduation in any science subject. The aim is to make students well versed with various aspects of chemical production including unit operations, unit processes, safety and abatement of pollution. Students with specialization in subjects like Botany, Zoology or Physics can also get a job in a chemical industry after completion of this course.
- The aim is to boost employability of students who score average marks (50 to 75%) in their graduation and fail to pursue post graduation because of inadequate marks at qualifying exams. Significantly large percentages of such average students become drop out and join the list of unemployed. Moreover, students doing graduation in other science subjects like Physics, Botany and Zoology also fail to get job.
- After graduation, the students are quite raw and the employer industries are unwilling to spend time and money on practical training of such candidates. The salary paid is often meager for initial two to three years and the candidates are not patient to develop expertise. They often leave the job and prefer to remain unemployed. This is one of the major reasons for unemployment of science graduates and also lack of skilled manpower in the industries.
- This situation calls for designing and implementing a tailor-made course that can satisfy the needs of both the students and the employers. The students from various science subjects can complete a **certificate** or **diploma** course in **Chemical Production Technology**, of one and two years respectively, while pursuing their three year graduation courses. The minimum qualification to get admission for the first year leading to Certificate Course will be XIIth Science pass and for Diploma will be satisfactory completion of Certificate Course.
- The two year Diploma Course will provide an in depth knowledge of various unit operations, unit processes, types of reactors, material of construction, material handling, types of boilers, industrial fuels, handling of industrial gases, toxic and hazardous material, fire-fighting, industrial safety, production record maintenance, effluent treatment and prevention of pollution and conservation of environment. Abreast with theoretical knowledge and practical training, getting a job in industry will be an easy task for the students and the employer will be willing to grab the right talents.

- A two-pronged strategy will be used for extensive training of the students to understand various aspects of operation of a Chemical Plant. First, the syllabi for the certificate and diploma course will be inclusive and extensive, and two, on-plant training of the students. This Course is designed after extensive interactions with the specific industries. Some of the industries have already expressed their desire for providing employment to students who complete such a diploma course. This will provide ample opportunity for placement of students in industries.

Course Structure:

First Year: Certificate Course:

- i. Title:** “Certificate in Chemical Production Technology”
ii. Eligibility: Passed H.Sc. (Science) (XIIth Science)
iii. Duration: One Year (July to February, on-plant training during vacations)

iv. Total Credits: 20 (300 Hrs; One Credit= 15 Hrs)

- v. Contact Hours:**
- | | |
|--|------------------------------------|
| a. Theory: | 12 credits (180 Hrs) |
| b. Practical and on-plant training: | 08 credits (120 Hrs) |
| c. On-Plant Training: | Minimum six days of Eight Hrs |
| d. Project Report: | On completion of on-plant training |

vi. Students Intake: Maximum 35 students

vii. Course Fees: As fixed by University of Pune.

viii. Theory Papers: (Total 12 Credits)

- Paper I: Introduction to General Chemical Industries (Four credits; 60 Hrs)
Paper II: Chemical Production Technology-I (Four credits; 60 Hrs)
Paper III: Industrial Fuels, Pollution and Environment Conservation (Four credits; 60 Hrs)

ix. Practical, field visits and Industrial training: 08 Credits (120 Hrs)

- a. Five practical of three hours duration. (One credit)
- b. Industrial visits: One day visit to minimum three industries. (Two credits)
- c. On-plant training:
Minimum 6 days of eight hours shift and project writing (Five credits)

(On-plant training may be on production plant of any organic/inorganic/sugar/food/agrochemical/dairy industry)

x. Examination: (Evaluation and Assessment)

Paper I: Introduction to General Chemical Industries: 80 Marks + 20 Marks for attendance and class performance.

Paper II: Chemical Production Technology-I: 80 Marks + 20 Marks for attendance and class performance

Paper III: Industrial fuels, pollution and environment conservation: 80 Marks + 20 Marks for attendance and class performance

Practical: Three hours duration: 80 Marks + 20 Marks for attendance and laboratory performance.

Industrial Training and Project Report: 100 Marks

Total maximum Marks: 500

xi. Award of Grades:	80% (> 400 marks) and above	O (out-standing)
	70 to <80% (350 to 399 marks)	A (Very Good)
	60 to <70% (300 to 349 marks)	B (Good)
	50 to <60% (250 to 299 marks)	C (Satisfactory)
	40 to <50% (200 to 249 marks)	D (Pass)
	< 40% (<200 marks)	Fails

xii. Syllabi for Certificate Course:

Paper I: Introduction to General Chemical Industries

Total Teaching Hours: 04 Credits; 60 Hours (July to February)

Units	Particulars of the Topics	Lectures Hrs
Unit I:	Introduction, nature and types of chemical industries, chemical industries and national economy, different departments, legal aspects, location of chemical industries, requirements of chemical industries.	05
Unit II:	Corrosion and corrosion control: Introduction, economic aspects, theories of corrosion, factors affecting corrosion, kinetics of corrosion, corrosion testing techniques,	10
Unit III:	Adsorption and catalysis: General aspects, physical and chemical adsorption, kinetics of chemisorption, theories of adsorption, heterogeneous catalysis, catalyst preparation, storage, catalyst poisoning, surface area determination of a catalyst.	15
Unit IV:	Inorganic heavy Chemical Industries: Introduction to Inorganic chemical industries, basic raw material, transportation, manufacturing process, physicochemical principles, flow sheet, chemical reactions for the production of H ₂ SO ₄ by contact process and HNO ₃ by ammonoxidation.	15
Unit V:	Introduction to Organic Chemical Industries: fine chemicals used as intermediates in production of drugs and pharmaceuticals, dyes, soaps and detergents and polymers	15

Reference:

1. Riegel's hand-book of industrial chemistry
2. RN Shreve: The Chemical Process Industries (MGH)
3. OA Hougen, RM Watson and RA Ragetz: Chemical Process Principles (Vol I & II).
4. Adamson: Surface Chemistry
5. JD Lee: Inorganic Chemistry
6. JK Stille: Industrial Organic Chemistry
7. PC Jain and M Jain: Engineering Chemistry 15th Edition, Dhanpat Rai Publishing Company

Paper II: Chemical Production Technology-I**Total Teaching Hours: 04 Credits; 60 Hours (July to February)**

Units	Particulars of the Topics	Lectures Hrs
Unit I:	Unit Operations I: Evaporation: types of evaporators, forced circulation evaporation, entrainment separators (upturned, deflector, tangential) effect of scale formation, multiple effect evaporators.	15
Unit II:	Unit Operations II: Distillation, simple, fractional, vacuum, flash, steam distillation and azeotropic mixtures	15
Unit III:	Unit Processes I: Details of reagents, reaction mechanism, kinetics, process parameters (temperature, pressure, solvent, stoichiometric ratio, catalyst) in Nitration and Sulphonation.	15
Unit IV:	Unit Processes II: Details of reagents, reaction mechanism, kinetics, process parameters (temperature, pressure, solvent, stoichiometric ratio, catalyst) in Halogenations and Oxidation.	15

Reference:

1. RN Shrove: The Chemical Process Industries (MGH)
2. OA Hougen, KM Watson, RA Ragetz: Chemical Process Principles (Vol I & II)
3. FA Henglein: Chemical Technology (Pergamon)
4. KA Gavhane: Unit Operations II (Nirali Prakashan)
5. PH Groggins: Unit Processes in Organic Synthesis. (MGH)
6. MG Rao and M Sittings: Outline of Chemical Technology (EWP)
7. Calusen and Mattson; Principles of Industrial Chemistry.
8. Kirk and Othmer: Encyclopedia of Chemical Technology
9. SD Shukla and GN Pandey: A Textbook of Chemical Technology Vol II.

Paper III: Industrial Fuels, Pollution and Environment Conservation

Total Teaching Hours: 04 Credits; 60 Hours (July to February)

Units	Particulars of the Topics	Lectures Hrs
Unit I:	Fuels, introduction, types of fuels, calorific value, selection of fuels, handling of fuels, safety standards, rules and regulation.	10
Unit II:	Concept of atom economy, waste minimization, source reduction, use and reuse, reclamation, treatment of waste, effluent treatment.	05
Unit III:	Environment Conservation: Introduction, pollution, types and nature of pollutants, pollution caused by chemical industries, adverse effect of pollution, Environmental legislation, Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act 1981, importance of waste management, management of regulatory affairs.	15

Unit IV:	Industrial Safety and Health: Occupational Health Hazards, promoting safety, safety and health training, stress management. Industrial Noise, sources and its control, effects of noise on auditory system and health; air Pollutants in industries, effect of particulate matter, acid fumes, smoke fog etc on health. Vibrations, effects and control	15
Unit V	Fire and other Hazards: General causes and classification of fires, detection of fire, extinguishing methods, fire fighting installations with and without water, electrical hazards, amperages, voltages, distance from lines, joints and connections, earthing standards, protection against voltage fluctuations.	15

Reference:

1. AK De: Environmental Chemistry
2. SP Mahajan: Pollution control in process industries (MH)
3. Wark and Warnor: air pollution Origin and Control
4. MJ Hammar: Water and waste water technology
5. R Horne: environmental chemistry, wiley
6. Liptak: Air Pollution
7. RK Jain and SS Rao: Industrial safety, health and environment management systems, Khanna publishers, New Delhi (2006)
8. L Slote: Handbook of Occupational safety and health, John Wiley and sons, NY.
9. PC Jain and M Jain: Engineering Chemistry 15th Edition, Dhanpat Rai Publishing Company

c. Practical: (Any five)

1. Distillation of a binary mixture of solvents (minimum two).
2. Purification of a solid using charcoalization and Recrystallization (minimum two).
3. Reaction monitoring using TLC technique (saponification of ethyl benzoate with sodium ethoxide).
4. Find percentage of available chlorine in the given sample of Bleaching Powder.
5. Preparation of p-nitroacetanalide, recrystallization, charcoalization, calculating yield.
6. Preparation of pentathiourea dicuprous nitrate and find its percentage purity.
7. Prepare and find practical percentage yield of zinc ferrite.
8. Preparation, purification and calculation of yield of aryloxyacetic acid.

d. Industrial Training and Project Report: Students are expected to complete minimum 6 days of on-plant training in any of the chemical, pharmaceutical, sugar or food industry and submit a project report on the same.

Second Year: Diploma Course:

- i. Title:** “Diploma in Chemical Production Technology”
- ii. Eligibility:** Earned 20 Credits in first year certificate course.
- iii. Duration:** One Year (July to February, on-plant training during vacations)

- iv. Total Credits:** 40 (20 earned from certificate course) (300 Hrs; One Credit= 15 Hrs)

- v. Contact Hours:**
 - a. Theory:** 12 credits (180 Hrs)
 - b. Industrial visit & training and Project:** 08 credits (120 Hrs)

- vi. Students Intake:** Maximum 35 students
- vii. Course Fees:** As fixed by University of Pune.

viii. Theory Papers: (Total 12 Credits, 180 Hrs)

Paper I: Chemical Production Technology-II (Four credits; 60 Hrs)
Paper II: Chemical Production Technology-III (Four credits; 60 Hrs)
Paper III: Industrial Management (Four credits; 60 Hrs)

ix. Industrial visits and Industrial training: 08 Credits (120 Hrs)

- a. Industrial visits (minimum four) (02 credits)
- b. On-plant training:
Minimum 12 days of eight hours shift and project writing (05 credits)
- c. Project writing (01credits)

(On-plant training may be on production plant of any organic/inorganic/sugar/food/agrochemical/dairy industry)

x. Examination: (Evaluation and Assessment)

Paper I: Chemical Production Technology-II: 80 Marks + 20 Marks for attendance and class performance.

Paper II: Chemical Production Technology-III: 80 Marks + 20 Marks for attendance and class performance

Paper III: Chemical Technology and Industrial Production Management: 80 Marks + 20 Marks for attendance and class performance

Industrial visits and Project report: 100 Marks

Industrial Training: 100 Marks

Total maximum Marks: 500

xi. Award of Grades:

80% (> 400 marks) and above	O (out-standing)
70 to <80% (350 to 399 marks)	A (Very Good)
60 to <70% (300 to 349 marks)	B (Good)
50 to <60% (250 to 299 marks)	C (Satisfactory)
40 to <50% (200 to 249 marks)	D (Pass)
< 40% (<200 marks)	Fails

xii. Syllabi for Diploma Course:

Paper I: Chemical Production Technology-II

Total Teaching Hours: 04 Credits; 60 Hours (July to February)

Units	Particulars of the Topics	Lectures Hrs
Unit I:	Unit Operations: III: Extractions: Types, extraction with reflux, with agitation, equipments, use and performance of extraction, continuous contact and agitator extractors, packed spray extractors, solid-liquid extraction, counter current extraction. Filtration: Classification of filters, sand filters, filter press, filter aids	15
Unit II:	Unit Operations IV: Heat and heat Exchangers: Introduction, conduction of heat (principles without mathematical treatment), convection of heat, thermal insulation. Heat Exchange Equipments: Introduction, double pipe, shell and tube, fixed tube, U tube exchangers,	15
Unit III:	Unit Operations V: Drying: general principles, rate of drying, factors affecting drying, drying equipments, tray dryers, rotary dryers, single drum dryer and spray dryer.	15
Unit IV:	Unit Operations VI: Crystallization: Growth of crystals, saturation, nucleation super saturation (Mier's Theory) caking of crystal, effect of impurities, classification of crystallizers, agitated tank, continuous vacuum crystallizer	15

Reference:

1. Riegel's hand-book of industrial chemistry
2. RN Shreve: The Chemical Process Industries (MGH)
3. OA Hougen, RM Watson and RARagetz: Chemical Process Principles (Vol I & II).
4. PH Groggins: Unit Processes in Organic Synthesis (MGH)
5. FA Henglein: Chemical Technology (Pragmon)
6. KA Gavhane: Unit Operations II (Nirali Prakashan, Pune)

Paper II: Chemical Production Technology-III**Total Teaching Hours: 04 Credits; 60 Hours (July to February)**

Units	Particulars of the Topics	Lectures Hrs
Unit I:	Equipment Design: Material of Construction: Mechanical properties, corrosion resistance, metals and alloys, stainless steel, special material for food and pharmaceutical equipments, protective coatings, surface treatment to metals for corrosion resistance Design of vessels: classification of chemical reactors, pressure vessels, maintenance, storage vessels for liquid and gases, design of chemical reactors, reactors with provision for addition of chemicals, agitation, heating purgers and vent outlets.	15
Unit II:	Material and energy balance: Process classification, choice of system, material balance calculations, multiple unit processes, recycle. Energy balance: Forms of energy, energy changes in physical processes, energy changes in chemical reactions, energy balance calculations.	15
Unit III:	Unit Processes III: Details of reagents, reaction mechanism, kinetics, process parameters (temperature, pressure, solvent, stoichiometric ratio, catalyst) in Esterification and Hydrolysis.	15
Unit IV:	Unit Processes IV: Details of reagents, reaction mechanism, kinetics, process parameters (temperature, pressure, solvent, stoichiometric ratio, catalyst) in Amination by reduction, Hydrogenation and FC Alkylation and Acylation	15

Reference:

1. PH Groggins: Unit Processes in Organic Synthesis (MGH)
2. MG Rao and M sittings: Outline of Chemical Technology (EWP)
3. FA Henglein: Chemical Technology (Pergamon)
4. Kirk and Othmer: Encyclopedia of Chemical Technology
5. SD Shukla and GN Pandey: A Textbook of Chemical technology Vol II
6. JK Stille: Industrial Organic Chemistry (P II)
7. RN Shreve: The Chemical Process Industries (MGH)

Paper III: Chemical Technology and Industrial Production Management

Total Teaching Hours: 04 Credits; 60 Hours (July to February)

Units	Particulars of the Topics	Lectures Hrs
Unit I:	Unit Processes V: Fermentation technology: Definition and basic concepts of fermentation, traditional fermentation: beer, wine and vinegar. Contemporary fermentation: Citric acid, antibiotics, enzymes and vitamins. Microorganism: bacteria, Fungi, algae and Actinomycetes. Factors affecting fermentation process: temperature, pH, UV light, heavy metals, surface tension	15
Unit II:	Industrial Instrumentation: Measurement of temperature, thermo couples, pyrometers, high temperature thermometers and optical pyrometers Measurement of pressure: Barometric and Bourdon gauges, vacuum gauges, Flow measurement. Liquid level indicators: Hook type, sight glass, float type, radiation level indicator.	15
Unit III:	Green Chemistry and Process Development: Introduction, tools of green chemistry, principles of green chemistry, examples of green chemistry. Process development: purpose, planning, design and operation, compromises to cope-up for safety.	15
Unit IV:	Sensor Technology: Introduction, recent trends, classification of sensors, electro analytical sensors, electrodes, metal membrane sensors, ionic conductors, thin and thick film sensors, nano sensors, application of sensors in industry	15

Reference:

1. AH Patel: Industrial Microbiology
2. Stanbury and Whitkar: Principles of Fermentation Technology (Pergamon)
3. RY Stainer: general Microbiology (Macmillan Press)
4. SK Singh: Industrial Instrumentation and Control Tata Mc Graw-Hill, New Delhi.
5. PT Anastasas and JC Warner: Green Chemistry; theory and Practice (Oxford Univeristy press)
6. D Patranabis: Sensors and Transducers.