Choice Based Credit System
(CBCS)

B. Sc Prog. with Industrial Chemistry

University of Delhi

UNDERGRADUATE PROGRAMME

(Courses effective from Academic Year 20xx-xx)

SYLLABUS OF COURSES TO BE OFFERED: ***Core Courses, Elective Courses & Ability Enhancement Courses***

SYLLABUS REVISED DURING THE ACADEMIC YEAR 2019

	Core Course Chemistry - III	Solutions, Phase Equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry -II	4
	Core Course Chemistry - III Practical	Solutions, Phase Equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry –II	2
	Core Course Mathophysics – III	Algebra	4
	Core Course Mathophysics – III Practical	Algebra	2
	Skill Enhancement Course-I		2
	Skill Enhancement Course –I Practical/Tutorials*		2
IV	**Core Course Industrial Chemistry -IV**	Pharmaceuticals, Cosmetics, Perfumes & Pesticides	4
	Core Course Industrial Chemistry- IV Practical	Pharmaceuticals, Cosmetics, Perfumes & Pesticides	2
	Core Course Chemistry-IV	Chemistry of s- and p- block elements, States of matter & Chemical kinetics	4
	Core Course Chemistry-IV Practical	Chemistry of s- and p- block elements, States of matter & Chemical kinetics	2
	Core Course Mathophysics-IV	Wave and Optics	4
	Core Course Mathophysics-IV Practical	Wave and Optics	2
	Skill Enhancement Course-II		2
	Skill Enhancement Course-II Practical/Tutorials*		2
V	**Discipline Specific Elective -1**	Industrial Chemistry	4
	Discipline Specific Elective -1 Practical/Tutorials*	Industrial Chemistry	2
	Discipline Specific Elective -I	Chemistry of d-Block elements, Quantum Chemistry & Spectroscopy	4
	Discipline Specific Elective –I Practical/Tutorials*	Chemistry of d-Block elements, Quantum Chemistry &	2

DISCIPLINE SPECIFIC ELECTIVES Chemistry (two)

1. Chemistry of d-Block elements, Quantum Chemistry & Spectroscopy **(Compulsory Chemistry DSE-I)**
2. Organometallics, Bio-inorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy
3. Applications of Computers in Chemistry
4. Analytical Methods in Chemistry
5. Molecular Modelling & Drug Design
6. Novel Inorganic Solids
7. Research Methodology for Chemistry
8. Molecules of life
9. Dissertation

DISCIPLINE SPECIFIC ELECTIVES Mathophysics

(One each from Maths and Physics)

1. Electricity and Magnetism
2. Elements of Modern Physics
3. Medical Physics
4. Differential Equations
5. Calculus and Geometry

SKILL ENHANCEMENT COURSE Industrial Chemistry (two)

1. IT Skills for Chemists
2. Basic Analytical Chemistry
3. Analytical Clinical Biochemistry
4. Chemical Technology and Society
5. Cheminformatics

ICT enabled: Students will be trained to use modern library searching and retrieval methods to obtain information about a topic, relating to Industrial chemistry. Communicate and present their ideas effectively through power-point presentations and appropriate software for analysis of data.

Lifelong learners: Students will be capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development. They will keep themselves updated with the best international practices and latest development in technologies which will help them to gain a broader Global perspective of the subject.

Career Opportunity: Graduates with B. Sc. Programme Industrial Chemistry, will have possibility to find employment in government departments, research and development institutes, production, biotechnology, quality control, pharmaceutical industry, process industry, fertilizer production industry, plastics industry, pulp and paper industry, tanning industry, consumer industry, oil and petroleum industry, textile industry, dyes and paints industry, cosmetics industry, cement industry, glass industry, water purification and waste water purification engineering including forensic science and patents, defence education and research, and areas related to polymer chemistry.

The course provides an opportunity to graduates to undertake masters in chemistry/ industrial chemistry/ biotechnology and allied courses. After their post-graduation, they may opt for Ph.D. in multidisciplinary areas.

Teaching learning process

A student-centered approach which actively engages the students in the learning process is critical if skills which result in healthy behavior are to be fostered and developed.

The B. Sc. Program Industrial Chemistry course is aims to make the students proficient in industrial chemistry through the transfer of knowledge in the classroom as well as in the laboratory. Industrial Chemistry program is designed to encourage the learning strategies that could be incorporated in a comprehensive approach that include self-directed learning, co-operative learning, and peer education. In the classroom this will be done through blackboard and chalk lectures, charts, PowerPoint presentations, and the use of audio visual resources that are available on the internet such s virtual lab. The process of effective learning to a great extent

(15 Lectures)

Unit 3

Batteries

Primary and secondary batteries, battery components and their role and Characteristics of Battery.

Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery.

Fuel Cells, Solar cell and polymer cell.

(10 Lectures)

Unit 4

Alloys

Classification of alloys, Ferrous and Non- Ferrous alloys, Specific properties of elements in alloys.

Industrial manufacture of Steel (removal of silicon decarbonization demagnetization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing).

Composition and properties of different types of steel.

(12 Lectures)

Unit 5

Industrial Metallurgy

Preparation of metals (ferrous and nonferrous) and ultra pure metals for semiconductor technology.

(3 Lectures)

Practical

1. Preparation of carbon nanotubes (CNTs).
2. Preparation of paints.
3. Determination of metal ions using complexometric titration.
4. Analysis of (Cu, Ni) (Cu, Zn) in alloy or synthetic samples.
5. Preparation of pigment (zinc oxide).
6. Study the loss of raw iron in acidic medium.
7. Study the loss of raw iron in basic medium.

2. Numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations).
3. Numerical integration (e.g. entropy/ enthalpy change from heat capacity data).
4. Probability distributions (gas kinetic theory) and mean values.
5. Mean, standard deviation and Least square curve fitting method for linear equation.
6. Matrix operations: addition, multiplication and transpose
7. Graphic programs related to Chemistry problems. e.g. van der Waals isotherm,Compressibilty versus pressure curves, Maxwell distribution curves, concentration-time graph, pH metric titration curve, conductometric titration curves, Lambert Beer's law graph, s, p, d orbital shapes, radial distribution curves, particle in one dimensional box.

- ***Use of Software Products***

1. Computer Software like Scilab and Excel, etc for data handling and manipulation.
2. Simple exercises using molecular visualization software.
3. Open source chemistry software to draw structures.

References:

- McQuarrie, D. A. Mathematics for Physical Chemistry University Science Books (2008).
- Mortimer, R. Mathematics for Physical Chemistry. 3rd Ed. Elsevier (2005).
- Steiner, E. The Chemical Maths Book Oxford University Press (1996).
- Yates, P. Chemical Calculations. 2nd Ed. CRC Press (2007).
- Harris, D. C. Quantitative Chemical Analysis. 6th Ed. Freeman (2007) Chapters 3-5.
- Levie, R. de, How to use Excel in analytical chemistry and in general scientific data analysis,Cambridge Univ. Press (2001).
- Noggle, J. H. Physical Chemistry on a Microcomputer. Little Brown & Co. (1985).
- Venit, S.M. Programming in BASIC: Problem solving with structure and style Jaico Publishing House: Delhi (1996).

Teaching Learning Process:

Since the course involves programming and use of software, the teaching learning process becomes more efficient when the theory classes are well coordinated with practical exercises. Once the students learn BASIC commands, they may be encouraged to make their own programs.
QBASIC is a DOS based language which does not run on 64 bits Windows and Linux based operating systems. This problem can be solved by using DOSBOX emulator for different operating systems and running QB45 in it.
Another version which runs on WINDOWS is QB64. This is compatible with most of the QBASIC commands.

Assessment Methods:

- The students to be assigned projects based on chemistry problems done in class or in practical classes and use BASIC program to solve it. The projects to be a part of internal assessment.
- Presentation
- Test
- Semester end examination

Composite materials: Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, bio-nanocomposites, environmental effects on composites, applications of composites.

(10 Lectures)

Unit 6:

Speciality polymers:

Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene, polyaniline

and polypyrole, applications of conducting polymers, ion-exchange resins and their applications.

Ceramic & Refractory:

Introduction, classification, properties, manufacturing and applications of ceramics, refractory and superalloys as examples.

(10 Lectures)

Practical:

(Credits: 2, Lectures: 60)

CHEMISTRY PRACTICAL - DSE LAB: NOVEL INORGANIC SOLIDS

1. Synthesis of silver nanoparticles by chemical methods and characterization using UV-visible spectrophotometer.

2. Synthesis of silver nanoparticles by green approach methods and characterization using UV-visible spectrophotometer.

3. Preparation of polyaniline and its characterization using UV-visible spectrophotometer.

4. Synthesis of metal sulphide nanoparticles (MnS, CdS, ZnS, CuS, NiO) and characterization using UV-visible spectrophotometer.

5. Intercalation of hydrogen in tungsten trioxide and its conductivity measurement using conductometer.

6. Synthesis of inorganic pigments ($PbCrO_4$, $ZnCrO_4$, Prussian Blue, Malachite).

7. Synthesis of pure ZnO and Cu doped ZnO nanoparticles.

8. Preparation of zeolite A and removal of Mg and Ca ions from water samples quantitatively using zeolite.

Unit 3:

Bonding in coordination compounds

Valence Bond Theory (VBT):salient features of theory, Concept of Inner and outer orbital complexes of Cr, Fe, Co and Ni. Drawbacks of VBT

Crystal Field Theory

Splitting of d orbitals in octahedral symmetry. Crystal field effects for weak and strong fields. Crystal field stabilization energy (CFSE) Concept of pairing energy. Factors affecting the magnitude of Δ. Spectrochemical series. Splitting of d orbitals in tetrahedral symmetry. Comparison of CFSE for Octahedral and Tetrahedral fields,Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

(14 Lectures)

Unit 4:

Quantum Chemistry

1. Postulates of quantum mechanics, quantum mechanical operators.
2. Free particle. Particle in a 1-D box (complete solution), quantization, normalization of wave functions, concept of zero-point energy.
3. Rotational Motion: Schrödinger equation of a rigid rotator and brief discussion of its results (solution not required). Quantization of rotational energy levels.
4. Vibrational Motion: Schrödinger equation of a linear harmonic oscillator and brief discussion of its results (solution not required). Quantization of vibrational energy levels

(12 Lectures)

Unit 5:

Spectroscopy

- Spectroscopy and its importance in chemistry. Wave-particle duality. Link between spectroscopy and quantum chemistry. Electromagnetic radiation and its interaction with matter.
- Types of spectroscopy. Difference between atomic and molecular spectra. Born- Oppenheimer approximation: Separation of molecular energies into translational, rotational, vibrational and electronic components.
- Microwave (pure rotational) spectra of diatomic molecules. Selection rules. Structural information derived from rotational spectroscopy.
- IR Spectroscopy : Selection rules, IR spectra of diatomic molecules. Structural information derived from vibrational spectra. Vibrations of polyatomic molecules. Group frequencies. Effect of hydrogen bonding (inter- and intramolecular) and substitution on vibrational frequencies.
- Electronic Spectroscopy: Electronic excited states. Free Electron model and its application to electronic spectra of polyenes. Colour and constitution, chromophores, auxochromes, bathochromic and hypsochromic shifts**.**

(12 Lectures)

components of nucleic acids, nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA(types of RNA),difference between DNA and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

(10 Lectures)

Unit 5:

Lipids

Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega-3&6 fatty acids, Trans fats, Hydrogenation, Hydrolysis, Acid value, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

(8 Lectures)

Unit 6:

Concept of Energy in Biosystems

Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation and Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

(8 Lectures)

Practical:

1. Separation of amino acids by paper chromatography
2. Study of titration curve of glycine and determination of its isoelectric point.
3. Estimation of proteins by Lowry's method
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat
8. Qualitative tests for carbohydrates- Molisch test , Barfoed's reagent test, rapid furfural test , Tollen's test and Fehling solution test(Only these tests are to be done in class)
9. Qualitative tests for proteins
10. Extraction of DNA from onion/cauliflower

References:

Theory:

- Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Berg, J. M., Tymoczko, J. L. & Stryer, L. Biochemistry 7th Ed., W. H. Freeman.

Practical:

- Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, ELBS.
- Introduction to Practical Biochemistry by S K Swahney and Randhir Singh,Nerosa Publications.
- Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
- Arthur, I. V. Quantitative Organic Analysis, Pearson.

Teaching Learning Process:

- The teaching learning process will involve the traditional chalk and black board method.
- Certain topics like Mechanism of enzyme action and enzyme inhibition, transcription and translation etc. where traditional chalk and talk method may not be able to convey the concept, are taught through audio-visual aids.
- Students are encouraged to participate actively in the classroom through regular presentations on curriculum based topics.
- As the best way to learn something is to do it yourself, practicals are planned in such a way so as to reinforce the topics covered in theory.

Assessment Methods:

Students evaluation done on the basis of regular class test and assignment during the course as per the curriculum.

Keywords:

Biomolecules, Enzymes, Mechanism of enzyme action and inhibition, SAR, Drug Receptor Theory, Energy concept in biological system, catabolic pathways and their inter-relationship.

DISSERTATION

DISCIPLINE ELECTIVE COURSES (DSE)
INDUSTRIAL CHEMISTRY

Green Chemistry

Industrial Metallurgy: Preparation of ultrapure metals for semiconductor technology.

(4 Lectures)

Unit 4:

Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.
Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere.
Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Major sources of air pollution. Pollution by SO_2 , CO_2 , CO, NO_x, H_2S and other foul smelling gases. Methods of estimation of CO, NO_x, SO_x and control procedures. Effects of air pollution on living organisms and vegetation.
Greenhouse effect and Global warming,
Environmental effects of ozone, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens,
Air pollution control. Settling Chambers, Venturi Scrubbers, Cyclones, Electrostatic Precipitators (ESPs).

(15 Lectures)

Unit 5:

Water Pollution:

Hydrological cycle, water resources, aquatic ecosystems. Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro fertilizer.
Sludge disposal. Industrial waste management, incineration of waste.
Water treatment and purification (reverse osmosis, electro dialysis, ion exchange).
Water quality parameters for wastewater, industrial water and domestic water.

(15 Lectures)

Unit 6:

Energy & Environment:

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar, Hydrogen, geothermal, Tidal and Hydel.
Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.
Biocatalysis: Introduction to biocatalysis: Importance in Green Chemistry and Chemical Industry.

(10 Lectures)

References:

- K.H. Buchel, H.H. Moretto, P. Woditsch, Industrial Inorganic Chemistry , Wiley-VCH, Second Edition (2003)
- E. Stocchi:Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.

- F.W. Billmeyer: Text Book of Polymer Science, John Wiley.
- P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill.
- R.W. Lenz: Organic Chemistry of Synthetic High Polymers.
- S. M. Ashraf, S. Ahmad, U. Riaz, A Laboratory Manual of Polymers, I.K. International Publishing House (2008).

Practical:

• Malcohm P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed.
• Harry R. Allcock, Frederick W. Lampe and James E. Mark, Contemporary Polymer Chemistry, 3rd ed. Prentice-Hall (2003)
• Fred W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley-Interscience (1984)
• Joel R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall (2003)
• Petr Munk and Tejraj M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John Wiley & Sons (2002)
• L. H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)
• Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005)
• Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

Teaching Learning Process:

Chalk and Talk method, ICT enabled teaching. Students need to make presentations.

Assessment Methods:

Assessment through continuous evaluation, assignments, class tests, presentations, quiz, projects.

Keywords:

Bonding, texture, polymerization, degradation, polymer solution, crystallization, Properties, applications.

Inorganic Materials of Industrial Importance

(CHEMISTRY DSE-1 (i)

Total Credits: 06 **(Credits: Theory-04, Practicals-02)**
(Total Lectures: Theory- 60, Practicals-60)

conventional teaching along with hands on exercise on computers.

Assessment Methods:

Assessment on solving chemistry related problems using spreadsheet.
Presentation on documentation preparation on any chemistry topic involving tables and graphs.
Semester end practical and theory examination.

Keywords:

Uncertainty in measurements, roots of quadratic and polynomial equations, Newton Raphson's method, binary bisection, numerical integration, trapezoidal rule, Simpson's rule, differential calculus, least square curve fitting method, Spreadsheet,charts, tables, graphs, LINEST, t-test, F-test

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BASIC ANALYTICAL CHEMISTRY

ChemistrySEC1-4(ii) **Total Credits: 04**
(Credits: Theory-02, Practicals-02)
(Hands on Exercises: 60 Lectures)

Objectives:

The aim of this course is to make students aware about the following concepts:

Knowledge of chemical analysis including water and soil, separation techniques like Chromatography, Column, ion-exchange chromatography, etc. Instrumental demonstrations of flame photometry and determinations of macro-nutrients using flame photometry.

Learning Outcomes:

By the end of this course, students will be able to learn:

1. How to handle analytical data
2. How to determine composition and pH of soil which can be useful in agriculture
3. Quantitative analysis metal ions in water
4. Separations techniques
5. Estimation of macro nutrients using Flame photometry

Unit 1:

- Presentations by Individual Student
- Class Tests
- Laboratory Tests
- Written assignment(s)
- End semester University Theory and Practical Examination

Keywords:

Analytical chemistry, sampling, accuracy, precision, significant figures, Soil analysis, Analysis of water, Chromatography, Ion exchange chromatography, Flame photometry

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CHEMICAL TECHNOLOGY AND SOCIETY

Chemistry SEC 1-4(iii) **Total Credits: 04**

(Credits: Theory-02, Practicals-02)

(Hands on Exercises: 60 Lectures)

Objectives:

This course will help students to connect chemical technology for societal benefits. It would fulfill the gap between academia and industries.

Course Learning Outcomes:

The students will be able to learn:

- Use of basic chemistry to chemical engineering
- Various chemical technology used in industries
- To develop scientific solutions for societal needs

Unit 1:

Chemical Technology

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry. Introduction to clean technology.

Society

- Need of Green Chemistry
- Importance of Green Chemistry in- daily life, Industries and solving human health problems (four examples each).
- A brief study of Green Chemistry Challenge Awards (Introduction, Award categories and study about five last recent awards).

(8 Lectures)

Unit 2:

Twelve Principles of Green Chemistry

- A brief introduction of the twelve principles of the Green Chemistry with their explanations
- Designing a Green Synthesis using these Principles with emphasis on
    - *Prevention of Waste / Byproducts*
    - *Atom economy, calculation of atom economy*
    - *Green solvents-Supercritical fluids, water as a solvent for organic reactions, ionic liquids, s*olvent less reactions, solvents obtained from renewable sources.
- Catalysis and Green Chemistry- Comparison of heterogeneous and homogeneous catalysis, bio-catalysis, asymmetric catalysis and photocatalysis.
- Green Energy and Sustainability
- Real-time analysis for Pollution Prevention
- Prevention of chemical accidents, designing greener processes, Inherent Safer Design, Principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route of carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.

(14 lectures)

Unit 3:

The following Real-world Cases in Green Chemistry should be discussed:
Surfactants for Carbon Dioxide – Replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.
Designing of Environmentally safe marine antifoulant.
Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments.
An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

(8 Lectures)

Practical:

Characterization by m. pt.; U.V.-Visible spectroscopy, IR spectroscopy, and any other specific method should be done (wherever applicable).

- Preparation and characterization of nanoparticles of gold using tea leaves/ silver nanoparticles using plant extracts.
- Preparation and characterization of biodiesel from vegetable oil preferably waste cooking oil.
- Extraction of D-limonene from orange peel using liquid CO_2 prepared from dry ice.

- Mechanochemical solvent free, solid-solid synthesis of azomethine using p-toluidine and o-vanillin (various other combinations of primary amine and aldehyde can also be tried).
- Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II).
- Designing and conducting an experiment by utilizing the productsand by products obtained in above preparations which become waste otherwise if not used. This is done by critical thinking and literature survey.

Some representative examples:

- Use of nanoparticles as catalyst for a reaction
- Use of azomethine for complex formation
- Conversion of byproduct of biodiesel to a useful product

References:

Theory:

- P. T. Anastas & J. C. Warner : Green Chemistry- Theory and Practice, Oxford University Press, (1998)
- Lancaster, Mike Green Chemistry: An Introductory Text: RSC Publishing, (2010) 2nd Edition, ISBN 978-1-84755-873-2.
- A.S. Matlack : Introduction to Green Chemistry, Marcel Dekker (2001)
- M. C. Cann & M. E. Connely : Real-World Cases in Green Chemistry, American Chemical Society, Washington, (2000)
- M. C. Cann and Thomas P. Umile ; Real-World Cases in Green Chemistry, American Chemical Society.
- Ryan, M.A. Introduction to Green Chemistry, Tinnesand; (Ed), American Chemical Society, Washington DC (2002)

Practical:

- Kirchof, M. & Ryan, M. A. Greener approaches to undergraduate chemistry experiment. American Chemical Society, Washington DC (2002).
- Sharma, R. K.; Sidhwani, I. T. & Chaudhari, M.K. Green Chemistry Experiments: A monograph I.K. International Publishing House Pvt. Ltd. New Delhi, Bangalore ISBN 978-93-81141-55-7 (2013).
- Pavia, D. L., Lampman, G. H. & Kriz, G. S.; Introduction to organic laboratory technique: A contemporaray approach. W.D Saunders Publication Philadalphia 1976.
- Sharma R. K., Sharma, C., & Sidhwani, I.T. (2010). Solventless and one-pot synthesis of Cu(II) phthalocyanine complex: a green chemistry experiment. Journal of Chemical Education, 2010, 88(1), 86-88.
- Sharma, R. K., Gulati, S., & Mehta, S. Preparation of gold nanoparticles using tea: a green chemistry experiment. Journal of Chemical Education, 2012, 89(10), 1316-1318.
- Wealth from waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated “A social Awareness Project” Indu Tucker Sidhwani, Geeta Saini, Sushmita Chowdhury, Dimple Garg, Malovika, Nidhi Garg, Delhi University Journal of Undergraduate Research and Innovation, Vol 1, Issue 1, Feb 2015. ISSN: 2395-2334.

Teaching Learning Process:

- ICT enabled classes
- Power point presentations
- visit to pharmaceutical industry
- Through videos classes
- Interactive classes

Assessment Methods:

- Power point presentations.
- Discussions on the problems
- Asking students to make charts showing the solutions of the surrounding problems
- Real world problems solutions discussion
- quiz
- Test
- Assignments

Keywords:

Green Chemistry, 12 Principles

INTELLECTUAL PROPERTY RIGHTS

CHEMISTRY SEC 1-4 (vi)

Total Credits: 04
(Total Lecture: Theory-60)

Objectives:

1. The course aims to give insights into the basics of the Intellectual Property (IP) and in its wider purview it encompasses intricacies relating to IP.
2. This course is designed to introduce a learning platform to those who may be involved in the making and creation of various forms of IP.
3. The course may also provide cursory understanding of the overall IP ecosystem in the country.

Learning Outcomes:

At the end of this paper, students will be able to:

1. Learn theoretical concepts of evolution of Intellectual Property Laws, and to differentiate between the different kinds of IP.
2. Know the existing legal framework relating to IP in India.
3. Comprehend the value of IP and its importance in their respective domains.

- This course may motivate the students to make their career in multifaceted field of intellectual property rights.

Unit 1:

Introduction

Basic concept of Intellectual Property, Rationale behind Intellectual Property, Justifications for protection of IP, IPR and Economic Development, Major International Instruments relating to the protection of IP, The World Intellectual Property Organization (WIPO), WTO and TRIPS Agreement.

(8 Lectures)

Unit 2:

Copyright and Related rights

Introduction to copyright and its relevance, Subject matter & conditions of protection, Ownership and term of copyright, Rights under copyright law, Infringement of copyright and remedies, Exceptions to infringement/ Public rights.

(10 Lectures)

Unit 3:

Patents

Introduction, Criteria for obtaining patents, Patentable subject matter, Non patentable inventions, Procedure for registration , Term of patent and Rights of patentee, Patent Cooperation Treaty & International registration, Basic concept of Compulsory license and Government use of patent, Infringement of patents and remedies, Software patents and importance for India, Utility model & patent, Trade secrets and know-how agreement, Traditional Knowledge and efforts of Indian Govt. for its protection.

(15 Lectures)

Unit 4:

Trade Marks

Meaning of mark and Trademark, Categories of Trademark : Service Mark, Certification Mark, Collective Mark,