Details of Minor Generic Elective (GE) Courses
Department of Chemistry

4 Credits each-3T+1P)

COURSE	NAME OF THE COURSE	CREDITS T=Theory Credits P=Practical Credits
CHEMISTRY-GE-1	Color Chemistry	T=3 P=1
CHEMISTRY-GE-2	Chemistry of Food Nutrients	T=3 P=1
CHEMISTRY-GE-3	Chemistry and Environment	T=3 P=1
CHEMISTRY-GE-4	Chemistry and Energy	T=3 P=1

CHEMISTRY- GE-1

Course Title: Color Chemistry

Total Credits: 04 (Credits: Theory-03, Practical-01)

Total Lectures: Theory- 45, Practical- 30

Objectives: The purpose of the course is to introduce students to important chemical materials such as colours, dyes, pigments, etc. The students would learn how fibres and related polymers are produced from natural sources and in synthetic forms. In addition, the applications of colours, dyes, pigments, fibres and polymers in the environment will be examined. New challenges and economic importance of chemical materials in an emerging economy will also be discussed.

Learning Outcomes:

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

- Explain the concept of colour, pigments, dyes and related materials
- Identify each of the colours, dyes and pigments; their properties and uses.
- Explain the relationship and difference between colours, pigment and dyes
- Illustrate how fibers and related polymers are produced
- Define the concept of dyeing and pigment technology in relation to specific materials
- Describe new challenges in the emerging world of chemical and material technology
- Demonstrate the basic mechanism and processes involved in dyeing and pigment.

Theory:

Unit 1: Colour, Pigments and Dyes **Lectures: 15**

Colour and its Features, Types of Colour, Pigments, Organic, Inorganic and Metallic Pigments, The Linkages between Pigments and Dyes, Application of Dyes and Pigments.

Unit 2: Classification of Dyes and Fibers **Lectures:10**

Classification of Dyes, Classification of Fibres, Natural Dyes and Dyeing Processes

Unit 3: Synthetic Dyes and Fibers **Lectures: 10**

Synthetic Fibres, Polymer Fibres, Polyesters and Polyamide Fibres, Polyurethanes, Cellulose and Polyacrylonitrile, Aramids, Poly (methyl methacrylate) and Polycarbonate

Unit 4: Dyeing Mechanisms **Lectures: 10**

Textile Dyeing Process, Beam Dyeing Machine, Hank Dyeing Machine and Jig Dyeing Machine, Jet Dyeing Machine

Practicals:

(Laboratory periods: 30)

1. Synthesis of different Azo dyes
2. Dyeing of fibers

References:

Theory:

1. Zollinger, H., 2003. *Color chemistry: syntheses, properties, and applications of organic dyes and pigments*. John Wiley & Sons.
2. Shore, J., 2002. Colorants and Auxiliaries, Volume 1-Colorants. *Hampshire: Society of Dyers and Colourists*, *1*.
3. Horiishi, N., Kathrein, H., Krieg, S., Pfaff, G., Pitzer, U., Ronda, C., Schwab, E., Besold, R. and Buxbaum, G., 2005. Specialty pigments. *Industrial Inorganic Pigments*, pp.195-295.
4. Herbst, W. and Hunger, K., 2006. *Industrial organic pigments: production, properties, applications*. John Wiley & Sons.
5. Venkataraman, K. ed., 2012. *The Chemistry of Synthetic Dyes V4* (Vol. 4). Elsevier.
6. Waring, D.R. and Hallas, G. eds., 2013. *The chemistry and application of dyes*. Springer Science & Business Media.

Practical:

1. Waring, D.R. and Hallas, G. eds., 2013. *The chemistry and application of dyes*. Springer Science & Business Media.
2. Gordon, P.F. and Gregory, P., 2012. *Organic chemistry in colour*. Springer Science & Business Media.

CHEMISTRY- GE-2

Course Title: Chemistry of Food Nutrients

Total Credits: 04 (Credits: Theory-03, Practical-01)

Total Lectures: Theory- 45, Practical- 30

Objectives: This introductory course on food chemistry is designed in such a manner that the students develop a basic understanding of the components of food, their source, properties and interactions as well as changes that occur during processing, storage, and utilization.

Learning Objectives:

On completion of the course, the student will be able to:

- Build a strong understanding of chemistry of food: composition of food, role of eachcomponent.
- Understand some of the reactions and changes in individual food components which occurduring processing, handling and storage

---

Theory:

Unit 1: Carbohydrates **Lectures: 10**

Introduction, sources, functions, classification: monosaccharide, oligosaccharide and polysaccharide, structure and importance of polysaccharides in food chemistry (pectin, cellulose,starch, gums), artificial sweetners (introduction only).

Unit 2: Lipids **Lectures:13**

Introduction, sources, classification (fatty acids, phospholipids, fats & oils, waxes), common fattyacids present in oils and fats, Omega- 3&6 fatty acids, trans fats, chemical properties- Reichert Meissel value, Polenski value, iodine value, peroxide value, saponification value, effect of fryingon fats, changes in fats and oils- rancidity, lipolysis, flavor reversion, auto-oxidation and its prevention.

Unit 3: Proteins **Lectures:10**

Introduction, sources, classification (simple, conjugated, derived), structure of amino acids and protein (primary, secondary and tertiary), protein denaturation.

Unit 4: Vitamins & Minerals **Lectures:12**

Vitamins: Introduction, classification: fat-soluble vitamins & water-soluble vitamins.
Minerals: Introduction, classification: macrominerals (Ca, P, Mg) & microminerals (Se, Fe, I, Co,Zn, Cu, Se, Cr).
Physiological importance of vitamins and minerals, effect of food processing on vitamins andminerals.

Practicals: (Laboratory periods: 30)/any four

1. Determination of moisture in food products by hot air oven-drying method.
2. Colorimetric determination of Iron in vitamin / dietary tablets.
3. 2, 6-Dichlorophenol indophenol method for estimation of vitamin C in a given solution/lemon Juice/chillies.
4. Estimation of total soluble sugar content by ferricyanide method (volumetric analysis).
5. Determination of saponification value of the given fat/oil.
6. Determination of iodine value of the given fat/oil.
7. Qualitative tests for proteins and carbohydrates.
8. Qualitative estimation of cholesterol by Liebermann Burchard method.

References:

Theory:

1. DeMan, J.M., Finley, J.W., Hurst, W.J., Lee, C.Y., 2018. *Principles of Food Chemistry*, 4th Edition, Springer.
2. Msagati, T.A.M., 2013. *Chemistry of Food Additives and Preservatives*, Wiley-Blackwell.
3. Fennema, O.R., 2017. *Food Chemistry*, 5th Edition, CRC Press.
4. Attokaran, M., 2017, *Natural Food Flavors and Colorants*, 2nd Ed., Wiley-Blackwell.
5. Potter, N.N., Hotchkiss, J.H., 1995. *Food Science*, 5th Ed., Chapman & Hall.
6. Brannen, D., Davidsin, P.M., Salminen, T. Thorngate III, J.H., 2002, *Food Additives*, 2nd Edition, CRC Press.
7. Coultate, T., 2016. *Food: The Chemistry of its Components*, 6th Edn., Royal Society of Chemistry.
8. Belitz, H. D.; Grosch, W., 2009. *Food Chemistry*, Springer.

Practical:

1. Ranganna, S., 2017. *Handbook of analysis and quality control for fruits and vegetable products*, 2nd Edn., McGraw Hill Education.
2. Sawhney, S.K., Singh, R., 2001. *Introductory Practical Biochemistry*, Narosa Publishing House.

CHEMISTRY- GE-3

Course Title: Chemistry and Environment

Total Credits: 04 (Credits: Theory-03, Practical-01)

Total Lectures: Theory- 45, Practical- 30

Learning Objectives:

To develop basic understanding of environment, contaminants & green house effect and to understand different toxic metal ions and organic toxicants.

Learning Outcomes:

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

- Understand the environment and fundamental environmental processes in air, water, and soil.
- Be aware of different types of toxic substances & responses.
- Apply basic chemical concepts to pollution.

Theory:

Unit 1: Environment — Lectures: 10

Introduction, Composition and layers of atmosphere of Earth, Contaminant behavior in the environment, Contaminants and their natural pathways of degradation and their abatement Organic Pollutants, Pollution from Combustion Systems, Coal Combustion, Photochemical Smog, Indoor Air Pollution

Unit 2: Pollution — Lectures: 15

Air Pollution: Carbon Monoxide, Oxides of nitrogen, Sulphur Dioxide, Volatile Organic Compounds, Analysis of air pollutant, such as, CO, SOX, NOX and particulate matters. Water Pollution: Ground and subsurface water contamination, Analytic methods for measuring BOD, DO, COD and chlorine demand. Cause affect relationship between a pollutant and community Health problems, Health effect of criteria pollutants. Soil Pollution: Soil Pollution, Contamination with toxic inorganic compounds, Nuclear Waste Management, Sewage Treatment, Solid Waste Management, ion exchange reactions in soil, soil fertility.

Unit 3: Green house Effect — Lectures: 10

Green house effect and Global Warming – Introduction - How the green house effect is produced - Major sources of green house gases - Emissions of CO_2 - Impact of green house effect on global climate - Control and remedial measures of green house effect - Global warming a serious threat - Important points.

Unit 4: Toxicology — Lectures: 10

Definition of toxicology, history, Dose-response relationship. Absorption, distribution and excretion of toxic materials. Toxicity of metal ions, (Pb, Hg, Al, Ni, As) organic toxicants such as Halogenated hydrocarbons, pesticides and solvents, Chemical Carcinogens.

Practicals: (Laboratory periods: 30)

1. Measurement of total hardness of water.
2. pH measurement of ground water.
3. COD determination of water sample.
4. BOD determination of water sample.
5. TDS measurement

References:

1. Manahan, Stanley E., 2001. *Fundamentals of Environmental Chemistry*, Boca Raton: CRC Press LLC.
2. Sonja Krause, Herbert M. Clark, James P. Ferris, Robert L., 2002. *Strong Chemistry of the Environment*, Elsevier Science & Technology Books.
3. Eugene R. Weiner, 2000. *Applications of Environmental Chemistry*, CRC Press, LLC
4. Clair N. Sawyer, Perry L. McCarty, Gene F. Parkin Chemistry for environmental engineering and science (5th edition) McGrawHill Professional
5. Sawyer, C.N., McCarty, P.L. and Parkin, G.F., 2003. *Chemistry for environmental engineering and science*. McGraw-Hill.
6. Bidlack, W.R., 2002. Casarett & Doull's toxicology: the basic science of poisons.
7. Maiti, S.K., 2003. *Handbook of methods in environmental studies* (Vol. 2, pp. 110-121). Jaipur: ABD publishers.
8. De Anil, K., 2003. *Environmental chemistry*. New Age International.

.

CHEMISTRY- GE-4

Course Title: Chemistry and Energy

Total Credits: 04 (Credits: Theory-03, Practical-01)

Total Lectures: Theory- 45, Practical- 30

Learning Objectives:

The objective of the course is to develop basic understanding of conventional energy and non-conventional energy and to understand the importance of fuels. The students will understand different sources of energies renewable and non-renewable.

Learning Outcomes:

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

- Classify fuels and know about the different conventional energy sources.
- Understand concepts of nuclear energy and address special engineering and environmental challenges of nuclear chemistry.
- Develop an understanding of renewable and non-renewable and their contributions to the energy and power needs of the nation.
- Understand the fundamentals of solar and geothermal energy.
- Use their knowledge in the development of sustainable energy technologies.

Theory:

Unit1: Introduction to Conventional Energy& solid fuels **Lectures: 08**

Fuels, Classification, Properties, Calorific value, Determination by Bomb calorimeter, Dulong's formula, Storage and handling of fuels, Principles of combustion, Combustion of oil, coal, and gas. Solid fuels: Coal, Classification, Analysis of Coal, Proximate and Ultimate analysis Metallurgical coke, Carbonization of Coal, Manufacture of metallurgical coke by Otto Hoffman's byproduct oven, Combustion calculations.

Unit 2: Liquid Fuels **Lectures: 05**

Origin of petroleum, Composition, Refining of petroleum, Cracking, Synthetic petrol, Reforming , Non - petroleum fuels, knocking, Antiknocking agent, Octane rating, Cetane rating, Diesel engine fuel, Kerosene, LPG.

Unit 3: Gaseous Fuels **Lectures: 05**

Gaseous Fuels: Natural gas, Coal mine gas, Producer gas, Water gas, coal gas, Gases derived from waste and biomass (wood gas), From other industrial processes (blast furnace gas), refinery gases, gasification of coal and oil, purification of gaseous fuels.

Unit 4: Nuclear energy **Lectures: 08**

Nuclear energy: Nuclear reactions, Reactor- Design and Construction of Nuclear Reactors, fuel materials- Uranium, Zirconium, Thorium and Beryllium. Types of nuclear wastes, Biological Effects of radiation, Reactor safety and security, International convention on safety aspects - radiation hazards prevention.

Unit 5: Introduction to Alternative and non-conventional Sources of Energy & Solar energy Lectures: 08

Limitation of fossil fuels, Role and potential of new Renewable and non-renewable energy sources, Energy consumption as a measure of Nation's development, Prospects of renewable energy sources. Solar Energy: Environmental impact of solar power, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data solar ponds. Solar Applications- solar heating/cooling technique, solar distillation anddrying.

Unit 6: Wind energy & Biomass **Lectures: 06**

Principle of wind energy conversion, Basic components of wind energy conversion systems, wind mill components, Wind patterns, Types of turbines, Kinetic energy of wind, Betz coefficient
Bio-mass: Principles of Bio-Conversion, Biogas generation plants, classification, advantages and disadvantages, constructional details, Anaerobic/aerobic digestion, types of Bio-gas digesters, Fuel properties of bio gas, and economic aspects

Unit 6: Geothermal energy **Lectures: 05**

Geothermal Energy: Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geopressured hot dry rock, magma. advantages, disadvantages and application of geothermal energy.

Practicals: (30 hrs)

Assignments/working models on related topics

Recommended Books:

1. Richard A. Dawe, 2001. *Modern Petroleum Technology*, Vol 1, Upstream, Ed. by, IP, 6th edition, John Wiley & Sons Ltd.
2. Sarkar S.K., 1990. *Fuels and combustion*, 2nd edition, Orient Longman Ltd.
3. Griswold, J., 1946. *Fuels, combustion, and furnaces*. McGraw-hill book company.
4. Thomas J.Cannoly, 1978. *Fundamentals of Nuclear Engineering*. John Wiley.
5. Collier J.G., and Hewitt G.F. 1987. *Introduction to Nuclear Power*, Hemisphere Publishing, New York,
6. Rai, G.D. and Rai, C.D., 1992. *Non-conventional energy sources*. Khanna.
7. Ramesh, R. and Kumar, K.U., 2004. Renewable Energy Technologies.
8. Solanki, C.S., 2008. *Renewable energy technologies: A practical guide for beginners*. PHI Learning Pvt. Ltd.