# Syllabus of 3rd Year B. Sc. Chemistry (Hons.)

## As Per National Education Policy 2020 (NEP 2020)

UPL UNIVERSITY OF SUSTAINABLE TECHNOLOGY

## UPL University of Sustainable Technology

## SRICT- Institute of Science & Research

**AY-2025-2026**

| UPL University of Sustainable Technology, Ankleshwar | | | | |
|---|---|---|---|---|
| SRICT-Institute of Science and Research (SRICT-ISR) | | | | |
| B. Sc. - Chemistry (Hons.) 3rd Year | | | | |
| **SEM** | **TYPE OF COURSE** | **COURSE CODE** | **NAME OF SUBJECT** | **Credits** |
| 5 | MAJOR | CHM400-3C | Applied Inorganic Chemistry | 4 |
| | MAJOR | CHM401-3C | Analytical Chemistry | 4 |
| | MAJOR | CHM402-3C | Practicals in Chemistry-III | 4 |
| | MINOR | CHE400-3C | Industrial Chemistry | 4 |
| | MINOR | CHE401-3C | Green Chemistry | 4 |
| | SEC | SEC400-3C | Basics of Unit Operations | 2 |
| | SEC | SEC401-3C | Advanced Spreadsheet Tools | 2 |
| | SEC | SEC402-3C | IT skills and Data Analysis | 2 |
| | | | Total Credits | 22 |
| 6 | MAJOR | CHM403-3C | Natural & Synthetic Molecules | 4 |
| | MAJOR | CHM404-3C | Electrochemistry, Equilibrium and Solid State | 4 |
| | MAJOR | CHM405-3C | Practicals in Chemistry-IV | 4 |
| | MINOR | CHE402-3C | Petrochemicals | 4 |
| | AEC | AEC400-3C | General Principles of Writing | 2 |
| | AEC | AEC401-3C | Business Communications | 2 |
| | SEC | SEC403-3C | Internship | 4 |
| | | | Total Credits | 22 |

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

### B. Sc. (Hons.) - CHEMISTRY
### B. Sc. SEM V
### Teaching/Exam Scheme
### (As per NEP-2020)

**w.e.f.: July-2025**

| No. | Course Code | Category of course | Course title | Hours Per week | | | Total hrs | Credit | CCE | SEE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | | | | |
| 1 | CHM400-3C | MAJOR | Applied Inorganic Chemistry | 4 | - | - | 4 | 4 | 50 | 50 | 100 |
| 2 | CHM401-3C | MAJOR | Analytical Chemistry | 4 | - | - | 4 | 4 | 50 | 50 | 100 |
| 3 | CHM402-3C | MAJOR | Practicals in Chemistry-III | - | - | 8 | 8 | 4 | 50 | 50 | 100 |
| 4 | CHE400-3C | MINOR | Industrial Chemistry | 4 | - | - | 4 | 4 | 50 | 50 | 100 |
| 5 | CHE401-3C | MINOR | Green Chemistry | 4 | - | - | 4 | 4 | 50 | 50 | 100 |
| 6 | SEC400-3C | SEC | Basics of Unit Operations | 2 | - | - | 2 | 2 | 25 | 25 | 50 |
| | SEC401-3C | SEC | Advanced Spreadsheet tools | 2 | - | - | 2 | 2 | 25 | 25 | 50 |
| | SEC402-3C | SEC | IT skills and Data Analysis | 2 | - | - | 2 | 2 | 25 | 25 | 50 |
| | | | Total | 18 | - | 8 | 26 | 22 | 275 | 275 | 550 |

- CCE - Continuous and Comprehensive Evaluation.
- SEE – Semester End Evaluation.

| | |
|---|---|
| Skill Enhancement Courses (SEC) | 1. SEC400-3C: Basics of Unit Operations<br>2. SEC401-3C: Advanced Spreadsheet Tools<br>3. SEC402-3C: IT skills and Data Analysis |

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: CHM400-3C

## Course Name: Applied Inorganic Chemistry

## Semester: V

**w.e.f.: July 2025**

**Type of course:** Major Course

**Prerequisite:** Should have an underlying knowledge of general inorganic chemistry.

**Rationale:** At the end of the course, students will have knowledge of polymer chemistry, organometallic chemistry, and nuclear chemistry.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | Total | CCE Marks | SSE Marks | |
| 4 | - | - | 4 | 50 | 50 | 100 |

**Contents:**

| Sr. No. | Content | Total Hours |
|---|---|---|
| | **SECTION - A** | |
| **1** | **Inorganic polymer**<br>Types of inorganic polymers, comparison with organic polymers, degree of polymerization, classification of polymers, number, weight and viscosity average molecular weights, polydispersity index and molecular weight distribution, some inorganic polymers: synthesis, structural aspects and applications of silicones and siloxanes, borazine, silicates, phosphazenes, polyphosphates and polysulphates. | **12** |
| **2.** | **Acids and bases**<br>Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, leveling solvents, Lewis's acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB), Application of HSAB principle. Acid-Base equilibria in solution: Hydrolysis of | **9** |

| | | |
|---|---|---|
| | salts, pH calculation. Buffer. | |
| **3** | **Organometallic chemistry**<br>Organometallic compounds. Ligands in organometallic compounds. Electron rule-applications and limitations. Preparation, properties, Structure and bonding in ferrocene, and Zeise's salt. Hydrogenation of olefins-Wilkinson's catalyst - Ziegler-Natta catalyst. | **12** |
| **SECTION - B** | | |
| **4** | **Bio - Inorganic chemistry**<br>Metal ions present in biological systems, Metallo biomolecules – classification, Structure and functions of hemoglobin, myoglobin, Metalloenzymes: Carbonic anhydrase, Carboxypeptidase, and peroxidase. Role of alkali and alkaline earth metal ions in biological system. Biological fixation of nitrogen. | **9** |
| **5** | **Nuclear chemistry**<br>Isotopes, Isotones, Isobar, stable and unstable isotopes, separation of isotopes by different methods, Nuclear reactions, Nuclear Fission and Fusion reaction, Nuclear equation, Energy released in Nuclear reaction, Mass defect, Nuclear Binding energy, Nuclear chain reaction, Nuclear reactor, Numerical problems. | **9** |
| **6** | **Inorganic industrial chemistry**<br>**Glass:** Glassy state and its properties, classification (silicate and nonsilicate glasses). Manufacture and processing of glass. Composition and properties of the different types of glasses.<br>**Ceramics**: Important clays and feldspar, ceramics, their types, and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes, carbon nanotubes, and carbon fiber.<br>**Cements:** Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick-setting cements. | **9** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks (%)** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **25** | **30** | **10** | **15** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

**Text Books:**

1. Lee J. D., Concise Inorganic Chemistry, 5th Edition, Oxford University Press, 2008.
2. Puri. Sharma and Kalia, Principles of Inorganic Chemistry, 33rd Edition, Vishal Publishing Co., 2020.
3. P. L. Soni, A textbook of inorganic chemistry, 11th Edition, Sultan Chand & Sons, 1963.
4. Gurudeep Raj, Goel, Advanced Inorganic Chemistry, 2nd Edition, Pub. House, Meerut, 1974.
5. Wahid U. Malik, G. D. Tuli, R. D. Madan, Selected Topics in Inorganic Chemistry, 1st Edition, S. Chand publishing, 1999.
6. R.K.Sharma, Textbook of Coordination Chemistry, 1St Edition, Discovery Publishing House, 2014.
7. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut, 1996.

**Reference Books:**

1. F.A. Cotton, G Wilkinson, Basics of Inorganic Chemistry, 3rd Edition, Wiley International, 2007.
2. Ajai Kumar, Coordination Chemistry, 7th Edition, Pub. House, Aaryush, 2020.

**Course Outcomes:**

**After completing this course, student will be able to**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Describe the basics of inorganic polymer. | 20% |
| CO-2 | Explain the basics and applications of the HSAB principle. | 15% |
| CO-3 | Discuss the 18 electron rule and organometallic catalyst. | 20% |
| CO-4 | Discuss the structure and functions of various metalloenzymes. | 15% |
| CO-5 | Discuss isotopes and separation of isotopes by different methods. | 15% |
| CO-6 | Discuss inorganic industrial chemistry. | 15% |

**List of Open Source Software/learning website:**

- https://emb-iitk.vlabs.ac.in/exp/tem-analysis/
- https://www.rsc.org/pe
- https://archive.nptel.ac.in/courses/

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: CHM401-3C

## Course Name: Analytical Chemistry

## Semester: V

**W.E.F.: July 2025**

**Type of course:** Major Course

**Prerequisite:** Should have underlying knowledge of basics of Analytical Chemistry, good laboratory practices and Analytical titrations.

**Rationale:** At the end of the course, students will have knowledge about good laboratory practices and different analytical titration methods.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | Total | CCE Marks | SSE Marks | |
| 4 | - | - | 4 | 50 | 50 | 100 |

**Contents:**

| Sr. No. | Content | Total Hours |
|---|---|---|
| | **SECTION - A** | |
| 1 | **Introduction of Analytical Chemistry**<br>Definition of analytical chemistry, Introduction to Analysis. Chemical and Instrumental Analysis and their advantages and disadvantages. Methods used in Quantitative analysis (classification of classical and instrumental analysis).<br>Idea of significant figures-its importance. Accuracy- Method of expressing accuracy error analysis- types of errors-minimizing errors. Precision- methods of precision – mean, median, mean deviation, standard deviation. . | **10** |
| 2. | **Separation Methods**<br>Solvent Extraction: Factors affecting extraction: Chelation, Ion pair formation and Solvation, Graph of percent extraction versus pH. Concept of [pH] 1/2 and | **10** |

| | | |
|---|---|---|
| | its significance (derivation not expected), Solvent extraction and Solid phase extraction: Principle, process and applications. Introduction, Principle, Theory of TLC, HPTLC, HPLC and GC. | |
| **3** | **Spectroscopy**<br>Basics of spectroscopy, Types of spectrum, Process involved in interaction with matter (Fluorescence, Phosphorescence), Components of Spectrophotometer- Sources, Grating and Prism as dispersing device, Sample handling, Detectors- Photo tube, Photomultiplier tube. Ultra-violet and Visible Spectroscopy: Basic principles of instrumentation for single and double beam instrument. Application of UV in various fields. Raman Spectroscopy: Introduction to Raman Spectroscopy and its applications. | **10** |
| **SECTION - B** | | |
| **4** | **Thermo Gravimetric Analysis**<br>Principle, Instrumentation, Determination of purity and thermal stability of primary and secondary standards, determination of correct drying temperature, determination of curie point, automatic determination of mixtures, analysis of alloys Characteristics of TGA curves- $CaC_2O_4.H_2O$, $CaSO_4.5H_2O$. Applications, Factors affecting TGA curves. . | **10** |
| **5** | **Electro Analytical Techniques-I**<br>Conductometric titrations: Principle and Applications of conductivity measurements. Different types of Conductometric titrations. Potentiometric titrations: Principle and applications. Potentiometric Determination of Fe (II) Vs. Cr (VI) and Fe (II) Vs. Mn (VII). pH METRIC TITRATIONS: Principle, Instrumental components and Applications of pH metric titrations. | **10** |
| **6** | **Electro Analytical Techniques-II**<br>Introduction and Basic Principles of Polarography. Residual current, migration current, diffusion current, half wave potential and Ilkovic equation. Instrumentation and techniques of Polarography technique. Introduction and Principles of Coulometry. Types of Coulometric methods: Potentiostatic and amperostatic coulometric methods. | **10** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks (%)** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |

| | | | | | |
|---|---|---|---|---|---|
| **25** | **30** | **10** | **15** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

**Text Books:**

1) Quantitative Analysis by R. A. Day & A. L. Underwood, 6th ed. Pub. Prentice Hall of India ltd.
2) Vogel's Text Book Inorganic Quantitative Analysis, 6th edition.
3) Analytical Chemistry (Principles & Technique) by Lary G. Hargis.
4) Fundamental of Analytical Chemistry by Skoog D. A. & West D. M.
5) Instrumental Methods of Analysis by B. K. Sharma.
6) Instrumental analysis by R. D. Braun Mc. Graw Hill.
7) Analytical Chemistry by Gary Christian.
8) Analytical Chemistry by Day and Underwood.

**Reference Books:**

1) Modern Analytical Chemistry by David Harvey, McGraw Hill Higher Education.
2) College Analytical Chemistry, Mangaonkar, Teckchandani, Sathe, Ghalsasi, Jain, Himalaya Publishing House.
3) Analytical Chemistry by Alka L. Gupta, PragatiPrakashan.

**Course Outcomes:**

**After completing this course, student will be able to**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Express and calculate errors. | 15% |
| CO-2 | Analyze the methods involved in separation techniques. | 15% |
| CO-3 | Understand the components of spectrophotometer, working principles of UV-Visible and Raman spectroscopy. | 20% |
| CO-4 | Explain the instrumentation and applications of TGA. | 15% |
| CO-5 | Describe principle, instrumentation and applications of Conductometric, Potentiometric and pH metric titrations. | 15% |

| | | |
|---|---|---|
| CO-6 | Explain principle, instrumentation and applications of Polarography and Coulometry. | 20% |

**List of Open Source Software/learning website:**

- https://www.library.qmul.ac.uk/subject-guides/chemistry/useful-websites/
- https://blog.feedspot.com/chemistry_websites/

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: CHM402-3C

## Course Name: Practicals in Chemistry-III

## Semester: V

**w.e.f. July 2025**

**Type of Course:** Major course

**Prerequisite:** Should have basic knowledge about practicals and its applications.

**Rationale:** At the end of the course students will have knowledge about analysis of inorganic compounds and physical equipments.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | C | CCE Marks | SEE Marks | |
| | - | 8 | 4 | 50 | 50 | 100 |

**Contents:**

| Sr. No. | Content | Total Hrs. 120 |
|---|---|---|
| | **SECTION-A: Inorganic Practicals** | |
| | **Gravimetric Analysis**:<br>1 Gravimetric determination of Fe in iron ore as $Fe_2O_3$.<br>2 Gravimetric estimation of Barium as Barium oxide/sulfate.<br>3 Gravimetric estimation of aluminum as aluminum oxide.<br>4 Gravimetric determination of Ni using DMG in Cu and Ni solution.<br>5 Gravimetric determination of Fe using $NH_4OH$ in Fe and Cr solution.<br><br>**Preparation of Co-Ordination Complexes:**<br>1 Preparation of hexamminenickel(II) chloride.<br>2 Preparation of tris(oxalato)ferrate (III).<br>3 Preparation of hexamminecobalt(III)chloride.<br>4 Preparation of trans-potassium diaquadioxalatochromate (III).<br>5 Preparation of tris(thiourea) copper (I) sulphate monohydrate. | **60** |
| | **SECTION-B: Analytical Practicals** | |

| | | |
|---|---|---|
| | 1. Study of conductometric titration of a strong acid (HCl) against a strong base (NaOH).<br>2. Study of conductometric titration of a weak acid ($CH_3COOH$) against a strong base (NaOH).<br>3. Study of pH metric titration of a strong acid (HCl) against a strong base (NaOH).<br>4. Study of pH metric titration of a weak acid ($CH_3COOH$) against a strong base (NaOH).<br>5. Study of Potentiometric titration of a weak acid ($CH_3COOH$) against a strong base (NaOH).<br>6. Study of Potentiometric titration of a strong acid (HCl) with a strong base (NaOH) using quinhydrone electrode.<br>7. Potentiometric titration of ferrous ammonium sulphate against Potassium Dichromate. | **60** |

**Reference Books:**

1. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.
2. Advanced Practical Inorganic Chemistry, Gurdeepraj, Goel Publishing House, 2001.
3. Practical Physical Chemistry –J. B. Yadav.
4. Practicals in Physical Chemistry – P. S. Sindhu.
5. Vogel's Textbook of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
6. Vogel's textbook of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).

**Course Outcomes:**

**After completing this course, student will be able to**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Understand what is qualitative and qualitative analysis. | 10% |
| CO-2 | Understand significance of gravimetric analysis in determination of metal ions. | 20% |
| CO-3 | To enable the students to develop skills in qualitative analysis and preparing inorganic complexes. | 20% |
| CO-4 | Understand Conductometric titrations. | 20% |
| CO-5 | Understanding of pH metric titrations. | 10% |
| CO-6 | Understanding of Redox titration and precipitation titrations. | 20% |

## Distribution of Practical Marks

| A Level | B Level | C Level | D Level |
|---|---|---|---|
| **10** | **15** | **15** | **10** |

**Legends:**

A= Conduction of Practical

B= Regular Record Writing

C= Viva –Voce

D= Understanding of Experiments

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: CHE400-3C

## Course Name: Industrial Chemistry

## Semester: V

**w.e.f July 2025**

**Type of course:** Minor

**Prerequisite:** Should have underlying knowledge of industrial Chemical Processes.

**Rationale:** At the end of the course, students will be able to understand the essentials of safety protocols, unit operations, and regulatory practices to ensure efficient and safe production. Students will gain knowledge of Material Safety Data Sheets (MSDS), hazardous chemicals, and Good Manufacturing Practices (GMP) and importance for preventing accidents and maintaining product quality. Also, students will be familiar with key processes like distillation, water treatment, and steam generation is vital for optimizing production and managing utility costs.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | Total | CCE Marks | SSE Marks | |
| 4 | - | - | 4 | 50 | 50 | 100 |

**Contents:**

| Sr. No. | Content | Total Hours |
|---|---|---|
| | **SECTION - A** | |
| 1 | **Fundamentals of Chemical Industry and Industrial Safety**<br>Basic principles of chemical industry. Material Safety Data Sheet (MSDS): Purpose of a MSDS, Obtaining MSDS requirements, Safety - general safety, safety during handling of chemicals, fire safety. Hazardous - toxic chemical materials (Solid, liquid and gas), precaution and action taken during accident by chemicals. | **12** |
| 2. | **Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP)**<br>Introduction, Objective of the Chemical GMP, Basic operational conditions and | **9** |

| | | |
|---|---|---|
| | procedures for GMPs, Elements of GMPs: Personnel Practices, Cleanliness, Education and training, Building and Facilities, Sanitary Operations, Pest Control, Production Controls, Documenting GMP and its Inspection, Elements of GMPs, Good laboratory practices (GLP). | |
| 3 | **Unit Processes**<br>Introduction to Chemical Processes, Batch vs Continuous Processes, flow chart, Nitration, Halogenation, Sulfonation and Sulfation, Oxidation, Hydrogenatio, Hydration, Hydrolysis, Esterification, Alkylation, Polymerization, Pyrolysis, Carbonization, Carbonation, Methanation. | **9** |
| **SECTION - B** | | |
| 4 | **Unit Operations**<br>Introduction to Unit Operations, Mixing, Grinding, Filtration, Distillation, Membrane Technology, Absorption, Adsorption, Evaporation, Crystallization, Solvent Extraction, Sublimation, Condensation, Heat exchanger, Drying. | **9** |
| 5 | **Preparation of Common Industrial Chemicals**<br>Hydrochloric Acid, Sulfuric Acid, ethylene, Sodium Hydroxide, Propylene, Nitrogen gas, Sodium Carbonate. | **9** |
| 6 | **Chemical Process Utilities**<br>Introduction to Chemical Process Utilities. Fuel: Types of fuels – advantages and disadvantages. Boilers: Types of boilers and their functioning. Water: Specifications for Industrial use, various water treatments. Steam: Generation and use. Air: Specifications for Industrial use, processing of air. Cost to utility. | **12** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks (%)** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **25** | **30** | **10** | **15** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

**Reference Books:**

1. Riegels handlook of industrial chemistry by James and Kent.
2. Industrial Chemistry by Shashi Chawla, Dhanpat Rai and Sons Publication.
3. Unit processes in organic synthesis by P. H. Groggins.

4. Industrial Chemical Process by R. N. Shreve
5. Outlines of Chemical Technology by
6. C. E. Dryden, East-West Press.
7. Plant Utilities by Dr. Mujawar, Nirali Prakashan Publication.
8. Plant Utilities by D.B. Dhone, Nirali Prakshan Publication.

**Course Outcomes:**

**After completing this course, student will be able to**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Comprehend Fundamentals of Chemical Industry and Industrial Safety. | 15% |
| CO-2 | Understand the importance of Good Manufacturing Practices and Good laboratory practices in the chemical industry. | 20% |
| CO-3 | Understand basic unit process used in chemical synthesis. | 20% |
| CO-4 | Understand about isolation and purify the products at chemical industries. | 15% |
| CO-5 | Learn about the preparation of Common Industrial Chemicals. | 15% |
| CO-6 | Know about Process Utilities and cost Utilities. | 15% |

**List of Open Source Software/learning website:**

- Students can refer to video lectures available on the websites including NPTEL
- https://www.rsc.org/pe
- https://archive.nptel.ac.in/courses/
- https://tech.chemistrydocs.com/Books/Applied%20-%20Industrial/Fundamentals-of-Industrial-Chemistry-Pharmaceuticals,-Polymers,-and-Business-by-John-A.-Tyrell.pdf
- https://tech.chemistrydocs.com/Books/Applied%20-%20Industrial/Fundamentals-of-Industrial-Chemistry-Pharmaceuticals,-Polymers,-and-Business-by-John-A.-Tyrell.pdf

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: CHE401-3C

## Course Name: Green Chemistry

## Semester: V

**w.e.f July 2025**

**Type of course:** Minor

**Prerequisite:** Fundamental knowledge of Green chemistry and its real life implementation.

**Rationale**: Designed of chemical products and processes that reduce or eliminate the use and generation of hazardous substances. Created awareness for reducing waste, and minimizing energy consumption in organic synthesis. Explain the techniques of green synthesis in organic reactions.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | Total | CCE Marks | SSE Marks | |
| 4 | - | - | 4 | 50 | 50 | 100 |

**Contents:**

| Sr. No. | Content | Total Hours |
|---|---|---|
| | **SECTION - A** | |
| 1 | **Green Chemistry**<br>Introduction to Green Chemistry. Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry. Twelve principles of Green Chemistry with their explanations and examples. | **9** |
| 2 | **Designing a Green Synthesis Using 12 Principles**<br>Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution, and elimination reactions. Prevention/ minimization of hazardous/ toxic products reducing toxicity. Risk = (function) hazard × exposure; waste or pollution prevention hierarchy. Selection of starting materials; avoidance of unnecessary derivatization – careful use of | **12** |

| | | |
|---|---|---|
| | blocking/protecting groups. - Real world cases (Traditional processes and green ones) Synthesis of Ibuprofen, Adipic acid, teriphthalic acid etc. | |
| 3 | **Green Solvents**<br>Supercritical fluids, water as a solvent for organic reactions, ionic liquids, Fluorous biphasic solvent, peg, solventless processes, immobilized solvents, and how to compare the greenness of solvents. | **9** |
| **SECTION - B** | | |
| 4 | **Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.**<br>Introduction, set up, and mechanism of both Microwave-assisted method & Ultrasound assisted methods**.** Microwave-assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave-assisted reactions in organic solvents: Diels-Alder reaction, and Decarboxylation reaction. Ultrasound-assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine) | **12** |
| 5 | **Cleaner production the cleaner production concept**<br>Requirements of cleaner production, difference with end of pipe concept, cleaner production and sustainable development, implementation of cleaner production, change of raw material, technology change, good operating practice, product change, on site reuse and recycling, who is responsible for cleaner production, government rules, green synthesis of nanoparticles. | **9** |
| 6 | **Future Trends in Green Chemistry**<br>Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co-crystal controlled solid state synthesis (C2S3); Green chemistry in sustainable development. | **9** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks (%)** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **25** | **30** | **10** | **15** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

**Reference/Text Books:**

1. Ahluwalia, V.K. & Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers (2005).
2. Anastas, P.T. & Warner, J.K.: Green Chemistry - Theory and Practical, Oxford University Press (1998).
3. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001).
4. Cann, M.C. & Connely, M.E. Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
5. Ryan, M.A. & Tinnesand, M. Introduction to Green Chemistry, American Chemical Society, Washington (2002).
6. Lancaster, M. Green Chemistry: An Introductory Text RSC Publishing, 2nd Edition, 2010.

**Course Outcomes:**

**After completing this course, students will be able to**

| Sr. No. | Co statement | Marks % weightage |
|---|---|---|
| CO-1 | Explain the field of green chemistry. | 15% |
| CO-2 | Acquire knowledge of the 12 principles of green chemistry. | 20% |
| CO-3 | Demonstrate the importance of green solvents. | 15% |
| CO-4 | Analyze the importance of alternate energy sources in green chemistry. | 20% |
| CO-5 | Develop an understanding of cleaner production | 15% |
| CO-6 | Summarize the application of green chemistry in sustainable development. | 15% |

**List of Open Source Software/learning websites:**

Students can refer to video lectures available on the websites including NPTEL

- https://www.library.qmul.ac.uk/subject-guides/chemistry/useful-websites/
- https://blog.feedspot.com/chemistry_websites/

https://www.acs.org/green-chemistry-sustainability.html

https://gctlc.org/

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: SEC400-3C

## Course Name: Basics of Unit Operations

## Semester: V

**w.e.f.: July 2025**

**Type of Course:** SEC Course

**Prerequisite:** Understanding foundation in basic unit operations and dimension knowledge.

**Rationale:**

After studying this course, students will be able to analyze processes by deconstructing complex tasks into basic, physically driven steps such as filtration, extraction, distillation, and evaporation.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | Total | CCE Marks | SSE Marks | |
| 2 | - | - | 2 | 25 | 25 | 50 |

**Contents:**

| Sr. No. | Content | Total Hrs. |
|---|---|---|
| | **SECTION-A** | |
| **1** | **Introduction**<br>Unit Operations, Mechanical Separations, Fluid Transportation, Units and Dimensions, Force, Pressure, Work/Energy, Power, Heat, Volume, Temperature, Conversion Factors. | **7** |
| **2** | **Fundamentals of Unit Operations**<br>Material Balances, Energy Balances, Molecular Units (Molar Units), Weight Fraction, Mole Fraction, Gas Laws, Mechanical Laws. | **8** |
| | **SECTION-B** | |
| **3** | **Filtration and Extraction Techniques**<br>• Basic introduction to Filtration, Simple filter, Vacuum filter, Nutsche filter, Plate and frame filter, Bed filter, Hypo filter, Screens, Centrifugal filter.<br>• Basic introduction to extraction, Simple extraction, Soxhlet extraction. | **7** |

| | | |
|---|---|---|
| **4** | **Distillation and Evaporation Techniques**<br>• Basic introduction to distillation, Flash Distillation, Simple Distillation, Fractional Distillation, Steam Distillation, Vacuum Distillation.<br>• Basic introduction to evaporation, Simple evaporation, Vacuum evaporation. | **8** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks (%)** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **25** | **30** | **10** | **15** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

**References:**

1. Unit Operations – I by K. A. Gavhane.
2. Principles of unit operations by Foust, Alan S., Leonard A. Wenzel, Curtis W. Clump, Louis Maus, and L. Bryce Andersen.
3. Unit Operations Handbook: Volume 1 (In Two Volumes), by John J. McKetta.
4. Riegels handbook of industrial chemistry by James and Kent.
5. Dryden's outlines of chemical Technology M. Gopal Rao.

**Course Outcomes:**

**After completing this course, student will be able to**

| **Sr. No.** | **CO statement** | **Marks % weightage** |
|---|---|---|
| CO-1 | Gain a knowledge of Unit Operations, and various units and dimensions. | 20% |
| CO-2 | Understand basics of material and energy balances, utilize molecular and fractional units, and understand key gas and mechanical laws. | 20% |
| CO-3 | Understand and apply various filtration methods to separate solids from liquids or gases. | 20% |
| CO-4 | Learn a different extraction method for efficient separation of desired components from mixtures. | 10% |
| CO-5 | Gain an understanding various distillation techniques for separating components in industrial and laboratory settings. | 20% |

| | | |
|---|---|---|
| CO-6 | Comprehend different evaporation techniques for the separation | 10% |

**List of Open-Source Software/learning website:**

- Students can refer to video lectures available on websites including NPTEL
- https://www.youtube.com/watch?v=vcXEEE4vE6o
- https://www.youtube.com/watch?v=bNaRUh8T_wQ
- https://www.youtube.com/watch?v=0k3SE16_bnU&list=PLyqSpQzTE6M-QFqMp7_FJ_NuGCXDuHqvf
- chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://elmoukrie.com/wp-content/uploads/2022/04/unit-operations-e28093-i-fluid-flow-and-mechanical-operations-k.-a.-gavhane-z-lib.org_.pdf

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: SEC401-3C

## Course Name: Advanced Spreadsheet Tools

## Semester: V

**w.e.f.: July 2025**

**Type of Course:** SEC Course

**Prerequisite:** Basic knowledge of spreadsheets, including data entry, simple formulas, and basic formatting.

**Rationale:**

The course equips learners with essential skills for efficient data management, analysis, and visualization. It bridges the skill gap by covering advanced functions, automation techniques, and reporting tools to enhance productivity. The course emphasizes hands-on learning to improve accuracy, decision-making, and efficiency. By mastering these tools, learners become more proficient in handling real-world data challenges across various industries.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | Total | CCE Marks | SSE Marks | |
| 2 | - | 0 | 2 | 25 | 25 | 50 |

**Contents:**

| Sr. No. | Content | Total Hrs. |
|---|---|---|
| | **SECTION-A** | |
| 1 | **Dealing with Data**<br>Data Entry and Formatting: Using Excel Tables Formatting Cells, Rows, and Columns Custom Number Formatting. Sorting and Filtering Data: Sorting Data (Single & Multiple Levels) Applying Filters for Quick Data Analysis Using Advanced Filters. Data Validation and Cleaning: Setting Up Data Validation (Drop-down lists, Rules) Removing Duplicates and Handling Empty Cells Text-to-Columns and Flash Fill. | **7** |
| 2 | **Functions and Formulas**<br>Logical Functions: IF, AND, OR, NOT Functions Nested IF Statements Using | **8** |

| | | |
|---|---|---|
| | IFERROR for Error Handling. Lookup and Reference Functions: VLOOKUP and HLOOKUP INDEX and MATCH XLOOKUP (for newer Excel versions). Essential Math and Statistical Functions: SUM, AVERAGE, COUNT, COUNTA, ROUND, INT, MOD, MIN, MAX, MEDIAN. | |
| **SECTION-B** | | |
| **3** | **Data Analysis and Visualization**<br>Pivot Tables and Charts: Creating Pivot Tables, Filtering Data. Charts and Graphs: Creating Basic Charts (Bar, Line, and Pie). Customizing Charts for Better Visualization. What-If Analysis: Goal Seek, Scenario Manager, Data Tables. | **7** |
| **4** | **Basic Productivity and Time-Saving Tools**<br>Keyboard Shortcuts and Quick Access Tools, Essential Excel keyboard shortcuts, Customizing the Quick Access Toolbar. Basic Data Entry Automation, AutoFill and Flash Fill, Using Named Ranges for quick referencing. Page Setup and Printing, Setting up print areas and page breaks, Printing headers and footers. | **8** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks (%)** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **25** | **30** | **10** | **15** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate**

**C: Create and above Levels (Revised Bloom's Taxonomy)**

**References:**

1. Microsoft Excel 2019 Bible – John Walkenbach, Wiley Publications
2. Excel Formulas & Functions For Dummies – Ken Bluttman, Wiley Publications
3. Data Analysis with Microsoft Excel – Kenneth N. Berk, Patrick Carey
4. Advanced Excel Reporting for Management Accountants – Neale Blackwood, Wiley
5. Online Microsoft Documentation: https://support.microsoft.com/excel

**Course Outcomes:**

**After completing this course, student will be able to**

| **Sr. No.** | **CO statement** | **Marks % weightage** |
|---|---|---|
| CO-1 | Organize, format, and manage large datasets using tables, sorting, filtering, and data validation techniques. | 20% |

| | | |
|---|---|---|
| CO-2 | Master logical, lookup, and statistical functions for advanced data calculations and analysis. | 15% |
| CO-3 | Create Pivot Tables, Charts, and use What-If Analysis tools to extract insights from data. | 15% |
| CO-4 | Use automation features like AutoFill, Flash Fill, and Quick Access Toolbar for efficient workflow. | 20% |
| CO-5 | Set up print areas, manage page layouts, and create structured, printable reports. | 10% |
| CO-6 | Apply advanced spreadsheet tools confidently in real-world scenarios. | 20% |

**List of Open Source Software/learning website:**

1. **Open-Source Spreadsheet Software:**
    - LibreOffice Calc (https://www.libreoffice.org/)
    - Apache OpenOffice Calc (https://www.openoffice.org/)
    - Gnumeric (http://www.gnumeric.org/)
2. **Learning Platforms for Excel and Data Analysis:**
    - NPTEL Online Courses: https://archive.nptel.ac.in/courses/
    - Khan Academy: https://www.khanacademy.org/
    - Coursera Free Courses: https://www.coursera.org/
    - Udemy Free Courses: https://www.udemy.com/
    - Microsoft Learn: https://learn.microsoft.com/en-us/training/

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: SEC402-3C

## Course Name: IT Skills and Data Analysis

## Semester: V

**w.e.f.: July 2025**

**Type of Course:** SEC Course

**Prerequisite:** Basic knowledge of data analysis, modeling, visualization and data coding.

**Rationale:**

Familiarise the student with the quantitative skills required for representing and Interpreting data for the purpose of decision making. Enable the student to analyse data and problem situations using relevant IT tools.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | Total | CCE Marks | SSE Marks | |
| 2 | - | - | 2 | 25 | 25 | 50 |

**Contents:**

| Sr. No. | Content | Total Hrs. |
|---|---|---|
| | **SECTION-A** | |
| **1** | **Introduction to Data Analysis Tool – Power BI**<br>Class Introduction (BI Basics), Class Introduction (Power BI Desktop Overview), Data Discovery with Power BI Desktop. Transforming Data (Basic Transforms), Transforming Data (Add Column From Example), Transforming Data (Appending Queries), Transforming Data (Merging Queries). Transforming Data (Combine Files), Transforming Data (M Query Basics), Transforming Data (Parameters and Templates), Transforming Data (Other Query Features). | **7** |
| **2** | **Introduction to Modeling Data**<br>Creating the Data Model (Modeling Basics), Creating the Data Model (Model Enhancements), Creating the Data Model (What If Parameters). Creating Calculated Columns and Tables (DAX Basics), Creating Calculated Columns and Tables (Navigation Function), Creating Calculated Columns and Tables (Calculated Tables). | **8** |

| | | |
|---|---|---|
| | Creating Calculated Measures (Measure Basics), Creating Calculated Measures (Time Intelligence Functions). | |
| **SECTION-B** | | |
| **3** | **Introduction to Visualizing Data**<br>Creating Basic Reports with the Power BI Desktop, Creating Interactive Reports (Adding Slicers for Filters), Creating Interactive Reports (Visualizing Tabular Data), Creating Interactive Reports (Visualizing Categorical Data). Creating Interactive Reports (Visualizing Data Trends), Creating Interactive Reports (Visualizing Categorical and Trend Data Together), Creating Interactive Reports (Visualizing Geographical Data with Maps), Creating Interactive Reports (Visualizing Goal Tracking). Creating Interactive Reports (Using Custom Visuals), Creating Interactive Reports (Digital Storytelling), Creating Interactive Reports (Other Features). | **7** |
| **4** | **Introduction to DAX Coding**<br>Data Modeling Basics (Overview), Data Modeling Basics (Tabular), What is DAX (Overview), What is DAX (Tabular), Creating Calculated Columns (Basics). Creating Calculated Columns (Basics Continued), Navigation Functions, Conditional and Logical Functions, Creating Calculated Measures. Time Intelligence (Overview), Time Intelligence (Time Intelligence Functions), Using X-Functions and A-Functions, Table Functions, DAX as a Query Language. | **8** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks (%)** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **25** | **30** | **10** | **15** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

**References:**

1. Alberto Ferrari ,Marco Russo, Introducing Microsoft Power BI
2. Devin Knight, Brian Knight, and Mitchell Pearson, Microsoft Power BI Quick Start Guide.

**Course Outcomes:**

**After completing this course, student will be able to**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Represent and interpret data in tabular and graphical forms | 20% |
| CO-2 | Understand and interpret the measures of central tendency and dispersion. | 15% |
| CO-3 | Use IT tools such as Power BI to visualise and analyse data. | 15% |
| CO-4 | Equip the student with some fundamental concepts, which play a critical role in Understanding and visualizing real world data. | 20% |
| CO-5 | Relevant concepts will be introduced which will be supplemented by hands-on activities enabled by the use of Power BI | 10% |
| CO-6 | Students learn about the concept of datasets and Different type of Variables Distinction between primary and secondary sources of data | 20% |

**List of Open Source Software/learning website:**

Students can refer to video lectures available on the websites including NPTEL

- https://learn.microsoft.com/en-us/power-bi/connect-data/desktop-data-sources
- https://community.powerbi.com/t5/Desktop/How-to-reference-a-table-column-within-an-API-url/td-p/2244511
- https://community.powerbi.com/t5/Power-Query/Query-references-other-queries-or-steps-so-it-may-not-directly/td-p/2836287
- https://learn.microsoft.com/en-us/power-bi/collaborate-share/service-url-filters

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

### B. Sc. (Hons.) - CHEMISTRY
### B.Sc. SEM-VI
### Teaching/Exam Scheme
*(As per NEP-2020)*

**w.e.f.: July-2025**

| No. | Course Code | Category of course | Course title | Hours Per week | | | Tot. hrs | Cr edit | CCE | SEE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | | | | |
| 1 | CHM403-3C | Major | Natural & Synthetic Molecules | 4 | - | - | 4 | 4 | 50 | 50 | 100 |
| 2 | CHM404-3C | Major | Electrochemistry, Equilibrium and Solid State | 4 | - | - | 4 | 4 | 50 | 50 | 100 |
| 3 | CHM405-3C | Major | Practicals in Chemistry-IV | - | - | 8 | 8 | 4 | 50 | 50 | 100 |
| 4 | CHE402-3C | Minor | Petrochemicals | 4 | - | - | 4 | 4 | 50 | 50 | 100 |
| 5 | AEC400-3C | AEC | General Principles of Writing | 2 | - | - | 2 | 2 | 25 | 25 | 50 |
| | AEC401-3C | AEC | Business Communications | 2 | - | - | 2 | 2 | 25 | 25 | 50 |
| 6 | SEC403-3C | INT* | Internship | - | - | - | - | 4 | 50 | 50 | 100 |
| | | | Total | 14 | - | 8 | 22 | 22 | 275 | 275 | 550 |

- CCE - Continuous and Comprehensive Evaluation.
- SEE – Semester End Evaluation.

| | |
|---|---|
| Ability Enhancement Course (AEC) | 1. AEC400-3C: General Principles of Writing<br>2. AEC401-3C: Business Communications |

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: CHM403-3C

## Course Name: Natural & Synthetic Molecules

## Semester: VI

**w.e.f.: July 2025**

**Type of course:** Major Course

**Prerequisite:** Should have underlying knowledge of natural & synthetic molecules and their applications.

**Rationale:** At the end of the course, the students should be able to describe the basic understanding of the chemistry of industrially important natural molecules such as lipids, fats, carbohydrates and synthetic molecules like soaps, detergents, dyes, paints, organic and organometallic reagents in organic synthesis.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | Total | CCE Marks | SSE Marks | |
| 4 | - | - | 4 | 50 | 50 | 100 |

**Contents:**

| Sr. No. | Content | Total Hours |
|---|---|---|
| | **SECTION - A** | |
| 1 | **Lipids and Fats**<br>Lipids-Definition, categories, biological, functions, metabolism, nutrition and health, tests, examples. Fats-Definition, biological importance, metabolism, digestion and its metabolism. Soaps, detergents and their action mechanism. | **9** |
| 2 | **Carbohydrates**<br>Carbohydrates: Classification and nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and | **9** |

| | | |
|---|---|---|
| | threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Cyclic structure of D (+)-glucose. Mechanism of mutarotation. General study of disaccharides. | |
| **3** | **Proteins**<br>Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Classification of proteins. | **12** |
| **SECTION - B** | | |
| **4** | **Organometallic Compounds**<br>Organo magnesium compounds- the Grignard reagent-formation, structure and chemical reactions. Organozinc compounds; formation and chemical reactions. Organosulphur Compounds- Nomenclature, structural formation, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine. | **9** |
| **5** | **Dyes and Paints**<br>Color and constitution, types of dyes, Alizarin, Indigo, Congo red, Malachite green, Methylene blue, Phenolphthalein, Methyl orange. Paints and Varnishes: Classification, Definition, components, chemistry, applications. | **9** |
| **6** | **Organic Reagents**<br>Reagent compounds, types of reagents, acetylene, ammonia, Bayer's reagent, NBS, n-butyl lithium, CAN, chromic acid, chromium trioxide, diborane, DMSO, dioxane, Fehling reagent, Grignard reagent, hydrazide, hydrogen peroxide, LAH, $OsO_4$, $PCl_5$, potassium dichromate, potassium permanganate, Raney Ni, silver nitrate, sodium borohydride, NaH, THF, TMS, $SOCl_2$, Tollen's reagent. | **12** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks (%)** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **25** | **30** | **10** | **15** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

**Text Books:**

1. Finar, I.L., "Organic Chemistry", Pearson Education India, 6th edition, 2002.

2. Eliel, E.L. and Wilen, S.H., "Stereochemistry of Organic Compounds", Willey,1st edition, 1994
3. Boyd, Morrison and Bhattacharjee, "Organic Chemistry", Pearson Education India, 7th edition, 2010.
4. Mukerji, S.M., "Reaction mechanism in Organic Chemistry", Laxmi Publications, 3rd edition, 2007.
5. Loudon, G. Marc, "Organic Chemistry", Oxford University Press, 4th edition, 2008.
6. Bahl, A. and Bahl, B.S, "Advance Organic Chemistry", S. Chand Publishing, India, 2010.

**Reference Books:**

1. Singh, Jagdamba and Yadav, L.D.S., "Undergraduate Organic Chemistry" Pragati Prakashan, India, Vol 1, 2011.
2. Madan, R.L., "Chemistry for Degree Students, B. Sc. Third Year", S. Chand Publishing, New Delhi, India, 3rd edition, 2011.

**Course Outcomes:**

**After completing this course, student will be able to**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Describe various phenomenon and aspects of Lipids and Fats. | 15% |
| CO-2 | Explain basic experimental understanding of Carbohydrates. | 15% |
| CO-3 | Discuss concepts and chemistry of Proteins. | 20% |
| CO-4 | Discuss theory of Organometallic Compounds. | 15% |
| CO-5 | Define and understand various aspects of Dyes and Paints. | 15% |
| CO-6 | Discuss vitality of Organic Reagents in organic synthesis. | 20% |

**List of Open Source Software/learning website:**

1. https://www.youtube.com/watch?v=xBNv80Dg6nI&list=PLmUlqVgZsTVUk5NkroUmYXvbterBXbk_J
2. https://www.youtube.com/watch?v=UgbaIFI_q6E
3. https://www.youtube.com/watch?v=tz0BrCqPTV0&t=15s
4. https://www.youtube.com/watch?v=2sHlLNzTpUU&t=4s
5. https://www.youtube.com/watch?v=ALaTCbetFSg&t=210s
6. https://www.youtube.com/watch?v=kruIzuor5v8
7. https://www.youtube.com/watch?v=IuERNLx-J7k&t=19s
8. https://www.youtube.com/watch?v=RW7KlYbpNxk&t=1414s
9. https://www.youtube.com/watch?v=LcUoeFe0iN8
10. https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm

11. https://nptel.ac.in/courses/104/103/104103111/
12. https://nptel.ac.in/courses/104/103/104103071/
13. https://onlinecourses.nptel.ac.in/noc19_cy24/preview
14. https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod10.pdf

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science
## Course Code: CHM404-3C
## Course Name: Electrochemistry, Equilibrium and Solid State
## Semester: VI

**w.e.f.: July 2025**

**Type of Course:** Major course

**Prerequisite:** Should have fundamental knowledge of general chemistry and thermodynamics.

**Rationale:** At the end of the course students will have knowledge of different states of matter, chemical equilibrium, and colligative properties of solutions.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | C | CCE Marks | SEE Marks | |
| 4 | - | - | 4 | 50 | 50 | 100 |

**Contents:**

| Sr. No. | Content | Total Hrs. |
|---|---|---|
| | **SECTION-A** | |
| 1 | **Electrochemistry:** Concept of Oxidation and Reduction, Electrochemical series (Reduction series). definition of electrode, half-cell and cell, single electrode potential, sign of electrode potential, standard electrode potential (oxidation and reduction potential), Electrochemical process, Galvanic cell with example of Daniel cell, EMF of a cell and its measurements, Standard Weston cell, Different types of reversible electrodes, Determination of single electrode potential, Calculation of standard EMF of cell and Determination of cell reaction, Standard Hydrogen Electrode, Calomel electrode and Ag –AgCl electrode. Numerical problems. | **12** |
| 2 | **Phase equilibrium:** Statement and meaning of the terms phase, component, degree of freedom, phase rule, and phase equilibria of one component system- water, $CO_2$, Sulphur system. | **09** |
| 3 | **Solid State:** Forms of solids, crystal systems, unit cells, Bravais lattice types, Symmetry | **09** |

| | | |
|---|---|---|
| | elements; Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices; Miller indices of different planes and interplanar distance, Bragg's law; Structures of NaCl, KCl and CsCl; Defects in crystals; Glasses and liquid crystals. | |
| | **SECTION-B** | |
| **4** | **Partial properties and chemical potential:** Partial molar quantities, Chemical potential and activity, the relation between chemical potential and Gibb's free energy and other thermodynamic state functions; variation of chemical potential (μ) with temperature and pressure; Gibbs-Duhem equation; fugacity and fugacity coefficient; Variation of thermodynamic functions for systems with variable composition; Equations of states for these systems, Change in G, S H and V during mixing for binary solutions | **09** |
| **5** | **Chemical Equilibrium:** Chemical equilibrium, Law of mass action, Thermodynamic derivation of the law of chemical equilibrium, Vant Hoff isotherm, Relations between Kp, Kc and Kx, Temperature dependence of the equilibrium constant: The van't Hoff Equation. Le-Chatelier principle. Numerical problems. | **09** |
| **6** | **Ionic Equilibrium:** Strong and weak electrolytes, degree of ionization, factors affecting the degree of ionization, ionization constant, and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect, dissociation constants of mono, di-and triprotic acids (exact treatment). Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action, Solubility and solubility product of sparingly soluble salts–applications of solubility product principle. Qualitative treatment of acid-base titration curves. Theory of acid-base indicators; selection of indicators and their limitations | **12** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **25** | **30** | **10** | **15** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E:Evaluate**

**C: Create and above Levels (Revised Bloom's Taxonomy)**

**Text Books:**

1. Textbook of Physical Chemistry, P. L. Soni, O. P. Dharmarha, U. N. Dash, Sultan Chand & Sons, 2023.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, Vishal Publishing House, 2008.
3. Essentials of Physical Chemistry, Arun Bahl, B S Bahl, G D Tuli, S. Chand 2000.
4. Atkin's Physical Chemistry, 8th Edn., Peter Atkins, Julio de Paula, Oxford University Press, 2006.

**Reference Books:**

1. Physical Chemistry, 3rd Edn. Gilbert W. Castellan, 1983
2. Principles of Physical Chemistry, Samuel H. Maron & Carl F. Prutton, 4th Edn. Macmillan,1965.
3. Physical Chemistry – A Molecular Approach, Donald A . McQuarrie, John D. Simon, Viva Books,1997.

**Course Outcomes:**

**After completing this course, student will be able to**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Students will know about oxidation and reduction reactions, electrochemical cells, and electromotive force. | 20% |
| CO-2 | Students will know about the terms phase, component, degree of freedom, phase rule, and phase equilibria of one component system. | 15% |
| CO-3 | Students will know about unit cells, structure of solids, and crystallography | 15% |
| CO-4 | Students will be able to understand chemical potential and fugacity. | 15% |
| CO-5 | Students will be able to understand various laws of chemical equilibrium | 15% |
| CO-6 | Students will know about terms of ionic equilibrium, pH, buffer | 20% |

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: CHM405-3C

## Course Name: Practicals in Chemistry-IV

## Semester: VI

**w.e.f.: July 2025**

**Type of Course:** Major course

**Prerequisite:** Should have fundamental knowledge glassware's and apparatus used in chemistry lab.

**Rationale:** At the end of the course students will have knowledge of semi micro qualitative analysis of four radical inorganic mixture and estimation of metal by complexometric titration.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | C | CCE Marks | SEE Marks | |
| | - | 8 | 4 | 50 | 50 | 100 |

**Contents:**

| Sr. No. | Content | Total Hrs. 120 |
|---|---|---|
| | **SECTION-A: Organic Practicals** | |
| | 1. Preparation of Orange-I dye.<br>2. Preparation of Orange-II dye.<br>3. Preparation of Aniline Yellow dye.<br>4. Preparation of Crysodine-G dye.<br>5. Dyeing of fabric pieces using basic dye Methyl red.<br>6. Estimation of peroxide value of fried oil sample.<br>7. Estimation of iodine value of oil sample.<br>8. To determine the amount of Glucose in the given solution by hypoiodite.<br>9. To determine the amount of Acetamide in the given solution.<br>10. Estimation of protein in milk using Kjeldahl method.<br>11. Estimation of Vitamin-C by volumetric method.<br>12. Estimation of Glycine using a titration method.<br>13. Estimation of Formaldehyde using a titration method. | **60** |

| | | |
|---|---|---|
| | 14. Estimation of Aspirin, https://vlab.amrita.edu/?sub=2&brch=191&sim=849&cnt=1<br>15. Estimation of Glucose, https://vlab.amrita.edu/?sub=2&brch=191&sim=692&cnt=1<br>Laser Flash Photometer, https://vlab.amrita.edu/?sub=2&brch=191&sim=608&cnt=1 | |
| **SECTION-B: Physical Practicals** | | |
| | 1. Investigate the reaction energy between $K_2S_2O_8$ and KI at two different temperatures and calculate the energy of activation for the reaction.<br>2. Determine the solubility of a given salt at room temperature and find the temperature for maximum solubility of a given salt by the solubility curve.<br>3. Find out the amount of ferrous sulfate/ferrous ammonium sulfate in a given flask potentiometrically using 0.1 N ceric salt solution.<br>4. To determine the equivalent conductivity of a given strong electrolyte (KCl and NaCl) at infinite dilution.<br>5. Construct a phase diagram of a given three-component system. | **60** |

**Reference Books:**

1. Furniss, B. S.,Hannafold, A. J.,Smith, P. W. G., Tatchell, A. R., Vogel's Textbook of Practical Organic Chemistry, 5th Ed., Pearson Education India, (1989)
2. Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis,V K Ahluwalia & R. Aggarwal Universities Press., (2001)
3. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.Agarwal, O. P., Advanced Practical Organic Chemistry, Krishna Prakashan, Meerut (2014).
4. Ahluwalia, V. K.; Aggarwal, R., Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, Universities Press (2000).
5. Clarke, H. T., A Handbook of Organic Analysis: Qualitative and Quantitative, 4th Ed., CBS Publishers India (2007).
6. Panda H,, The Complete Technology Book on Dyes & Dye Intermediates, ISBN- 978-8186623794, NPCS Publisher, 2nd edition, (2003).
7. Advanced-Physical-Chemistry-Experiments-by-J-N-Gurtu-&-Amit-Gurtu, Pragati Prakashan, 2008

8. A Textbook of Physical Chemistry: Experimental Aspects In Physical Chemistry (SI Units) Volume 7 by KL Kapoor

**Course Outcomes:**

**After completing this course, student will be able to**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Able to calculate the activation energy and partition coefficient. | 10% |
| CO-2 | Able to determine the solubility and equivalent conductivity of a salt | 20% |
| CO-3 | Able to perform potentiometric titration and construct phase diagram | 20% |
| CO-4 | Understand concepts of preparation of dyes and dyeing. | 20% |
| CO-5 | Acquainted with the methods of analysis of fat and lipids. | 10% |
| CO-6 | Estimation of organic molecules by different types of titrations. | 20% |

## Distribution of Practical Marks

| A Level | B Level | C Level | D Level |
|---|---|---|---|
| **10** | **15** | **15** | **10** |

**Legends:**

A= Conduction of Practical

B= Regular Record Writing

C= Viva –Voce

D= Understanding of Experiments

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: CHE402-3C

## Course Name: Petrochemicals

## Semester: VI

**w.e.f July 2025**

**Type of course:** Minor

**Prerequisite:** Should have underlying knowledge of chemistry of petrochemicals.

**Rationale:** At the end of the course, students will have a fundamental understanding of petrochemicals, including their production processes, properties, and applications. They will also learn about the challenges associated with petrochemical manufacturing, such as feedstock availability, environmental concerns, and process optimization. The course will make them aware of the current and future role of petrochemicals in various industries, emphasizing sustainable practices, technological advancements, and the development of eco-friendly alternatives.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | Total | CCE Marks | SSE Marks | |
| 4 | - | - | 4 | 50 | 50 | 100 |

**Contents:**

| Sr. No. | Content | Total Hours |
|---|---|---|
| | **SECTION - A** | |
| **1** | **Chemistry and Composition of Petrochemicals**<br>Composition, Characteristics, Constituents of Petroleum. Types of Hydrocarbons and Non- hydrocarbons present in petroleum, their physical and chemical properties. Natural gas: Composition, Natural gas as Petrochemical feed stock. Crude oil: Composition, Distillation and Refining, Utilization of various fractions (oil product). | **9** |
| **2** | **Classification of Petrochemicals** | **12** |

| | | |
|---|---|---|
| | First, Second and Third generation petrochemicals. Conversion process: Cracking reforming, Isomerisation, Hydrogenation, Alkylation and Hydrodealkylation, Dehydrocyclisation of petroleum products, Polymerization of gaseous hydrocarbons. | |
| **3** | **Extraction of Petrochemicals-I**<br>Manufacture and industrial applications of Methane: Methanol, Synthesis gas, Ammonia (C1 cut of petroleum). Manufacture and industrial applications of Ethylene: Ethanol, Acetaldehyde (Wacker-Chemie process), Ethylene Glycol (C2 cut of petroleum). Manufacture and industrial applications of Acetylene: Acrylic acid, Acrylonitrile, Vinylchloride (C2 cut of petroleum). | **9** |
| **SECTION - B** | | |
| **4** | **Extraction of Petrochemicals-II**<br>Manufacture and industrial applications of Propylene: Iso propyl alcohol, Acetone (Wacker-Chemie process), Propylene oxide (Halcon process) (C3 cut of petroleum). Manufacture and industrial applications of Butadiene: Butylalcohols, Methyl terbutyl ether (MTBE), Cyclopentadiene (C4 cut of petroleum), other monomers like Penta erythritol and Di-isocyanates. | **12** |
| **5** | **Application of Petrochemical Compounds-I**<br>Industrial Fuels: Natural fuels, Synthetic fuels, Hydrogen- Fuel of tomorrow, Fuel for rocket (Hydrazine). Intermediates of Pharmaceuticals and Dyes: Quinoline, Sulphanilamide, H-acid, J-acid, Paracetamol, Methyl Anthranilate. | **9** |
| **6** | **Application of Petrochemical Compounds-II**<br>Recovery process of BTX and the manufacture and industrial applications of benzene, toluene, xylene, naphthalene, phenol, styrene, aniline, maleic anhydride, phthalic anhydride, terephthalic acid, and dimethyl terephthalate. | **9** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks (%)** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **25** | **30** | **10** | **15** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

**References:**

1. Introduction to petrochemicals by Sukumar Maiti oxford and IBH pubs co. New Delhi.
2. A text on petrochemicals by Dr. B. K. Bhaskar Rao, Khanna pubs. New Delhi.
3. Chemicals from petroleum by A. L. Wadams (ELBS and John Murray London)
4. Petrochemicals by S. L. Venkatewarn (Colour pubs. Pvt. Ltd. Bombay)
5. Petrochemicals digest by MGK Manon (Asia Publishing house Bombay)

**Course Outcomes:**

**After completing this course, student will be able to**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Identify sources of petrochemicals. | 20% |
| CO-2 | Explain various conversion process. | 20% |
| CO-3 | Describe petrochemicals obtained from C1 and C2 cut of petroleum. | 20% |
| CO-4 | Describe petrochemicals obtained from C3, C4 and C5 cut of petroleum. | 10% |
| CO-5 | Understand the applications of petrochemical compounds. | 20% |
| CO-6 | Compare the properties & application of BTX aromatic compounds. | 10% |

**List of Open Source Software/learning website:**

- Students can refer to video lectures available on the websites including NPTEL
- https://www.rsc.org/pe
- https://archive.nptel.ac.in/courses/
- https://www.ugierkl.ac.in/lecture_files/prpct_1702534712.pdf
- https://chemindia.chemicals.gov.in/Reportpdf/HandbookofPetrochemicalProcesses2019.pdf
- https://nios.ac.in/media/documents/313courseE/L32A.pdf

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: AEC400-3C

## Course Name: General Principles of Writing

## Semester: VI

**Type of Course:** Ability Enhance Course

**Prerequisite:** Basic Knowledge of English

**Rationale:** At the end of the course, students will have knowledge of English language. It also targets the understanding of grammar, focusing on comprehension, and writing skills.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | C | CCE Marks | SSE Marks | |
| 2 | - | - | 2 | 25 | 25 | 50 |

**Content:**

| Sr. No. | Content | Total Hrs. |
|---|---|---|
| | **SECTION-A** | |
| 1 | **General Writing**<br>Process of writing, First draft of Writing, Analyzing the errors and preparing the final draft, Paragraph writing, Email Writing, Essay Writing (Composition). | 7 |
| 2 | **Scientific/Academic Writing:** A journal article, a scientific poster, a research proposal, research writing: Nature and conventions, research proposal format, strategies for writing effective research proposals, format of research papers. | 7 |
| | **SECTION-B** | |
| 3 | **Report Writing**<br>Types of Report – Formal (Business, Feasibility and Progress), Format of report writing. **Suggested topics:** Accidental, Natural Calamities, Celebration of festivals, and Progress of a product and, Launching of a product in the market. | 8 |

| | | |
|---|---|---|
| **4** | **Formal Writing**<br>Notice, Agenda of meeting, Minutes of meeting, Job application, Types of resume: Chronological, Functional, and Combination resume. | **8** |

**Specification table with Marks (Theory):**

| Distribution of Theory Marks | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **10** | **15** | **15** | **10** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E:Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

**Reference Books:**

1. David Green: Contemporary English Grammar Structure and Usage
2. M L Tickoo and Subramanian: Intermediate Grammar, Usage and Composition
3. Wren and Martin – High School English Grammar and Composition
4. Murphy, R. (2019). English Grammar in Use (5th ed., p. 80) Cambridge: Cambridge University Press.
5. Advance Writing Skill by D.S Paul

**Course Outcomes: After completing this course, student will be able to**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Use English in day-to-day communication | 20% |
| CO-2 | Use various scientific/academic writing methods. | 20% |
| CO-3 | Comprehend the dynamics of various rules of grammar and check its validation in writing various documents. | 20% |
| CO-4 | Use grammar effectively for improving professional writing. | 10% |
| CO-5 | Write various formal and informal documents of day to day life | 20% |
| CO-6 | Prepare for formal writing. | 10% |

**List of Open Source Software/learning website:**

- http://www.english-online.org.uk/
- http://www.learnenglish.de/

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code: AEC401-3C

## Course Name: Business Communication

## Semester: VI

**w.e.f.: July 2025**

**Type of Course:** Ability Enhance Course

**Prerequisite:** Basic Knowledge of English

**Rationale:** At the end of the course, it will enhance communication skills of the students and make them well equipped for business communication with regard to various corporate sectors.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | C | CCE Marks | SSE Marks | |
| 2 | - | - | 2 | 25 | 25 | 50 |

**Content:**

| Sr. No. | Content | Total Hrs. |
|---|---|---|
| | **SECTION-A** | |
| 1 | **Interview Preparation**<br>• Meaning and Types of Interviews [ Face to Face, Telephonic, Video]<br>• Interview procedure [ Opening, Listening, Closure]<br>• Preparation for Interview<br>• Types of questions generally asked at interviews<br>• Importance of non - verbal aspects<br>• Resume Writing | **8** |
| 2 | **Group Discussion (GD)**<br>• Meaning and Definitions of Group Discussion<br>• Types of Group Discussion<br>• Procedure of Group Discussion.<br>• Group discussion common mistakes<br>• Importance of Group Discussions | **8** |

| | | |
|---|---|---|
| | • Skills Evaluated in Group Discussions | |
| **SECTION-B** | | |
| **3** | **Effective Presentation Strategies**<br>• Introduction<br>• Purpose of Presentation<br>• Analyzing audience Locale<br>• Organizing content(Introduction, Main body, Conclusion)<br>• Use of Visual Aids<br>• Modes of delivery(Extemporaneous, Manuscript, Impromptu, Memorization) | **8** |
| **4** | **Leadership skills and Team work**<br>• Role of an effective leader<br>• Qualities of a leader<br>• Importance of team work<br>• Team work as an employability skills<br>• Significance of team spirit | **8** |

**Specification table with Marks (Theory):**

| **Distribution of Theory Marks** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **10** | **15** | **15** | **10** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E:Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

**Text Book:**

1. Soft Skills & Employability Skills (Cambridge) By: Pillai Sabina, Fernandez Agna. New Delhi: Cambridge University Press, 2019 (Reprint)

**Reference Books:**

1. Paul Emmerson. Business English –Handbook Advanced.India:Macmillan Publishers,2007.
2. Norman Whitby. Business Benchmark (Cambridge English). Cambridge University Press, 2014

3. G. Damodar .English for Communication:Cambridge University Press,2021.
4. Sanjay, Kumar.,Pushp, Lata., Communication Skills Oxford Higher Education,2nd Ed. OUP,2015.
5. Kaul. Effective Business Communication, Pentice Hall:New Delhi.
6. Robinson, Netrakanil and Shintre . Communication Competence in Business English, Orient Longman: Hyderabad
7. Tengse,Ajay. Sodt-Skills -A Textbook for Undergtraduates.Orient Blackswan 2015.
8. Dhanvel,S.P. English and Soft -skills Orient Blackswan 2021.
9. Jungeja, Om. Mujumdar Aarati. Business Communication. Orient Blackswan 2010.
10. .Parikh, J. P. Surve, Anshu. Swarnabharati, Behrinnwala, Asma. Business Communication (Basic Concepts and Skills) Orient Blackswan.2011.
11. Samson, T. Alexander, Susan. Thomas Mary Sowmya. Effective Business Communication, Cambridge, 2020.

**Course Outcomes: After completing this course, student will be able to**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Students will be able to know the importance and need of communication skills for better employment and performance in industry | 20% |
| CO-2 | Students will be able utilize and implement the presentation skills along with collegiality skills in their day to day tasks at the workplace. | 20% |
| CO-3 | Relate themselves orally using business English. | 20% |
| CO-4 | Narrate to various situations through the fictional presentation of ideas. | 10% |
| CO-5 | Using and apprehending the business skills efficiently | 20% |
| CO-6 | Students will be able to inculcate employability skills ensuring their extraordinary achievement in a corporate setting and beyond. | 10% |

**List of Open Source Software/learning website:**

- http://www.english-online.org.uk/
- http://www.learnenglish.de/

# UPL University of Sustainable Technology

## SRICT Institute of Science & Research

## As Per National Education Policy 2020 (NEP 2020)

## Bachelor of Science

## Course Code:SEC403-3C

## Course Name: Internship

## Semester: VI

**w.e.f.: July 2025**

**Type of Course:** Major

**Prerequisite:** Basic Knowledge of chemical processes and operations.

**Rationale:** To provide students with practical, real-world experience, focusing on work experience, professional activities, or cooperative education, at the end of the course, students will learn about the application of Chemistry concepts in modern chemical industries. This will also provide the students an opportunity to practically use their chemical science-based skills in a life-science industry.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | Total Marks |
|---|---|---|---|---|---|---|
| L | T | P | C | CCE Marks | SSE Marks | |
| - | - | - | 4 | 50 | 50 | 100 |

**Content:**

| Sr. No. | Content | Total Hrs. |
|---|---|---|
| | | |
| 1 | The students shall carry out 02 weeks internship in an industry of national/international repute. They must prepare an internship report on a specific template provided by the University. Upon completion of the internship, students are required to present their work before the expert committee. Students must submit 01copy of their spiral internship report to the department. | 120 |