5.1 EMPLOYABILITY SKILLS – I

L	T	P
-	-	2

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 is to prepare students for employability in job market and survive in cut throat competition among professionals.

DETAILED CONTENTS

1. Writing skills (08 hrs)
   - i) Official and business correspondence
   - ii) Job application - covering letter and resume
   - iii) Report writing - key features and kinds

2. Oral Communication Skills (20 hrs)
   - i) Giving advice
   - ii) Making comparisons
   - iii) Agreeing and disagreeing
   - iv) Taking turns in conversation
   - v) Fixing and cancelling appointments

3. Generic Skills (04 hrs)
   - i) Stress management
   - ii) Time management
   - iii) Negotiations and conflict resolution
   - iv) Team work and leadership qualities

5.2 ENVIRONMENTAL EDUCATION

L	T	P
3	-	-

RATIONALE

Education about environment protection is a must for all the citizens. In addition, a diploma holder must have knowledge of different types of pollution caused by industries and construction activities so that he may help in balancing the eco system and controlling pollution by adopting pollution control measures. He should also be aware of environmental laws related to the control of pollution.

DETAILED CONTENTS

1. Definition, Scope and Importance of Environmental Education (02 hrs)

2. Basics of ecology, biodiversity, eco system and sustainable development (03 hrs)

3. Sources of pollution - natural and manmade, causes, effects and control measures of pollution (air, water, noise, soil, radioactive and nuclear) and their units of measurement (12 hrs)

4. Solid waste management – Causes, effects and control measures of urban and industrial waste (06 hrs)

5. Mining and deforestation – Causes, effects and control measures (04 hrs)

6. Environmental Legislation - Water (prevention and control of pollution) Act 1974, Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board, Environmental Impact Assessment (EIA) (10 hrs)

7. Role of Non-conventional Energy Resources (Solar Energy, Wind Energy, Bio Energy, Hydro Energy) (04 hrs)

8. Current Issues in Environmental Pollution – Global Warming, Green House Effect, Depletion of Ozone Layer, Recycling of Material, Environmental Ethics, Rain Water Harvesting, Maintenance of Groundwater, Acid Rain, Carbon Credits. (07 hrs)

INSTRUCTIONAL STRATEGY

The contents will be covered through lecture cum discussion sessions. In addition, in order to have more appreciation of need for protection of environment, it is suggested that different activities pertaining to Environmental Education like video films, seminars, environmental awareness camps and expert lectures may also be organized.

RECOMMENDED BOOKS

1. Environmental Engineering and Management by Suresh K Dhameja; SK Kataria and Sons, New Delhi.
2. Environmental Science by Dr. Suresh K Dhameja; SK Kataria and Sons, New Delhi.
3. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
4. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
5. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
7. Environmental Studies by Erach Bharucha; UGC University Press.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted for Lectures (Periods)	Marks Allotted (%)
1	02	04
2	03	06
3	12	24
4	06	12
5	04	10
6	10	20
7	04	10
8	07	14
Total	**48**	**100**

5.3 CHEMICAL REACTION ENGINEERING

L	T	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. Introduction to Chemical Kinetics (12 hrs)

   Homogenous Reaction, Heterogeneous Reaction, Catalytic and Non-catalytic reaction, Elementary and Non – elementary, Simple and Multiple reaction, Reversible and Irreversible reaction, Endothermic and Exothermic reaction – definition and example. Chemical Equilibria, Le-chatlier principle and factors affecting chemical Equilibria like temperature, concentration, pressure, catalyst.

2. Kinetics of Homogenous Reaction (14 hrs)

   Concept of rate of reaction, rate equation, rate constant, order of reaction, molecularity of reaction, factors affecting rate of reaction. Theories of reaction rate constant; Arrhenius Law and problems based on it from thermodynamics, from collision theory, from transmission state theory. Activation energy – concept.

3. Interpretation of Batch Reactor Data (20 hrs)

   Constant Volume Batch Reactor, Relation of concenteration and conversion for constant volume batch reactor, analysis of total pressure data obtained in constant volume batch reactor. Methods used to analyse the kinetic data/rate data or to determine order of reaction: Integral method of analysis of rate data – procedure. Integral method of analysis for irreversible unimodecular, first order reaction, bimolecular second order reaction, n^{th} order reaction, zero order reaction and simple problems. Half life concept for the overall order of irreversible reaction. Differential method of analysis of rate data or order of reaction – only procedure. Variable Volume Batch Reactor – concept only.

4. Reactors (12 hrs)

Basic type of reactors - batch reactor, CSTR, plug flow reactor, semi-batch reactor. Fixed bed reactor Vs Fluidised bed reactor. Performance equation for ideal batch reactor, MFR, PFR for constant volume – no derivation only final expression and their graphical representation of first order irreversible reaction. Concept of space time, space velocity, and holding time.

5. Catalysis (06 hrs)

Definition, types and classification, preparation of catalyst, ingredients (promoters, inhibitors, accelerators). Catalyst poisoning, regenerator.

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 Hrs
1	12	15
2	14	25
3	20	30
4	12	20
5	06	10
Total	**64**	**100**

5.4 MASS TRANSFER – II

L	T	P
4	-	3

RATIONALE

In this subject, the basic concepts of mass transfer are covered to enable the students to understand working of various mass transfer equipment like distillation columns, crystallizers and extractors which are used in industries.

DETAILED CONTENTS

1. Distillation (22 hrs)

- Concept of Distillation, Vapour Liquid Eqilibria, Roault's Law, Dalton's Law Volatility: Relative Volatility, Derivation to calculate Vapour composition and liquid composition.

- Methods of Distillation: Differential or simple Distillation, Rayleigh's equation. Flash or Equilibrium Distillation. Material Balance, Rectification: Fractionating Column, Material Balance, Mc Cabe Theile Method (only procedure) Feed plate, feed line, q-line, effect of feed condition, reflux ratio, total reflux ratio, Minimum reflux ratio, optimum reflux ratio.

- Based Distillation, Azeotropic Distillation, Extractive Distillation, steam Distrillation.

- Equipment for distillation – plate column, packed column. Concept of flooding, Weeping, Entrainment and loading in distillation columns.

2. Leaching and Extraction (12 hrs)

- Extraction: Definition and application of extraction, (final expression and physical meaning of terms therein, no derivation) equipment: mixer settler, spray and packed extraction towers, perforated plate extraction tower, agitated tower extractor.

- Leaching: Definition and application of leaching, equipment: leaching through stationary solid beds, moving beds, ideal stages in counter current leaching.

3. Crystallization (10 hrs)

- Concept of crystallization, saturation and super saturation and solubility curve, mechanism of crystallization/crystal formation, method of super saturation – Miers saturation theory.

- Classification of crystallizers – construction and working of agitated tank crystallizer, draft tube, baffle tube crystallization, Swenson and walker crystallizer, vacuum crystallizer.

4. Adsorption (10 hrs)

Concept of Adsorption operation, types of adsorption and nature of adsorbent, effect of temp. on adsorption and industrial application, adsorption isotherms.

5. Membrane Separation (10 hrs)

Introduction to Membrane Separation, Types of Membrane, Membrane Separation Processes, Brief Introduction: reverse osmosis, microfiltration, ultra filtration, dialysis.

LIST OF PRACTICALS

1. To separate given solution mixture with the help of a bubble cap distillation column.
2. To draw calibration curve for a given mixture using refractive index and to find out the unknown concentration from this calibration curve.
3. Experiment on extraction of oil from solids
4. Experiment on crystallizer
5. To study the reverse osmosis set up
6. To separate a mixture of two liquids using liquid extraction
7. To verify Rayleigh's equation using batch distillation set up.

INSTRUCTIONAL STRATEGY

Field visit will make the students familiar with different types of column (packed/tray), different types of packing used in the column, different types of extractors and membrane separation techniques. This will also make the students aware of auxiliary equipment/model/ supports for different equipments. Emphasis should also be given to problem solving and practices especially for distillation column and extraction.

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 Pigford and Wilke; McGraw Hill Publication

5. Chemical Engineering Handbook 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 Hrs
1	22	35
2	12	20
3	10	15
4	10	15
5	10	15
Total	**64**	**100**

5.5 PETROLEUM AND PETROCHEMICAL TECHNOLOGY

L	T	P
4	-	3

RATIONALE

Petroleum industry is one of the fastest growing industries and it has large employment potential. Therefore, this subject is being offered as a core subject. Students will be imparted detailed knowledge of petroleum and petroleum products along with processes involved in their production.

DETAILED CONTENTS

1. Introduction (10 hrs)

   Petroleum industry in India, origin of petroleum, exploration, drilling and production of petroleum crude, transportation of crude and products, crude pretreatment composition and classification of crudes.

2. Testing Methods of Petroleum Products (10 hrs)

   Method of Evaluation : ASTM, TBP & EFV distillation, definition and practical utility of cloud and pour point, flash and fire point, octane number and cetane number, smoke point and aniline point, API gravity and specific gravity, properties and specification of petroleum products such as LPG, gasoline, naphtha, kerosene, diesel oil, lubricating oils and waxes.

3. Thermal and Catalytic Processes (10 hrs)

   Cracking, reforming, alkylation, polymerization.

4. Separation Processes (10 hrs)

   Operation of topping and vacuum distillation units, tube still furnaces, solvent extraction process for lube oil.

5. Important Petrochemical Feed Stocks and Precursors (10 hrs)

   Name and uses of important chemicals from: C_1 compound (Methanol and Synthesis gas), C_2 compound (ethylene and acetylene), C_3 compound (propylene), C_4 compounds (Butanes and Butenes).

6. Manufacturing Process of Petrochemicals (flow sheet and description only) (14 hrs)

   Synthesis gas, acetaldehyde, vinyl acetate, ethylene oxide, vinyl chloride, styrene, cumene, acetone, benzaldehyde, acrylonitrile , butadiene, phenol from cumene.

LIST OF PRACTICALS

1. To find out flash and fire point of given oil.
2. To find out smoke point of given oil.
3. To find out viscosity by redwood viscometer.
4. To find out cloud and pour point of given oil.
5. To find out calorific value by using bomb calorimeter.
6. To determine the softening of bitumen.
7. To determine the percentage moisture of given oil.
8. To perform the ASTM distillation of gasoline.
9. To determine the penetration number of grease sample.

INSTRUCTIONAL STRATEGY

Theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with assignments. Extension lectures by experts from petroleum industry can enrich the students with better inputs regarding the various processes involved for improving he quality of petroleum products. Also a visit of the students to a refinery will further help them to understand the different processes and equipment involved in the petroleum and petrochemical industry.

RECOMMENDED BOOKS

1. Petroleum Refinery Engineering by WL Nelson, 5th edition, McGraw Hill, 1985
2. Petroleum Processing by RJ Hengsbeck
3. Modern Petroleum Refining Proesses, B.K. Rao, 5th Edition, Oxford and IBH Publishing Co, 2009
4. Introduction to Petrochemicals, S. Maiti, Oxford and IBH Pub.Co. Ltd. New Delhi, 1992
5. The Chemistry of Petrohemicals, M.J. Astle, Reinhold.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted Hrs
1	10	15
2	10	20
3	10	15
4	10	15
5	10	15
6	14	20
Total	**64**	**100**

5.6 COMPUTER APPLICATIONS IN CHEMICAL INDUSTRY

L	T	P
-	-	3

RATIONALE

In today's environment almost all the processes in chemical industry are computerized. In order to prepare diploma holders to work in this environment, this subject has been kept as a core subject. This subject will ensure the students to have proficiency in handling different types of softwares used in chemical industries.

DETAILED CONTENTS

1. Introduction (6 hrs)

   Introduction to computers and its various parts; CPU, peripheral devices (Input devices : mouse, keyboard, joystick, touchpad, tract ball, light pen etc. Output devices: printers, monitors, speakers etc.)

2. Hardware and Software (Application software and system software). (6 hrs)

3. Introduction to various computer generations (I to V Generations) and their development : Languages : Machine language, Assembly language, High level languages. (5 hrs)

4. Types of Computers: Personal Computers, Minicomputers, Microcomputers, Mainframe and Supercomputers, Based on the data handled: Digital, Analog and Mixed Computers. (4 hrs)

5. Concept of timesharing, multiprogramming, multi-testing and real time processing. (3 hrs)

6. Application software like: MS-Word, MS-Excel and MS-Powerpoint. (12 hrs)

7. Simple programmes related to Chemical Industry in Excel (8 hrs)

   Example:

   - Calculation of area of Heat Exchanger
   - Calculation of area of cylinder
   - Conversion of Unit (^{o}F to ^{o}C)
   - Calculation of velocity from volumetric flow rate and area

8. Introduction to Internet (4 hrs)

Types of connections/networks : LAN, MAN, WAN, dial-up, leased. History of internet, usage of internet, email etc.

INSTTRUCTIONAL STRATEGY

The subject will require theory as well as practical aspects of the use of computer beginning with introduction of computers, its various parts and its different generations. The main emphasis will be on the use of MS Office and also solving simple programmes related to chemical engineering.

RECOMMENDED BOOKS

1. Introduction to Computers by A. Leon and Leon

2. Algorithm and Data Structure Program by Wirth, PHI

3. The Art of Computer Programming by Kruth, Addison Wesley Publicaiton

4. A First House in Computers by Sanjay Saxena, 2000, Vikas Publication

5.7 PLANT SAFETY

L	T	P
3	-	-

RATIONALE

This subject is introduced to give the students a thorough knowledge of safety techniques and other safety parameters, which is essentially required for working in any chemical industry.

DETAILED CONTENTS

1. Safety Consideration in Process Industries (12 hrs)

   Introduction, OSHA and PSM (occupational safety and health administration and process safety management). HARA (Hazard analysis and risk assessment). Accident and their causes (unsafe act, unsafe condition, multiple causes).

2. Types of Hazards in Industries (12 hrs)

   Heat and Temperature, Pressure, Toxic material, Fire explosion, Radiation. Terms related to concentration levels (maximum allowable concentration, ceiling value, threshold limit value, short term exposure limits), toxic chemicals and their effect on human system.

3. Risk Management Plan (12 hrs)

   The personal protective equipment (Head, Finger, Hand, Arm, Ear, Face and Eye, Foot and Leg, Lungs and Respiratory Tract, Body Protection), fire triangle, fire tetrahedron. Classification of fires, Fire extinguishers, types of fire extinguishers (water, carbon dioxide, Foam, Dry Powder) common terms used in fire hazards (fire escapes, fire towers, exits, travel distance, floor area ratio), planning for emergencies.

4. Important Industrial Acts Related to Safety (12 hrs)

   - Health and Safety Provisions of the Factories Act 1948
     (Cleanliness and disposal of wastes and effluents, ventilation and temperature, dust and fumes, artificial humidifiction, avoidance of over crowding, lighting, drinking water, latrines, urinals and spittoons)

   - Safety Provision of the Act

   - India Boiler Act 1923
     (Purpose of the Act, meaning of accident, function of central boilers, bore, provision of the Act, registration of the boiler, renewal of the certificate)

INSTRUCTIONAL STRATEGY

Industry visits can be planned to give idea about the practices, adopted in the industry. Demonstrations can be arranged for various types of fire extinguishers used in buildings. Pictures and movies can be shown to the students regarding prevention and abetment of fire, use of fire fighting devices, precautions taken while storing and transporting chemicals.

RECOMMENDED BOOKS

1. Industrial Safety Management, By N.K. Tarafdar and K.J. Tarafdar, Dhanpat Rai and Company
2. Handbook of Industrial Chemistry Organic Chemicals by Mohammad Farhat Ali, Bassam M.E. Ali; McGraw Hill Publisher
3. Safety and Accident Prevention in Chemical Operation by Fawelt and Wood, Inter Science Publication.
4. Chemical Engineering, Vol I, II, III and IV by Coulson and Richardson, Pergamon Press Publication.
5. Safety in Process Plant Design by Wills, G.I.
6. Loss Prevention in Process Industries by Less, F.P.
7. Safety for Chemical Engineers, AI. ChE Publications, 1976-77.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted Hrs
1	12	25
2	12	25
3	12	25
4	12	25
Total	**48**	**100**

5.8 MINOR PROJECT WORK

L	T	P
-	-	6

Minor project work aims at exposing the students to field practices, size and scale of operation and work culture at practical sites. For this purpose, students during the semester are required to be sent to different work sites. Some of the good industries are as follows:

List of Industries

1. Ballarpur Industried Limited, Yamunanagar
2. Panipat Refinery, Panipat
3. National Fertilizers Ltd., Panipat
4. Bharat Starch & Chemicals Ltd., Yamunanagar
5. Karnal Coopretive Sugar Mills Ltd., Karnal
6. National Dairy Research Institute , Karnal
7. Indian Acrylic, Bhawanigarh
8. Pepsi Foods, Channo (Bhawanigarh)
9. JCT, Hissar
10. M/S Cure Quick Pharma, Karnal 20/3, HSIDC, Karnal
11. Ruchire Paper Mills Ltd., Kala amb
12. NFL, Nangal
13. PACL Nangal
14. Max GB. Ropar
15. Ranbaxy, Ropar
16. Shreyans Paper Mill, Ropar
17. PCPL Derabassi
18. SIEL Complex, Rajpura
19. JIL, Hamira
20. Rana Sugar Mill, Bulter
21. Trident, Barnala
22. IAL, Saugrur
23. Barnala Paper Mill
24. Paper Mill, Jagadhari
25. Thermal Plant, Panipat
26. NFL, Bathinda
27. Sukhjit Starch and Chemicals, Phagwara
28. Horlicks, Nabha
29. NESTLE, Ferozpur Road, Moga
30. K.B.R.L., Dhrui-Malerkotla Road, Bhasaur, Dist Sarangrur
31. Oswald Oils and Fats, Raikot
32. A.P Solvex Ltd. Dhuri
33. Shreyans Paper Mills, Ahmedgarh
34. Ind Swift- Barwala road, Chandigarh
35. Panecea BioTech, Lalroo

36. Morpen Pharmaceuticals, Parwanoo
37. Sanchez Pharmaceuticals, Tohana, Tricrossing Tohana, Distt. Fatehabad
38. Wochert, Ambala-Chandigarh. Road, Lalroo
39. Amrit Vanaspati, Rajpura
40. Diplast Industries, Mohali
41. Mount Shivalik Breweries, Derabassi
42. PCPL Chemicals, Derabassi

As a minor project activity, each student is supposed to study the material and technologies used at site and prepare a detailed project report of the observation of processes seen by him/her. The students should be supervised and guided by respective subject teachers. Each teacher may guide a group of four to five students.

The teacher along with field supervisors will conduct performance assessment of students. The components of evaluation will include the following:

a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with workers	15%
d)	Industrial training report	55%