

Department of Chemistry

UG Chemistry courses that integrate cross-cutting issues relevant to Environment and Sustainability into the Curriculum.

Environment and Sustainability in curriculum

To achieve sustainable development it is necessary to study the environment systematically and to discover remedial measures by introducing related courses in the curriculum. In B.Sc Chemistry programmes the courses like Environmental Chemistry, Agriculture Chemistry and Industrial Chemistry are introduced to give basic knowledge of environment and sustainability. These courses aware the student about conservation of nature and ecosystem.

1. **Environmental Chemistry** course introduced to give basic knowledge of environment, water conservation, pollution control and effects. It also educates students about natural resources and the importance of its conservation such as ozone layer, plantation, water bodies, etc.
2. **Agriculture Chemistry** Course introduces students about the role of agriculture chemistry and its potential. Understand basic concepts of soil, plant nutrients, understand importance of manures as compared to chemical fertilizers', various techniques to protect the plants, provide knowledge of various pesticides, insecticides, fungicides, herbicides and quality irrigation water, water quality standard and analysis of irrigation water.
3. **Industrial Chemistry** Course introduced as a compulsory course for TYBSc Chemistry to educate students about pollution, importance of natural fertilizers, disposal of waste of various industries, importance of fermentation industry, preparation of bio-diesel, etc.

Supportive Document: Syllabus Copy/ Course curriculum

Semester- III

Course: Industrial Chemistry (CH-335)

Topics	No. of lectures
1. Modern Approach to Chemical Industry	08
2. Agrochemicals	08
3. Manufacture of Basic Chemicals	08
4. Petrochemicals and eco-friendly fuels	08
5. Food and Starch Industry	08
6. Cement and Glass industry	08
Total Lectures	48

1. Modern Approach to Chemical Industry (08)

Introduction, basic requirements of chemical industries, chemical production, raw materials, unit process and unit operations, Quality control, quality assurance, process control, research and development, pollution control, human resource, safety measures, classification of chemical reactions, batch and continuous process, Conversion, selectivity and yield, copy right act, patent act, trade marks

Ref. 1: Chapter 2 (relevant pages)

2. www.wikipedia.org/wiki/copyright_act_of1976

3. www.wikipedia.org/wiki/patentact

4. www.wikipedia.org/wiki/trademark

2. Agrochemicals (08)

General introduction and scope of agrochemicals, meaning and examples of: Insecticides, Herbicides, Fungicides, Rodenticides, Pesticides, Plant growth regulators. Pesticide formulation, slow release pesticide formulations, storage stability test, and Industrial entomology. Advantages and disadvantages of agrochemicals. Structure,: DDT, BHC, Warfarin, Aldrin, Endosulphan, synthesis and application: DDT, BHC and Endosulphan. Biopesticides like Neem oil and Karanj oil.

Ref. No. 5-7

3. Manufacture of Basic Chemicals (08)

a) Ammonia: Physicochemical principles involved, Manufacture of ammonia by modified Haber-Bosch process, its uses.

b) Sulphuric acid: Physicochemical principles involved, Manufacture of sulphuric acid by contact process, its uses.

c) Nitric acid: Physicochemical principles involved, Manufacture of nitric acid by Ostwald's process, its uses.

Ref.No.1: P.No. 571 to 588, 618 to 664

4. Petrochemicals and eco-friendly fuels (08)

a) Introduction, occurrence, composition of petroleum, resources, processing of petroleum, calorific value of fuel, cracking, octane rating (octane number), cetane number, flash

point, and petroleum refineries, applications of petrochemicals, synthetic petroleum, lubricating oils & additives

b) *Fuels and eco-friendly fuels*: liquid, gaseous fuel (LPG, CNG), fossil fuels, diesel, bio diesel, gasoline, aviation fuels. Use of solar energy for power generation.

Ref. 15, 16, 17

5. Food and Starch Industry

(08)

Food Industry:

(a) Definition and scope, nutritive aspects of food constituents, , food deterioration factors and their control; (b) Preservation and processing: Heat and cold preservation and processing, cold storage, food dehydration and concentration, various foods, their processing and preservation methods, fruits, beverages, cereals, grains, legumes and oil seeds; (c) Food additives: Enhancers, sugar substitutes, sweeteners, food colors,

Ref.12

Starch industries:

Chemistry of starch, manufacturing of industrial starch and its applications, characteristics of some food starches, non-starch polysaccharides-cellulose-occurrence.

Ref. 11

6. Cement and Glass industry

(08)

Cement industry:

Introduction, Importance, composition of portland cement, raw materials, proportioning of raw materials, setting and Hardening of cement, reinforced concrete.

Ref.1: P.No. 313-333 Ref. 8: P.No173-176, Ref. 10: P.No.188-192

Glass industry

Introduction, importance, physical and chemical properties of glass, chemical reaction, annealing of glass Special glasses: colored, safety, hard, borosilicate, optical, photosensitive, conducting, glass laminates.

Ref.1: P. No.160-171;Ref. 8: P. No. 247-265; Ref.9: P. No. 197-212

Aims and objectives

1. Modern Approach to Chemical Industry

The students are expected to learn;

- i. Importance of chemical industry,
- ii. Meaning of the terms involved,
- iii. Comparison between batch and continuous process,
- iv. Knowledge of various industrial aspects

2. Agrochemicals

Students should know the

- i. Various insecticides,

- ii. Pesticides,
- iii. Fungicides,
- iv. Rodenticides & biopesticides used in agriculture field with their synthesis and applications.

3. Manufacture of Basic Chemicals

Students should know the

- i. Concept of basic chemicals,
- ii. their uses and manufacturing process.
- iii. They should also know the physical chemical principles involved in manufacturing process

4. Petrochemicals and eco-friendly fuels

Introduction, occurrence, composition of petroleum, resources, processing of petroleum, other properties

Fuels and eco-friendly fuels, use of solar energy etc.

5. Food and Starch Industry

Food Industry:

Students should know

- i. Scope,
- ii. Nutritive aspects of food constituents,
- iii. Quality factors and their measurements,
- iv. Food deterioration factors and their control;
- v. Food preservation and Food additives

Starch Industry:

Students should know about the

- i. Chemistry of starch,
- ii. Manufacturing of industrial starch and its applications,
- iii. Characteristics of some food starches,
- iv. Non-starch polysaccharides-cellulose-occurrence

6. Cement and Glass industry

Cement industry

The students are expected to

- i. Learn importance of these industries,
- ii. Manufacture of cement by modern methods
- iii. Definition of setting and hardening
- iv. Reinforced concrete

Glass industry

The students are expected

- i. To learn about making of glass by different methods,
- ii. Various operations involved in the manufacture and compositions,
- iii. Properties and uses of special glasses.

References

1. Industrial Chemistry-B.K. Sharma, Goyal publishing house, Mirut, Chapter 2 (relevant pages)
 2. www.wikipedia.org/wiki/copyright_act_of1976
 3. www.wikipedia.org/wiki/patentact
 4. www.wikipedia.org/wiki/trademark
 5. Insects and Pesticides, Saxena A B, Anmol Publications
 6. Emergency Medicine: Chapter 146 Insecticides, Herbicides & Rodenticides, by James Adams
 7. Growth Regulators in Agriculture and Horticulture, by Amarjit Basra, CRC Press, 2000
 8. Shreeve's chemical process industries 5th Edition, G.T. Oustin, McGraw Hill
 9. Riegel's hand book of Industrial chemistry, 9th Edition, Jems A. Kent
 10. Industrial chemistry –R.K. Das, 2nd Edition, 1976.
 11. Chemistry and industry of starch, New York, N.Y., Academic Press, incby Kerr, Ralph Waldo Emerson
 12. The Complete Manual Of Small-Scale Food Processing, by Peter Fellows, Practical Action Pub
 13. Polymeric Materials, C. C. Winding and G. D. Hiatt McGraw Hill Book Co. Polymer Science by Gowarikar
 14. Polymer science, Bill Meyer, F. W. Jr. John Wiley& sons
 15. The Petroleum chemicals industry by R. F. Goldstine, e &Fn London
 16. Fundamentals of petroleum chemical technology by P Below.
 17. Petro Chemicals Volume 1 and 2 ; A Chauvel and Lefevrev ; Gulf Publishing company
 18. Perfumes Soaps Detergents & Cosmetics (Soaps & Detergents) (Volume 1) 1st Edition, CBS Publisher
 19. Dyes & Paints: A Hands-On Guide to Coloring Fabric, by Elin Noble
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Semester- IV
Course: Industrial Chemistry (CH-345)

Topics	No. of lectures
1. Polymer chemistry	10
2. Sugar and Fermentation Industry	08
3. Soap, detergents and Cosmetics	08
4. Dyes and paints	08
5. Chemistry of pharmaceutical industries	08
6. Pollution prevention and waste management	06
Total Lectures	48

1. Polymer chemistry **(10)**

Classification of Polymers: Organic and Inorganic polymers

(a) Basic concepts, nomenclature, degree of polymerization, classification of polymerization reactions, thermodynamic and transport properties of polymer

b) *Commercial polymers and their importance:* (a) Nylon, polyesters (terylene and dacron), rubber, vulcanization of rubber, synthetic rubber, Bun 2-N rubber, copolymers of butadiene, PVC, acrylic, teflon, polyethylene and acrylonitrile; (b) Silicone polymers: silicone oils, rubber, grease and resin; (c) Resins: Phenol-formaldehyde resins, urea-formaldehyde resins, epoxy resins, melamine-formaldehyde resins;

Ref. 13, 14

2. Sugar and Fermentation Industry **(08)**

Sugar: Occurrence, Manufacturing of refine cane sugar from sugar cane, general idea of carbonation and sulphitation processes and their comparison, by-product and their use.

Ref.8-10

Fermentation Industry:

Introduction, importance, Basic requirement of fermentation process, Manufacture of industrial alcohol from molasses, fruits, food grains, & ethylene, Manufacturing of wine, beer, whisky, rum ; importance Power alcohol

Ref. 1, 8-10

3. Soap, detergents and Cosmetics **(08)**

- A. Chemistry of soap, raw material, chemical reaction, types of soap.
- B. Meaning of the terms detergent and surfactants, emulsion and emulsifying agents, wetting and non-wetting, hydrophobic and hydrophilic nature, amphipathic structures, types of surfactants, raw materials for detergents, washing action of soaps and detergents, detergent builders, additives.

- C. Raw materials: emulsifiers (natural, synthetic and finely dispersed solids), lipid components (oils, waxes, fats), humectants, colours (dyes and pigments), preservatives and antioxidants. (b) Cosmetics for skin: Types and problems of skin, key ingredients of skin cleansing, toners, moisturizers, nourishing, protective sunscreen, talcum powder and bleaching products. (c) Hair care: classification, ingredients, special additives for conditioning and scalp health, hair colourants (temporary, semi-permanent and gradual colourants), the plant materials (herbs) used in hair cosmetics.

Ref. 18.

4. Dyes and paints

(a) *Dyes*: Introduction, classification of dyes: Structures and applications, nitro, nitroso, azo, heterocyclic, phthalenes, xanthenes, rhodamines, thiazine, cyanine, anthraquinone, indigoids, thioindigoids, phthalocyanines, wet dyes.

(b) *Paints*: Introduction of paints, ingredients and classification, new technologies; properties of coatings; solvents, plasticizers, dyes and bioactive additives;

(c) *Pigments*: Introduction, classification and general physical properties.

Ref.1: P. No.777-814; Ref.9: P. No.863-915 ;Ref.10 Relevant page

Ref. 19.

5. Chemistry of pharmaceutical industries

(08)

- General aspects of drug action*: Introduction, classification, nomenclature, structure-activity relationship, action of drugs, factors affecting drug action, metabolism of drugs, chemical structures, methods of production and pharmacological activity.
- Meaning of the terms: Prescriptions, doses, analgesic, antipyretic, diuretic, anesthetics, antibiotics, anti-inflammatory, anti-viral, tranquilizer, antiulcer, antialergic and bronchodilators, cardiovascular, cold preparations, anti-hypertensive, cough preparation, anti-neoplastic, sedative and hypnotics, steroidal, contraceptive, histamine and antihistamine.
- Synthesis and uses: Paracetamol, Aspirin, Sulphanilamide.

Ref.1: P. No.762-775; Ref.8: P. No.803-804, 818-822 ; Ref.9: P. No.987-1011

6. Pollution prevention and waste management

(06)

Introduction, importance of waste management, concept of atom economy, Terms involved in waste minimization: source reduction, recycling, product changes, source control, use and reuse, reclamation, assessment procedures, types of wastes, treatment and disposal of industrial waste. Treatment of wastes or effluents with organic impurities. Treatment of wastes or effluents with inorganic impurities. The nature, effect and treatment of some important chemical wastes-(Pulp and paper industries, soap and detergent industries and food processing industries).

Ref. 1: P.No. 8-92; Ref.6: P.No. 15-30;

Ref. www.wikipedia.org/atom economy

Aims and Objectives:

1. Polymer chemistry

Students should know

- i. Basics of polymer,
- ii. Nomenclature,
- iii. Degree of polymerization,
- iv. Classification of polymerization reactions,
- v. Thermodynamic and transport properties of polymer,
- vi. Commercial polymers and their importance,
- vii. Biomedical polymers: implants,
- viii. Contact lens and dental polymers.

2. Sugar and Fermentation Industry

The students are expected to learn

- i. Importance of sugar industry,
- ii. Manufacture of direct
- iii. Consumption (plantation white) sugar with flow diagram.
- iv. Cane juice extraction by various methods,
- v. Clarification by processes like carbonation,
- vi. Sulphitation,
- vii. Phosphatation, etc.
- viii. Concentration of juice by using multiple effect evaporator system,
- ix. Crystallization of sucrose by using vacuum pan.

Fermentation Industry

- i. Importance,
- ii. Basic requirement of fermentation process,
- iii. Manufacturing of ethyl alcohol by using molasses,
- iv. Food grains, fruits & ethylene.
- v. Manufacturing of wine, beer, whisky, rum etc.

3. Soap, detergents and Cosmetics

Students should know about

- i. Different types of soap products,
- ii. Chemistry of soap.
- iii. Students should know about various cosmetics,
- iv. Raw materials,
- v. Properties and various types of cosmetics used.
 - i. Meaning of the terms detergent,
 - ii. Surfactants, emulsion and emulsifying agents,
 - iii. Wetting and non-wetting,
 - iv. Hydrophobic and hydrophilic nature,
 - v. Amphipathic structures,
 - vi. Types of surfactants,
 - vii. Raw materials for detergents,

- viii. Washing action and detergents,
- ix. Detergent builders, additives.

4. Dyes and paints

Students should know about

- i. *Dyes*: introduction,
- ii. Dye intermediates,
- iii. Preparation of dye intermediates,
- iv. Structural features of a dye;
- v. Classification of dyes,
- vi. Structures and applications,
- vii. Nitro, nitroso,
- viii. Azo, heterocyclic,
- ix. Phthalenes,
- x. Xanthenes,
- xi. Rhodamines,
- xii. Thiazine,
- xiii. Cyanine,
- xiv. Anthraquinone,
- xv. Indigoids,
- xvi. Thioindigoids,
- xvii. Phthalocyanines, wet dyes.

(b) *Paints*:

- i. Introduction of paints,
- ii. Ingredients and classification,
- iii. New technologies;
- iv. Properties of coatings;
- v. Solvents, plasticizers, dyes and bioactive additives.

(b) *Pigments*:

- i. Introduction,
- ii. Classification and general physical properties.

5. Chemistry of pharmaceutical industries

Students should know about

- i. *General aspects of drug action*:
- ii. Introduction, classification,
- iii. Nomenclature,
- iv. Structure-activity relationship,
- v. Action of drugs,
- vi. Assay of drugs and factors affecting drug action,
- vii. Metabolism of drugs,
- viii. Chemical structures,
- ix. Methods of production and pharmacological activity.
- x. Meaning of the terms of the various drugs.
- xi. Synthesis and uses of few drug molecules.

6. Pollution prevention and waste management

The students are expected to learn all the problems of pollution and disposal of waste of various industries.

References

1. Industrial Chemistry-B.K. Sharma, Goyal publishing house, Mirut, Chapter 2 (relevant pages)
 2. www.wikipedia.org/wiki/copyright_act_of1976
 3. www.wikipedia.org/wiki/patentact
 4. www.wikipedia.org/wiki/trademark
 5. Insects and Pesticides, Saxena A B, Anmol Publications
 6. Emergency Medicine: Chapter 146 Insecticides, Herbicides & Rodenticides, by James Adams
 7. Growth Regulators in Agriculture and Horticulture, by Amarjit Basra, CRC Press, 2000
 8. Shreeve's chemical process industries 5th Edition, G.T. Oustin, McGraw Hill
 9. Riegel's hand book of Industrial chemistry, 9th Edition, James A. Kent
 10. Industrial chemistry –R.K. Das, 2nd Edition, 1976.
 11. Chemistry and industry of starch, New York, N.Y., Academic Press, inc by Kerr, Ralph Waldo Emerson
 12. The Complete Manual Of Small-Scale Food Processing, by Peter Fellows, Practical Action Pub
 13. Polymeric Materials, C. C. Winding and G. D. Hiatt McGraw Hill Book Co. Polymer Science by Gowariker
 14. Polymer science, Bill Meyer, F. W. Jr. John Wiley & sons
 15. The Petroleum chemicals industry by R. F. Goldstine, e & fn London
 16. Fundamentals of petroleum chemical technology by P Below.
 17. Petro Chemicals Volume 1 and 2 ; A Chauvel and Lefevrev ; Gulf Publishing company
 18. Perfumes Soaps Detergents & Cosmetics (Soaps & Detergents) (Volume 1) 1st Edition, CBS Publisher
 19. Dyes & Paints: A Hands-On Guide to Coloring Fabric, by Elin Noble
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Semester-III

Course: Environmental and Green Chemistry (CH-336D)

Name of the Topic	Number of lectures
1. Concepts and scope of Environmental Chemistry	02
2. Atmosphere and Air Pollution	14
3. Hydrosphere and water pollution	08
4. Introduction to Green Chemistry	10
5. Green Chemistry and Technology for sustainable development	10
6. Green Chemistry and Hazardous Organic Solvents	04
Total lectures	48

Chapter 1: Concepts and scope of Environmental Chemistry

(02)

- 1.1 Introduction
- 1.2 Terminologies
- 1.3 Units of concentration
- 1.4 Segments of Environment

Ref. 1, Ref. 3

Aims and Objectives-

Students should know-

- i. Importance and conservation of environment.

Chapter 2: Atmosphere and Air Pollution

(14)

- 2.1 Composition and structure of atmosphere
- 2.2 Chemical and photochemical reactions in atmosphere
- 2.3 Chemistry of O₃, SO_x, NO_x and chlorides in atmosphere
- 2.4 Primary air pollutants
- 2.5 Sampling of air
- 2.6 Particulate matter: inorganic and organic
- 2.7 Smog: reducing and photochemical
- 2.8 Mechanism of ozone depletion
- 2.9 Stability and reactions of CFCs
- 2.10 Harmful effects of CFCs
- 2.11 CFCs substitutes
- 2.12 Bhopal gas tragedy

Ref. 1, Ref. 3, Ref. 5

Aims and Objectives-

Students should know-

- i. Segments of atmosphere

- ii. Hazards of flue gases
- iii. Ozone depletion
- iv. Ecological changes due to hazardous gases
- v. Understand the social issues

Chapter 3: Hydrosphere and water pollution (08)

- 3.1 Water resources
- 3.2 Physical chemistry of sea water: composition, equilibria, pH, pE
- 3.3 Microbially mediated aquatic reactions, nitrogen cycle, iron and manganese bacteria
- 3.4 Classification of water pollutants
- 3.5 Organic and Inorganic pollutants: Pesticides, Detergents, Eutrophication, Marine, Oil, Acid mine drainage, remedial measures and sediments
- 3.6 Thermal pollution
- 3.7 Sampling and monitoring water quality parameters: pH, D.O. (Winkler Method), COD, TOC, Total hardness, free chlorine.

Ref. 1, 2, 3, and 5

Aims and Objectives-

Students should know-

- i. Water resources
- ii. Quality of potable water
- iii. WHO limits for toxic materials in water stream
- iv. Quality measures

Chapter4. Introduction to Green Chemistry [10]

- 4.1 Chemistry is good
- 4.2 The environment and the five environmental spheres
- 4.3 What is environmental Chemistry?
- 4.4 Environmental Pollution
- 4.5 What is green Chemistry?
- 4.6 Green Chemistry and synthetic chemistry
- 4.7 Reduction of risk: Hazard and exposure
- 4.8 The risk and no risks
- 4.9 Waste prevention
- 4.10 Basic principles of green chemistry
- 4.11 Examples based on green technology

[Ref: Green Chemistry By Stanley E Manahan, Chemchar Research Inc. (2006) -2ndEdn. chapter 1, P1-17 and Ref.6 Relevant pages.]

Chapter 5. Green Chemistry and Technology for sustainable development [10]

- 5.1 Green Chemistry from theory to practice
- 5.2 The twelve principles of green chemistry
- 5.3 Green Chemistry and sustainable Development
- 5.4 Designing Products under the holistic approach “ Cardle-to Cardle”
- 5.5 Scientific areas for practical applications of green chemistry
- 5.6 Use of alternative basic chemicals as feedstocs in chemical industry and research

- 5.7 Green Chemistry and Reduction of solvent Toxicity (Alternative Solvents or replacement)
5.8 Applications of New Methodologies in the synthesis of chemical compounds- catalysis and green chemistry.

[Ref : Green Chemistry–Green engineering by AthanasiosValavanidis and ThomaisVlachogianni (March 2012) ; Chapter 2 p17-37 and Ref.6 Relevant pages]

Chapter 6. Green Chemistry and Hazardous Organic Solvents (Green solvents, replacement and Alternative techniques) [04]

- 6.1 Introduction to Green Chemistry and Toxic organic solvents
6.2 Green solvents and Alternative methods
6.3 Green Chemistry, Green solvents – Alternative techniques in organic synthesis

[Ref : Green Chemistry –Green engineering , Chapter 5, p81-91, Ref.6 Relevant pages]

Aims and Objectives-(for Chapters 4, 5 and 6)

Students should know-

- i. Need of green chemistry technology
- ii. Principles of green chemistry
- iii. Advantages of green chemistry
- iv. Simple examples to clarify the principles
- v. Catalytic routes for sustainable developments

Reference Books:

- 1: Environmental Chemistry – A. K. De, 5th Edition (New age international publishers)
 - 2: Environmental Chemistry – J. W. Moore and E. A. Moore (Academic Press, New York)
 - 3: Environmental Chemistry – A. K. Bhagi and C. R. Chatwal (Himalaya Publishing House)
 - 4: Analytical Chemistry – G. D. Christian 4th Edition (John Wiley and Sons)
 - 5: Environmental Chemistry – H. Kaur 2nd Edition 2007, PragatiPrakashan, Meerut, India
 6. Environmental Chemistry with Green Chemistry A. K Das , Books and Allied (P) Ltd, and
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Semester-III
Course: Environmental and Green Chemistry (CH-346D)

Name of the Topic	Number of lectures
1. Water treatment and effluent management	08
2. Soil and solid waste management	04
3. Instrumental methods in environmental analysis	08
4. Green House Effect and Global Warming	04
5. Water the ultimate Green solvent	12
6. Energy Relations	12
Total lectures	48

Chapter 1: Water treatment and effluent management **[08]**

- 1.1 Domestic sewage, waste water treatment: primary, secondary and tertiary treatments, aerobic, anaerobic and upflow anaerobic sludge bed treatment processes
- 1.2 Industrial waste water treatment i) filtration method ii) ion-exchange method iii) membrane techniques: ultrafiltration, reverse osmosis and electrodialysis
- 1.3 Treatment of drinking water

Aims and Objectives-

Students should know-

- i. Methods of water purification
- ii. Waste water treatment process
- iii. Waste water treatment plants

Chapter 2: Soil and solid waste management **[04]**

- 2.1 Composition of soil and types of soil.
- 2.2 Organic and inorganic components of soil
- 2.3 Acid base and ion exchange reactions in soil and pH of soil
- 2.4 Chemistry of disposal of solid waste i) sanitary landfills ii) incinerators iii) pyrolysis

Ref.1, Ref. 2, Ref. 3

Aims and Objectives-

Students should know-

- i. Types of soil
- ii. Components of soil
- iii. Types of solid waste and their disposal

Chapter 3: Instrumental methods in environmental analysis **[08]**

- 3.1 Atomic absorption spectroscopy: determination of Hg, As, Zn, Ag, Pb, Mn, Fe, Cu, Cr, Cd
- 3.2 Gas chromatography: detection and determination of CO, HC and pesticides
- 3.3 HPLC: determination of pesticides, PAH as metabolites
- 3.4 Spectrophotometry: determination of NO_x, SO₂, NH₃, CN, PO₄, Cd, Pb, Hg
- 3.5 Chemiluminescence: determination of NO_x and O₃.

- 3.6 Non Dispersive IR spectrometry of determination of CO
3.7 Ion selective electrodes: determination of NO₃ and dissolved oxygen (D. O.)

[Ref. 1, Ref. 2]

Aims and Objectives-

Students should know-

- i. Techniques used to monitor hazardous materials present in environment

Chapter 4: Green House Effect and Global Warming

[04]

- 4.1 Introduction
- 4.2 Greenhouse gases
- 4.3 Radiative forcing
- 4.4 Sources and sinks of CO₂
- 4.5 Causes of fluctuations in global temperature
- 4.6 Global warming and climate changes
- 4.7 Implications of climate changes

[Ref. 5]

Aims and Objectives-

Students should know-

- i. Green house gases and their effects
- ii. Global warming
- iii. Climate change

Chapter 5. Water the ultimate Green solvent

[12]

- 5.1 H₂O : Simple formula and complex molecule
- 5.2 Important properties of water
- 5.3 The hydrologic cycle
- 5.4 Bodies of water and life in water
- 5.5 Chemical process in water
- 5.6 Fizzy water from underground
- 5.7 Oxygen in water
- 5.8 Weak acid from sky
- 5.9 Why natural water contains alkalinity and calcium
- 5.10 Metals in water
- 5.11 Water interactions with other phases

[Ref: Green Chemistry By Stanley E Manahan, Chemchar Research Inc. (2006)-2ndEdn Chapter 7 : P 161-173]

Aims and Objectives-

Students should know-

- i. What do you mean by green solvent
- ii. Resources of green solvents like alcohol and water
- iii. Importance of water as a green solvent

Chapter6 .Energy Relations :

[12]

- 6.1 Energy

- 6.2 Radiant Energy from the sun
- 6.3 Storage and release of energy by chemicals
- 6.4 Energy sources
- 6.5 Conversions between forms of energy
- 6.6 Green engineering and energy conversion efficiency
- 6.7 Conversion of chemical energy
- 6.8 Renewable energy sources

[Ref: Green Chemistry By Stanley E Manahan, Chemchar Research Inc. (2006) -2ndEdn Chapter 6 : P 135-157]

Aims and Objectives-

Students should know-

- i. Natural resources of energy
- ii. Conventional and nonconventional energy resources
- iii. Conservation of energy
- iv. Utilization of solar and wind energies.

Reference Books:

- 1: Environmental Chemistry – A. K. De, 5th Edition (New age international publishers)
 - 2: Environmental Chemistry – J. W. Moore and E. A. Moore (Academic Press, New York)
 - 3: Environmental Chemistry – A. K. Bhagi and C. R. Chatwal (Himalaya Publishing House)
 - 4: Analytical Chemistry – G. D. Christian 4th Edition (John Wiley and Sons)
 - 5: Environmental Chemistry – H. Kaur 2nd Edition 2007, PragatiPrakashan, Meerut, India
 - 6. Environmental Chemistry with Green Chemistry A. K Das , Books and Allied (P) Ltd.
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Semester-III

Course: Agriculture Chemistry (CH-336E)

Name of the Topic	Number of lectures
1. Soil Chemistry	10
2. Problematic Soil and Soil testing	10
3. Quality of Irrigation Water	08
4. Plant Nutrients	08
5. Fertilizers and Manures	06
6. Protection of Plants	06
Total lectures	48

Chapter I –Soil Chemistry

(10 L)

- 1.1 Role of agriculture chemistry
- 1.2 Scope and importance of agricultural chemistry
- 1.3 Agricultural chemistry and other science
- 1.4 Definition of soil, Soil components-mineral component, organic matter or humus, soil atmosphere, soil water, soil microorganism
- 1.5 Physical properties of soil- soil texture, soil structure, soil color, soil temp, soil density, porosity of soil.
- 1.6 Surface soil and sub-soil
- 1.7 Chemical properties of soil, soil reactions and solutions
- 1.8 Factor controlling soil reaction, buffering capacity, importance of buffer action in agriculture, ion exchange

Ref 1- Pagers 8-12, 92-94, 98-113, 116-146

Ref 3- Pages 28-50

Chapter II – Problematic Soil and Soil testing

(10 L)

- 2.1 Acid soil- formation of acid soil, effect of soil acidity of soil, reclamation of acidic soil
- 2.2 Alkali Soil- formation of alkali soil, reclamation of alkali soil
- 2.3 Classification of alkali soil- saline soil, saline alkali soil, non-saline alkali soil
- 2.4 Calcareous soils
- 2.5 Introduction to soil testing
- 2.6 Objectives of soil testing
- 2.7 Phases of soil testing- collection of soil sample, analysis in the laboratory and fertilizer applications

Ref 1- 345-370, Ref 3- 301-312, Ref 4- 135-147 and 150-159

Chapter III- Quality of Irrigation Water

(08 L)

- 3.1 Sources of Water- Atmospheric water, Surface Water, Stored Water, Ground Water
- 3.2 Impurities in Water, Water quality, related problems in public health, environment and agriculture

3.3 Analysis of irrigation Water (ppm, meq/lit.epm)

3.4 Dissolved constituents and their functions

Major constituents- Ca, Mg, Na, K, Carbonate, bicarbonate, sulfate, Chloride and nitrate

Minor constituents- B, Si, nitrite, Sulfide and fluoride

3.5 Water quality standard- total soluble salt (TSS), sodium adsorption ratio (SAR), Exchangeable sodium percentage (ESP), Residual sodium carbonate, salinity classes for irrigation water

Ref 8- Pages 293-309

Chapter IV- Plant Nutrients

(08 L)

4.1 Need of plant nutrients, forms of nutrients updates, nutrient absorption by plants

4.2 Classification of essential nutrients

4.2.1 Primary nutrients (N, P, K), its role and deficiency symptoms in plants

4.2.2 Secondary nutrients, (Ca, Mg, S), its role and deficiency symptoms in plants

4.2.3 Micronutrients, General functions of micronutrients (Zn, Fe, Mn, Cu, B, Mo, Cl)

4.3 Effect of environmental condition, nutrient uptake

Ref 3- Pages 207-241, Ref 4- Pages 176-195, Ref 7- pages 287-300

Chapter V- Fertilizers and Manures

(06 L)

Fertilizers

5.1 Introduction, Classification & application of fertilizers

5.2 Time and methods of fertilizers

5.3 Factors affecting efficiency of fertilizers

5.4 Vermicompost preparation, effect of vermicompost on soil fertility

5.5 Synthetic fertilizers definition, comparison of synthetic fertilizers with organic fertilizers , environmental effect of synthetic fertilizers

Manures

5.6 Introduction, Definition and classification of manures

5.7 Effect of bulky organic manures on soil, farm yard manures (FYM), Factors affecting on FYM, method of preparation, losses during handling and storage

5.8 Biogas plant. Human waste, sewage and sludge, types of sludge, carbon nitrogen ratio, sewage irrigation and uses

5.9 Green manuring, types of green manuring, characteristics, advantages and disadvantages of green manuring

6.0 Biofertilizers: definition, classification, role & advantages

Ref 2- Pages 205-213, Ref 3- 90-112, 137-149

Chapter VII- Protection of Plants

(06 L)

Pesticide Classification and mode of action

7.1 Insecticide- Definition, Classification, chemical properties, elemental composition, mode of action of synthetic and plant originated compounds organophosphates, malathion, parathion, carbamates

7.2 Fungicides- Definition, Classification, Chemical properties, mode of action of S

& Cu fungicides

7.3 Herbicides- Definition,, Classification, composition, mode of action of Selective and non-selective herbicides.

Ref 6- Relevant Pages

Learning Objectives of Agriculture Chemistry

After studying this course, student is expected to

1. Know the role of agriculture chemistry and its potential
2. Understand basic concept of soil, properties of soil & its classification on the basis of pH
3. Know the different plant nutrients, Their functions and deficiency symptoms
4. Understand importance of manures as compared to chemical fertilizers'
5. Understand the importance of green manuring
6. Have the knowledge of the use of proper the plants
7. Know various techniques to protect the plants
8. Have the knowledge of various pesticides, insecticides, fungicides and herbicides
9. Identify the problematic soil and recommend method for their reclamation
10. Have the knowledge of quality irrigation water, water quality standard and analysis of irrigation water

Reference Books

1. A text book of soil science (Recise Ed) J.A. Daji, Revised by J.R. Adam, N.D. Patil, Media promoters and publishers, Mumabi, 1996
 2. Text book of soil science, T.D. Biswas, S.K. Mukharjee, Tata McGraw Hill Publishing company, New Delhi
 3. Introduction to Agronomy and soil, water management, V.G. Vaidya, K.R. Sahashtra Buddhe (Continental Prakashan)
 4. Principals of soil science, M.M. Rai, Millian complex of India, Bombay, 1977
 5. Manures and fertilizers (sixth ed), K.S. Yawalkar, J.P. Agarwal and Bokde, Agrihorticulture publishing house, Nagpur, India
 6. Chemistry of insecticides and fungicides, U.S. Sreeramula (2nd Ed), oxford and IBH Publishing company, New Delhi
 7. Fundamentals of soil sciences, C.E. Millar and L.M. Turk, Bio-Tech- New Delhi (1st Ed 2001)
 8. Soil, Plant, Water and fertilizer analysis, P.K. Gupta, Published by Agro Botanica
 9. **Biofertilizers** and biopesticides , Author: Deshmukh, A. M. (ArvindMadhavrao),
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1.3.1 Institution integrates crosscutting issues relevant to Professional Ethics, Gender, and Human Values, Environment and Sustainability into the Curriculum

Response:

Various cross-cutting issues are well addressed and incorporated in the syllabus designed by the University, the courses selected by the college, and various activities organized by the college. The Following cross-cutting issues are integrated with educational and extracurricular activities.

Environment and Sustainability in the curriculum

The course introduces the students to its multidisciplinary nature and also emphasizes on the renewable and non-renewable resources and the problems associated with the environment. Lectures are conducted for the students as well as students have to prepare a project report. In science programmes the topic Related to, Public Health and Hygiene

Or Medical Entomology, Environmental Biology and Toxicology, Biodiversity, Environmental and Pollution Biology, are introduced to give basic knowledge of the environment, pollution, and the effects of pollution. It informs students by providing solutions to safeguarding the environment through the Environment Protection Act, Wildlife Protection Act and Forest Conservation Act and aware the student about the conservation of nature, Wildlife management, and ecosystem.

Human Values in the curriculum

To introduce human values, there is a course in prescribed for the students of F. Y. B.Sc. Introduced choice based credit courses at UG level. Animal Ecology - Characteristic of population: Density, Natality, Mortality, Fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion

GENDER ISSUES:-

For gender sensitization, are introduced to give basic knowledge of the same papers Genetics, Mammalian Histology, Mammalian Physiology & Endocrinology, Genetics and Molecular Biology all paper for F.Y.B.Sc. &T.Y.B.Sc.Zoology.



**LONAVALA EDUCATION TRUST'S DR. B. N. PURANDARE ARTS,
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DEPARTMENT OF ZOOLOGY

1.3.1: Institution integrates crosscutting issues relevant to Professional Ethics, Gender, Human Values, Environment and Sustainability into the Curriculum/ Syllabus

List of Courses including crosscutting issues into the Curriculum :- University of Pune Three Year B. Sc. Degree Course in Zoology

Sr. No.	Programme Name	Course Name	Course Code	Remarks
GENDER ISSUES				
1	F. Y. B. Sc.	Genetics	ZY 102	Gender issues
2	T. Y. B. Sc.	Mammalian Histology	ZY-332	Gender issues
3	T. Y. B. Sc.	Mammalian Physiology & Endocrinology	ZY-342	Gender issues
4	T. Y. B. Sc.	Genetics and Molecular Biology	ZY-333	Gender issues
HUMAN VALUES				
1	F. Y. B. Sc.	Animal Ecology	Zo112	Human Values
ENVIRONMENT AND SUSTAINABILITY				
1	S. Y. B. Sc.	Applied Zoology	ZY-212	Environment and Sustainability
2	S. Y. B. Sc.	Applied Zoology	ZY-222	Environment and Sustainability
3	T. Y. B. Sc.	Environmental Biology and Toxicology	ZY-334	Environment and Sustainability
4	T. Y. B. Sc.	Public Health and Hygiene or Medical Entomology	ZY-346	Environment and Sustainability

Note: - Attached Syllabus

PDF - Three Year B. Sc. Degree Course in Zoology.

ORGANIZED BY THE COLLEGE:-

Various activities organized by the college. The following cross-cutting issues are integrated with educational and extracurricular activities. The college also organizes workshops on Human Values and Human rights for students and faculty.

- 1) National Conference on 'Environment and Development.
- 2) National Conference on Animal Dissection – Need and alternatives

Attached Conference Document.