Department of Chemistry

Scheme and Syllabus

Courses offered

for

Degree program

Subject Code	Name of course	Semester	Credits
BSCH-401	Applied Chemistry	I & II	L T P C 3 1 0 4
BSCH-402	Applied Chemistry Lab	I & II	L T P C 0 0 2 1
OECY-711 A	Green & Sustainable Chemistry	VII	L T P C 3 0 0 3
OECY-711 B	Energy Sciences		
OECY-711 C	Chemistry of Materials		

BSCH-401 **Applied Chemistry**

L	T	P	C
3	1	0	4

Course Pre-requisites:10+2

Course Outcomes:

Upon successful completion of the course, the students should understand:

CO1: The properties of water and various treatment methodologies.

CO2: Polymers, their commercial and technological usage.

CO3: Applications of the phase rule in metallurgy and other chemical processes.

CO4: Characterization methods using various spectroscopic techniques.

CO5: Corrosion and nanomaterials.

COs	Programme outcomes (POs) S-strong, M-medium and W-weak indicates the strength of correlation											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S	S	S	M	S	S	S	M	S	S
CO2	S	S	M	S	S	S	S	S	S	M	S	S
CO3	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	M	S	M	M	M	M	M	M	M	M	M
CO5	M	M	S	S	M	S	S	S	M	S	S	S

Unit-1

Water and its treatment: Introduction, Hardness and its determination, Degree of hardness, Treatment and purification of water for domestic and industrial purposes- Sedimentation, Filtration, Flocculation, Sterilization, Break point chlorination, Ozonization, Caustic embrittlement, Sludge and Scale formation. Methods of boiler water treatment- Lime-Soda process (hot and cold), Permutit (Zeolite) process, Deionization (Demineralization). Desalination of Brackish Water.

(10hrs)

Polymers: Polymerization-Functionality, Degree of polymerization, Glass transition temperature, Types of polymerization reactions and mechanisms. Molecular weight determination-viscometry method. Preparation and properties of commercially important polymers (PC, ABS, PET, polyester, epoxy resins and polyurethanes) with their engineering applications. Conducting polymers (conjugated π electrons, element filled, doped, blended).

8hrs

Phase Rule and Distribution law: Definitions - Phase, Component, Degree of freedom, Phase equilibrium. Gibbs phase rule, One component system (Water system, Carbon dioxide system, Sulphur system), Two component system (Lead-Silver system, Potassium Iodide-Water system, Sodium Sulphate-Water system and Iron-Carbon system). Nernst distribution law and its applications (association & dissociation of solute, complex ions, solvent extraction). 8hrs

Unit-2

Spectroscopic Techniques: Introduction, Elementary idea of the principles, instrumentation andapplications of Electronic(UV-VIS)**,** Fluorescence, Vibrational (IR) and Nuclear magnetic resonance (NMR) spectroscopy.

12hrs

Corrosion: Introduction, Thermodynamics, Types of corrosion-Dry corrosion, Wet corrosion (Galvanic, Concentration, Pitting, Stress, Waterline). Passivity, Galvanic series, Factors affecting corrosion, Protection - metallic coatings, electroplating, electrolessplating, cathodic protection, anodic protection, organic coatings and corrosion inhibitors.

6hrs

Nanochemistry: Nanomaterials-Classification, Synthesis (Top-down, Bottom-up) Molecular self-assembly (monolayers, mesoscale, nanocrystal, supramolecular). Carbon nanomaterials- Fullerenes, Graphite, Nanotubes, Nanocones and Nanowires. Applications of nanomaterials.

4hrs

Recommended Books:

1. P. C. Jain & M. Jain, Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi, 2005.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, 2008.
3. F.W. Billmayer, Textbook of Polymer Science. 3rd Edn, Wiley. N.Y. 1991.
4. C. N. Banwell& E.M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edn, Tata Mc Graw-Hill Edition, 1995.
5. H. K.Chopra, Chemistry for Engineers, Narosa Publishing House Pvt. Ltd., New Delhi, 2016
6. B. Sivasankar,Engineering Chemistry, Tata Mcgraw Hill
7. A. Mallick, Engineering Chemistry, Viva Books, 2008.
8.Pavia, Lampman and Kriz, Introduction to spectroscopy Indian Edition, Cengage learning.
9. J. R. Dyer, Applications of Absorption Spectroscopy of Organic Compounds, PHI Learning Pvt. Ltd., New Delhi, 2009

BSCH-402 Applied Chemistry Lab

Course Outcomes:

After successful completion of Applied Chemistry laboratory course, students should be able to:

CO1: use critical thinking strategies to make connection and association between chemical principles.
CO2: handle different type of instruments for chemical analysis.
CO3: develop skills in building technical competence through experimental methods.
CO4: have practical knowledge of instrumental method of analysis.
CO5: develop basic knowledge on accuracy and performance in analysis.

BSCH-402	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	S	S	M	S	M	S	S	--	S	S	S	S	--	--
CO2	S	S	S	S	S	M	M	--	S	S	S	S	--	--
CO3	S	S	M	S	S	M	M	--	M	M	M	S	--	--
CO4	S	M	S	S	S	S	M	--	M	M	S	S	--	--
CO5	M	S	M	M	M	W	M	--	M	W	W	S	--	--

List of Experiments:

1. Determination of total hardness of water (tap, lake, pond, river) using standard EDTA solution and Eriochrome Black T (EBT) indicator.
2. Determination of available chlorine in bleaching powder titrimetrically.
3. Estimation of iron in water by titrimetric method.
4. Preparation and characterization of nylon 66.
5. Preparation and characterization of polystyrene.
6. Preparation and characterization of urea -formaldehyde resin.
7. Preparation and characterization of phenol-formaldehyde resin (Bakelite).
8. To determine the molecular weight of a polymer (polystyrene) by viscometric method.
9. To find the eutectic point for two component system by cooling curve method.
10. To determine the partition coefficient of iodine between CCl_4 and H_2O.
11. Identification of functional groups by FT-IR spectroscopy.
12. To determine λ_{max} (wavelength of maximum absorption) of a solution of $KMnO_4$ using UV spectrophotometer.
13. Determination of concentration of an unknown sample by UV spectroscopy.
14. Determination of coefficient of viscosity of the given liquids by Ostwald's viscometer method.
15. Investigation of rusting of iron in different conditions.
16. Investigation of the effect of metal coupling on rusting of iron.
17. Greener synthesis of nanoparticles using ultrasonication and characterization (UV/Vis, FESEM and XRD)

As per curriculum requirements Course coordinator can device/modify any two experiments.

(Any twelve to be performed) **from July 2018 onwards**

TABLE:

S.No.	Name of experiment	CO Mapping
1	Determination of total hardness of water (tap, lake, pond, river) using standard EDTA solution and Eriochrome Black T (EBT) indicator.	CO1, CO2 CO3,CO5
2	Determination of available chlorine in bleaching powder titrimetrically.	CO1, CO2 CO3, CO5
3	Estimation of iron in water by titrimetric method.	CO1, CO2 CO3 CO5
4	Preparation and characterization of nylon 66.	CO3 & CO5
5	Preparation and characterization of polystyrene.	CO3 CO4 CO5
6	Preparation and characterization of urea -formaldehyde resin.	CO3 CO4 CO5
7	Preparation and characterization of urea -formaldehyde resin.	CO3 CO4 CO5
8	To determine the molecular weight of a polymer (polystyrene) by viscometric method.	CO1 CO4 CO5
9	To find the eutectic point for two component system by cooling curve method.	CO1 CO5
10	To determine the partition coefficient of iodine between CCl_4 and H_2O.	CO1 CO5
11	Identification of functional groups by FT-IR spectroscopy.	CO4 CO5
12	To determine λ_{max} (wavelength of maximum absorption) of a solution of $KMnO_4$ using UV spectrophotometer.	CO2 CO4 CO5
13	Determination of concentration of an unknown sample by UV spectroscopy.	CO2 CO4 CO5
14	Determination of coefficient of viscosity of the given liquids by Ostwald's viscometer method.	CO2 CO4 CO5
15	Investigation of rusting of iron in different conditions.	CO1 CO5
16	Investigation of the effect of metal coupling on rusting of iron.	CO1 CO5

ELECTIVE COURSE

OECY-711A Green and Sustainable Chemistry

L	T	P	C
3	0	0	3

Course Pre-requisites: 10+2
Course Outcomes:

Upon successful completion of the course the student will be able to:

CO1. Understand the environment and fundamental environmental processes in air, water, and soil.

CO2. Be aware of different types of toxic substances & responses.

CO3. Apply basic chemical concepts to pollution.

CO4. understand the energy crisis and different aspects of sustainability.

CO5. know modern techniques in green chemistry based on Current need.

CO/PO Mapping S-strong, M-medium and W-weak indicate the strength of correlation												
Cos	Programme outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S	W	M	S	M	M	W	W	W
CO2	M	S	M	M	W	M	M	W	W	M	M	W
CO3	M	W	M	S	M	S	S	M	M	M	W	M
CO4	S	S	S	S	S	S	S	W	S	W	M	S
CO5	S	S	S	S	S	S	M	M	S	M	S	S

Unit-I

Environment
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

7 hrs

Pollution
Air Pollution Control Techniques: Carbon Monoxide, Oxides of nitrogen, Sulphur Dioxide, Volatile Organic Compounds, Analysis of air pollutant, such as, CO, SO_X, NO_X 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.

12 hrs

Green House Effect

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. 5 hrs

Unit-II

Toxicology

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. 6 hrs

Green chemistry

History of Green Chemistry and Sustainability, Twelve principles of Green Chemistry with their explanations, Designing a Green Synthesis using these principles; Prevention of Waste/ by products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy, Prevention of chemical accidents designing greener processes, Green polymer chemistry, Exploring nature, Biomimetic, Proliferation of solvent-less reactions; Non-covalent derivatization, Biomass conversion, emission control 12 hrs

Recommended Books:

1. Manahan, Stanley E. Fundamentals of Environmental Chemistry Boca Raton: CRC Press LLC,2001
2. Sonja Krause, Herbert M. Clark, James P. Ferris, Robert L. Strong Chemistry of the Environment, Elsevier Science & Technology Books 2002
3. Eugene R. Weiner Applications of Environmental Chemistry 2000 CRC Press, LLC
4. By Clair N. Sawyer, Perry L. McCarty, Gene F. Parkin Chemistry for environmental engineering and science (5^{th} edition) McGrawHill Professional
5. V. Kumar, "An Introduction to Green Chemistry" Vishal publishing Co. Reprint Edition 2010
6. Caserett&Doulls, 'Toxicology: The Basic Science of Poisons'.
7. Rashmi Sanghi, M.M Srivastava "Green Chemistry" Fourth Reprint - 2009
8. Anastas& Warner, Green Chemistry: Theory & Practice, Oxford Univ. Press, New York,1998

ELECTIVE COURSE

OECY-711B **Energy Science**

L	T	P	C
3	0	0	3

Course Outcomes:

After successful completion of the course, the students should be able to

CO1: Classify fuels and know about the different conventional energy sources.

CO2:understand concepts of nuclear energy and address special engineering and environmental challenges of nuclear chemistry.

CO3: Develop an understanding of renewable and non-renewable and their contributions to the energy and power needs of the nation.

CO4: Understand the fundamentals of solar geothermal and wave energy.

CO5: Use their knowledge in the development of sustainable energy technologies.

CO/PO Mapping
S-strong, M-medium and W-weak indicate the strength of correlation

COs	Programme outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	W	M	S	W	M	M	W	W	M	W	S
CO2	S	M	S	S	M	S	S	W	M	M	W	M
CO3	M	S	W	S	M	S	S	M	W	M	S	M
CO4	S	W	W	M	S	S	S	W	M	W	W	S
CO5	S	S	S	S	S	M	S	M	M	S	S	S

UNIT-1

Introduction to Conventional Energy: 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.3hrs

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. 4hrs

Liquid fuels: 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.

4hrs

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.3hrs

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. 7 hrs

UNIT-2

Introduction to Alternative and non-conventional Sources of Energy: 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. 4hrs

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.5hrs

Wind Energy: 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 3 hrs

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 3 hrs

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. 3 hrs.

Wave Energy: Potential and conversion techniques, mini-hydel power plants, and their economics. 3 hrs

Recommended Books:

1. Modern Petroleum Technology, Vol 1, Upstream, Ed. by Richard A. Dawe, IP, 6th edition, John Wiley & Sons Ltd. 2001.
2. Fuels and combustion, S. Sarkar, 2nd edition, Orient Longman Ltd., 1990.
3. Fuels combustion and furnaces, John Griswold, Chemical engineering series, McGraw Hill Book Company, Inc. 1946.
4. Thomas J.Cannoly,"Fundamentals of Nuclear Engineering" John Wiley 1978.
5. Collier J.G., And Hewitt G.F,"Introduction To Nuclear Power", Hemisphere Publishing, New York,1987.
6. Non-Conventional Energy Sources /G.D. Rai
7. Renewable Energy Technologies /Ramesh & Kumar /Narosa
8. Renewable energy technologies - A practical guide for beginners - Chetong Singh Solanki, PHI.

ELECTIVE COURSE

OECY-711C CHEMISTRY OF MATERIALS

L	T	P	Cr
3	0	0	3

Course Outcomes:

After successful completion of the course, the students should be able to

CO1: understand the fundamentals of chemistry of materials, classification and their applications.

CO2: tunderst and the importance of polymeric materials, structure-activity relationship, and applications in various fields.

CO3: acquire knowledge of nanoscience and technology and applications in optical and energy storage devices

CO4:learn about the various types of organic materials that are used and their applications in engineering of materials.

CO5:gather knowledge about solid state devices.

CO/PO Mapping S-strong, M-medium and W-weak indicate the strength of correlation											
Programme outcomes (POs)											
PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
S	W	M	S	W	M	M	W	W	M	W	S
S	M	S	S	M	S	S	W	M	M	W	M
M	S	W	S	M	S	S	M	W	M	S	M
S	W	W	M	S	S	S	W	M	W	W	S
S	S	S	S	S	M	S	M	M	S	S	S

UNIT I

Introduction: Materials and their classification, Role of Chemistry in Material design

2 hrs

Metallic and Ceramic materials – metallic and ionic bonds, Atomic structure of solids, Crystalline and amorphous materials, unit cell and crystal faces, structures, properties and applications.

4 hrs

Catalytic Materials: Types of catalysts, structure, properties, porous catalysts, pore diffusion, adsorption, adsorption isotherms 5hrs

Polymeric Materials: Polymeric Materials: Molecular shape, structure and configuration, crystallinity, stress-strain behaviour, thermal behaviour, polymer types and their applications, conducting and ferro-electric polymers. 7 hrs

UNIT II

Nanomaterials and nanocomposites: Introduction to nanoscience and nanotechnology, Bulk to nano transition , Physical phenomenon-3, 2, 1, 0D nanosystems, metal semiconductors, quantum dots and nanomaterials for optical and energy storage devices. 12hrs

Organic Materials: Conducting organics - charge transfer materials and conducting polymers, Organic superconductors, Fullerenes, Molecular ferromagnets and ferroelectrics, Liquid crystals: mesomorphic behaviour, optical properties of liquid crystals, display devices.

10hrs

Recommended Books:

1. Material Science and Engineering, An Introduction, W.D. Callister, Wiley.
2. Materials Science, J.C. Anderson, K.D. Leaver, J.M. Alexander and A.D. Rawlings,ELBS
3. Thermotropic Liquid Crystals, Ed., G.W. Gray, John Wiley.
4. Handbook of Liquid Crystals, Kelker and Hatz, Chemie Verlag.
5. Nan Yao, Zong Lin Wang, Handbook of Microscopy for Nanotechnology, Kluwer academic publishers, London, 2005.