Syllabus Book

B. Sc. Chemistry

P P Savani University

School of Sciences

Department of Chemistry

Effective From: 2022-23

Authored by: P P Savani University

PPSU
P P SAVANI UNIVERSITY

School of Sciences

Programme Outcomes- Chemistry	
Chemistry is an alluring field on the campus surrounded by a plethora of industries. The current needs of the growing industries inspired us to start this program. The students are trained with modern skills and techniques to face the current problems. The curriculum is designed carefully to achieve the following outcomes.	
PO-1	**Creative Thinking:** Students will be able to think creatively (divergently and convergent) to propose novel ideas in explaining facts and figures or providing new solutions to the problems in Chemistry. The skills of observations and drawing logical inferences from scientific experiments will also be developed. Deep knowledge of the topic which can develop problem-solving skills using chemical principles.
PO-2	**Knowledge Skill:** Equip the student with skills to analyze problems, formulate a hypothesis, evaluate and validate results, and draw reasonable conclusions thereof. Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge.
PO-3	**Analytical skills:** Develop analytical skills such as synthesizing, separating, and characterizing chemical compounds and chemical reactions with the help of sophisticated instruments.
PO-4	**Scientific Communication Skills:** Imbibe effective scientific and/or technical communication in both oral and writing. Ability to show the importance of the subject as a precursor to various scientific developments since the beginning of the civilization.
PO-5	**Ethics:** Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate the highest standards of ethical issues in the subject concerned. Ability to identify unethical behavior such as fabrication, falsification, or misrepresentation of data and adoptive objective, unbiased and truthful actions in all aspects.
PO-6	**Enlightened Citizens:** Create awareness to become an enlightened citizen with commitment to deliver one's responsibilities within the scope of bestowed rights and privileges.
PO-7	**Analytical Reasoning:** Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyse and synthesise data from a variety of sources; draw valid conclusions and support them with evidence and examples, and address opposing viewpoints.
PO-8	**Lifelong Learning:** Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning throughout life, through self-paced and self-directed learning aimed at personal development, and adapting to changing academic demands of workplace through knowledge/ skill development/ reskilling. Acquire an advanced level of knowledge in natural products as well as biological systems from the Chemistry point of view.
PO-9	**Leadership Qualities:** Capability for mapping out the tasks of a team or an organization, setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination in a

	smooth and efficient way.
PO-10	**Research Skills:** Prepare students for pursuing research or careers in industry in concerned subjects and allied fields. Capability to use appropriate software like Origin, and ChemDraw and to solve various problems with software like Matlab, to various scientific investigations, problem-solving, and interpretation. Additionally, to develop research skills through dissertation/Project work in different fields of chemistry such as organic, nanoscience, analytical, physical, etc students will be able to work on projects at different research as well as academic institutions.
PO-11	**Interdisciplinary Approach:** Students will realize how developments in any science subject help in the development of other science subjects and vice-versa and how the interdisciplinary approach helps in providing better solutions and new ideas for sustainable developments. Also, the knowledge of subjects in other faculties such as physics, maths, biology, and environment to name a few, and a foreign language **GERMAN** can greatly and effectively influence and inspires in evolving new scientific theories and inventions.
PO-12	**Personality Development:** Students will imbibe ethical, moral, and social values in their personal and social life leading to a highly cultured and civilized personality with a course like **IPDC**. They will also realize that the pursuit of knowledge is a lifelong activity and in combination with untiring efforts and a positive attitude and other necessary qualities leads to a successful life.
PO-13	**Team player:** The course curriculum has been designed to provide an opportunity to act as a team player by contributing in laboratory, field-based situations, and industry.
PO-14	**Industry-ready skill development:** In addition, industrial visits/industrial projects are encouraged and added to the curriculum in order to enhance better exposure to jobs/employment opportunities in industries, scientific projects, and allied sectors.
PO-15	**Digital Literacy:** Students are expected to be digitally literate for them to enroll and increase their core competency via e-learning resources such as MOOC and other digital tools for lifelong learning. Students should be able to spot data fabrication and fake news by applying rational skepticism and analytical reasoning.

Programme Specific Outcomes- Chemistry	
PSO-1	The students pursuing this course would have to develop in-depth understanding of various aspects chemistry.
PSO-2	Demonstrate an understanding of the fundamental principles, including scientific reasoning to solve problems, of organic chemistry, inorganic chemistry, analytical chemistry, and physical chemistry,
PSO-3	To create a foundation for research and development in Chemistry and to familiarize with current and recent developments in Chemistry.
PSO-4	Students will demonstrate research skills in chemistry, including proper laboratory notebook and record-keeping skills, recognizing hazards, minimizing risks, and safe laboratory practices.

Sem-1

Course Name:	Environmental Studies
Course Code:	SSES1070
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist the **students** to acquire awareness on the basic fundamentals of environment like scope, importance etc.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Multidisciplinary nature of environmental studies** Definition, scope and importance, Need for public awareness.	**02**	**10**
2	**Natural Resources.** Renewable and non-renewable resources: Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. d) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. e) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. f) Role of an individual in conservation of natural resources g) Equitable use of resources for sustain able lifestyles.	**08**	**30**
Section-II			
3	**Biodiversity and its conservation** Introduction – Definition: genetic, species and ecosystem diversity.	**10**	**35**

	• Bio geographical classification of India Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values • Biodiversity at global, National and local levels. • India as a mega-diversity nation • Hot-sports of biodiversity. • Threats to biodiversity: habitat loss, poaching of wildlife, man wild life conflicts. • Endangered and endemic species of India Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.		
4	**Social Issues and the Environment** From Unsustainable to Sustainable development • Urban problems related to energy • Water conservation, rain water harvesting, watershed management • Resettlement and rehabilitation of people; its problems and concerns. Case studies. • Environmental ethics: Issues and possible solutions. • Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. • Waste land reclamation. • Consumerism and waste products. • Environment Protection Act. • Air (Prevention and Control of Pollution) Act. • Water (Prevention and control of Pollution) Act • Wildlife Protection Act • Forest Conservation Act • Issues involved in enforcement of environmental legislation. • Public awareness.	**10**	**25**

Course outcome:

CO-1: To understand basic knowledge of environment fundamentals.
CO-2: To understand the role of Environment in the field of science.
CO-3: To understand the acts and laws that deal with the environment.
CO-4: To provide the information about how to live without degrading the environment

Reference Books:

Title	Authors	Publisher
The Biodiversity of India	Bharucha Erach	Mapin Publishing Pvt. Ltd
Environmental Biology	Agarwal, K.C.	Nidi Publ. Ltd. Bikane
Water Management in India	Bansil, P.C. 2004	Concept Publishing Company, India
Water Resources Management VII	Water Resources Management VII	WIT Press.

Course Name:	Water & Water Resources
Course Code:	SSES1080
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The students will understand basic concepts of different types of water resources, basic Physical (Temperature, Color, Odour etc.), Chemical (COD, BOD, Acidity, Alkalinity etc.), and Biological (Phytoplanktons, Zooplanktons, Phytobenthos etc.) properties of water and wastewater, sources of pollution in ground water and surface water, different types of wetlands, Convention held for preservation of wetlands, Ecological significance and threats to wetlands.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Introduction** Sources and types of water; hydrological cycle; precipitation, run off, infiltration, evaporation, evapo-transpiration; classification of water resources (oceans, rivers, lakes and wetlands).	4	15
2	**Properties of water** Physical: temperature, colour, odor, total dissolved solids and total suspended solids; Chemical: major inorganic and organic constituents, dissolved gases, DO, COD, BOD, acidity and alkalinity, electrical conductivity, sodium adsorption ratio; Biological: phytoplankton, Phytobenthos, zooplankton, macro-invertebrates and microbes.	8	25
Section-II			
3	**Surface and subsurface water** Introduction to surface and ground water; surface and ground water pollution; water table; vertical distribution of water; formation and properties of aquifers; techniques for ground water recharge; river structure and patterns; watershed and drainage basins; importance of watershed and watershed management; rain water harvesting in urban settings.	12	35
4	**Wetlands and their management** Definition of a wetland; types of wetlands (fresh water and marine); ecological significance of wetlands; threats to wetlands; wetland conservation and management; Ramsar Convention, 1971; major wetlands of India.	6	20

Course outcome:

CO-1: To understand basic knowledge of different types of water resources.
CO-2: To understand the basic properties of water and wastewater.
CO-3: To provide information of surface and subsurface water.
CO-4: To provide the information about wetlands and its management

Reference Books:

Title	Authors	Publisher
The Biodiversity of India	BharuchaErach	Mapin Publishing Pvt. Ltd
Environmental Biology	Agarwal, K.C.	Nidi Publ. Ltd. Bikane
Water Management in India	Bansil, P.C. 2004	Concept Publishing Company, India
Water Resources Management VII	C. A. Brebbia	WIT Press.

Course Name:	Environment Studies & Water & Water Resources Practical
Course Code:	SSES1090
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

Students will get the information of the various characteristics of water, the determination of water characteristics, to collect different kind of samples for analysis purpose.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1	Visit to a local area to document environmental assets river/forest/grassland/hill/mountain	05
2	Visit to a local polluted site-Urban/Rural/Industrial/Agricultural	05
3	Describe the environmental problem of your locality and suggest a remedy.	05
4	Case Studies-I	05
5	Case Studies-II	05
6	Seminars	05
7	Collection of samples- air, water and soil	05
8	Determination of pH from soil and water samples	05
9	Estimation of D.O. in water	10
10	Determination of conductivity from soil samples	10

Course outcome:

CO-1: To Familiarize with the various characteristics of water.

CO-2: To understand how to determine Characteristics of water

CO-3: To understand how to collect samples from water, soil and air

CO-4: To estimate pH, D.O. and conductivity of various samples.

Reference Books:

Title	Authors	Publisher
The Biodiversity of India	BharuchaErach	Mapin Publishing Pvt. Ltd
Environmental Biology	Agarwal, K.C.	Nidi Publ. Ltd. Bikane
Water Management in India	Bansil, P.C. 2004	Concept Publishing Company, India
Water Resources Management VII	Water Resources Management-VII	WIT Press.

Course Name:	Inorganic Chemistry – I
Course Code:	SSCH1010
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist the students to study about Classical Mechanics of Atom, periodic properties of elements and detailed learning about chemical bonding and structure of molecules.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Atomic structure - Classical Mechanics** Atom, sub-atomic particles, Rutherford's atomic model, Mosley's determination of atomic number, Electromagnetic spectrum, Continuous spectrum, atomic spectra, atomic spectrum of hydrogen, Quantum theory of radiation, Explanation to Photoelectric effect, Compton effect, Bohr's model of atom, arrangement of electrons in orbits, Zeeman effect.	08	27
2	**Periodic Properties of Elements** Classification of elements, periodic table, Mendeleev's periodic table, significance and its limitation, Modern periodic table, the long form of periodic table, electronic configurations of elements and periodic table, s, p, d, f block elements, Detailed discussion of the following properties of the elements, with reference to s and p-block. (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b) atomic radius, metallic radius, ionic radius, crystal radii, van der Waals, Covalent radii (c) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (d) Electron gain enthalpy, trends of electron gain enthalpy. (e) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's, electronegativity scales, Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity	12	40
Section-II			
3	**Chemical Bonding and Structure of Molecules:** **General terms**: Chemical bond, valence, valence electrons, Bonding and Non-bonding electrons, Lewis symbols, Octet rule. **Ionic bond**: Definition, Condition for formation of ionic bond, Factors governing formation of ionic bond, Characteristics of ionic compounds.	10	33

	Covalent bond: Definition, conditions for covalent bond formation, examples, General characteristics of covalent compounds, valence bond approach, Concept of hybridization, Hybridization and shape of molecules, Limitations of Valence bond theory, VSEPR theory. **Hydrogen bonding:** Definition, conditions for H-bond formation, examples, Types of H-bonds, Characteristics of H-bonded compounds. **Metallic bond:** Definition, Electron Sea model		

Course outcome:

CO-1: To describe the theories of atom's discovery with its' spectral emission, Bohr's atomic model, Photoelectric effect.
CO-2: To explain Periodic table, electronic configuration of elements and detailed discussion about properties of the elements of periodic table.
CO-3: To demonstrate the structural geometry and hybridization of the molecules, Ionic bonding, Covalent bonding, Metallic bonding, hydrogen bonding

Reference Books:

Title	Authors	Publisher
Concise Inorganic Chemistry	J.D. Lee	Wiley India
Engineering Chemistry (16th Edition)	P.C. Jain and Monika Jain	Dhanpat Rai publishing company
Essentials of Physical Chemistry	A. Bahl, B.S. Bahl and G.D. Tuli	S. Chand Publishing
Advanced Practical Physical Chemistry	J. B. Yadav	Krishna Prakashan Media
Vogel's Qualitative Inorganic Analysis 7th Edition	G. Svehla, B. Sivasankar	Pearson

Course Name:	Physical Chemistry – I
Course Code:	SSCH1020
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist solution preparation and titrations, study of liquid state with its' properties including a brief introduction to colloids, acid and bases concept.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Solution** Solute, Solvent, Solution, Methods of expressing concentration terms for solution, Examples of solution preparation, Titration, Types of titrations, Measuring the endpoint of a titration via different methods, Difference between endpoint and equivalence point, Theory of acid–base indicators; selection of indicators and their limitations.	6	20
2	**Liquid state** Types of intermolecular forces with suitable examples (Dipole- Dipole, London forces, H-bonding), Definition, unit, effect of temperature and characterization for following physical properties: 1) Vapor pressure, 2) Surface tension, 3) Viscosity, 4) Refractive index, 5) Optical Activity.	8	27
Section-II			
3	**Colloids** Introduction, Classification of colloids, Preparation of colloidal solutions via condensation and dispersion methods, Dialysis, Ultra-filtration, Properties of colloidal solutions, Coagulation or flocculation of colloids, Stability of colloids by different methods, Gold number, Zeta potential, Application of colloids.	8	27
4	**Acids and Bases** Basic properties of acids and bases, Acid-base concepts, Derive equation for relative strength of strong acids and bases, Calculate the relative strength of weak acids and bases, pH, pH scale, measurements of pH by pH paper, indicators and pH meter, common ion effect, Buffer solutions, Discuss how the addition of a small amount of acids or bases not affects the pH of buffer solutions, derivation of Henderson equation	8	26

	and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Numerical Problems.		

Course outcome:

CO-1: To explain solution preparation with a brief idea of different concentration units, titration and theory of acid-base indicator.
CO-2: To describe intermolecular forces with suitable examples and physical properties of liquid.
CO-3: To Introduce colloids with its classification, preparation, properties and application.
CO-4: To describe properties and relative strength of acid and bases, pH, indicator, Buffer solutions and its' application in analytical chemistry and Biochemical process.

Reference Books:

Title	Authors	Publisher
Concise Inorganic Chemistry	J.D. Lee	Wiley India
Engineering Chemistry (16th Edition)	P.C. Jain and Monika Jain	Dhanpat Rai publishing company
Essentials of Physical Chemistry	A. Bahl, B.S. Bahl and G.D. Tuli	S. Chand Publishing
Advanced Practical Physical Chemistry	J. B. Yadav	Krishna Prakashan Media
Vogel's Qualitative Inorganic Analysis 7th Edition	G. Svehla, B. Sivasankar	Pearson

Course Name:	Chemistry Practical
Course Code:	SSCH1030
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to learn practical about analytical and applied chemistry with safety features

Course Contents:

Module	Name of the practical	Hours
1.	Introduction to laboratory, safety rules during practical, knowledge about different sign and symbols regarding hazardous materials, calibration and use of apparatus/common glassware and their uses. Volumetric titrations, quantitative analysis, quantitative analysis, precautions during experiments and titrations.	**6**
2.	Prepare given concentration solutions and standardized them.	**6**
3.	Estimation of free alkali present in different soaps/detergents	**6**
4.	Estimation of oxalic acid and sodium oxalate in a given mixture.	**6**
5.	Estimation of ferrous ions using potassium dichromate by internal indicator method	**6**
6.	Prepare 0.1N NaOH solution.	**6**
7.	Surface tension measurements of different solvents by stalagmometer	**6**
8.	Viscosity of different solvents by Ostwald's viscometer.	**6**
9.	pH metric titration of (i) strong acid vs. strong base	**6**
10.	Determine the precipitation values for arsenious sulphide sol.	**6**

Course outcome:

CO-1: To describe solution preparation, estimation of free alkali in soap/detergents, ferrous ions by internal indicator method,
CO-2: To measure of viscosity by Ostwald's viscometer, surface tension by stalagmometer,
CO-3: pH metric titration of strong acid vs. strong base, and precipitation values for arsenious sulphide sol.

Reference Books:

Title	Authors	Publisher
Advanced Practical Physical Chemistry	J. B. Yadav	Krishna Prakashan Media
Vogel's Qualitative Inorganic Analysis 7th Edition	G. Svehla, B. Sivasankar	Pearson

Course Name:	Introduction to Microbiology-I
Course Code:	SSMB1010
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist Students to learn about the different fields in microbiology, the different types of microorganisms and their significance, the morphology structure, characteristics of Algae and their significance, the morphology structure, characteristics of Fungi and their significance

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	History and scope of Microbiology, Introduction to microorganisms, Discovery, Types of microbes, Golden period of microbiology, Scope and future of microbiology	12	25
2	Bacterial Diversity: General characteristics of Bacteria, archaea, cyanobacteria. Classification and economic importance	11	25
Section-II			
3	Fungal Diversity: General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, Classification and Economic and importance of fungi	11	25
4	Algal Diversity: General characteristics of algae including occurrence, thallus organization, algae cell ultra-structure, Classification and Economic importance of algae	11	25

Course outcome:

CO-1: To introduce the students with the history and scope of microbiology and basics of different fields in Microbiology
CO-2: To make student aware about various types of microorganism and their general characteristics.
CO-3: To understand diversity, morphology, Structure, life cycle, useful and harmful activities of Algae
CO-4: To understand diversity, morphology, Structure, life cycle, useful and harmful activities of Fungi

Reference Books:

Title	Authors	Publisher
Microbiology	Prescott	McGraw-Hill
Microbiology	Peleczar	Tata McGraw-Hill
General Microbiology	Stanier RY, Ingraham JL, Wheelis ML, and Painter PR	5th edition. McMillan (2005)
Experiments in Microbiology, Plant Pathology and Biotechnology	Aneja	New Age Publisher
Microbiology Introduction	Tortora Gerad	Benjamin Cumming

Course Name:	Introduction to Microbiology -II
Course Code:	SSMB1020
Prerequisite:	Introduction to Microbiology-I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course that Students will be able to know the basis of the classification of various microorganisms, to differentiate microbes based on their morphology and categorize, the major differences between prokaryotic and eukaryotic microbes based on their internal structure, specialization in microscopic techniques for the identification of microbes.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	Microbial Classification, Systems of classification: Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility, Bacterial systematics	15	30
2	Major cell Morphologies, Morphology and Biology, Cell size and significance of smallness, Significance of surface to volume ratio, Lower limits of cell size.	11	25
Section-II			
3	Bacterial cell surface appendages, Pili, Fimbrae, Cell inclusions, Gas Vesicles, Endospores, Nucleoid, Chemotaxis, Structures responsible for motility in bacteria, Types of motilities	11	25
4	Concept of Microscopy-resolution, simple and compound microscopy, various types of microscopy	08	20

Course outcome:

CO-1: To familiarize students with the different classification and nomenclature systems for microbes.
CO-2: To familiarize students with the external features and structures of microbes
CO-3: To learn the important internal structures of microbes including bacteria.
CO-4: To know the identification of different microbes by suitable microscopic techniques.

Reference Books:

Title	Authors	Publisher
Microbiology	Prescott	McGraw-Hill
Microbiology	Peleczar	Tata McGraw-Hill
General Microbiology	Stanier RY, Ingraham JL, Wheelis ML, and Painter PR	5th edition. McMillan (2005)
Experiments in Microbiology, Plant Pathology and Biotechnology	Aneja	New Age Publisher
Microbiology Introduction	Tortora Gerad	Benjamin Cumming

Course Name:	Microbiology practical
Course Code:	SSMB1030
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist the students to prepare solid and broth agar media for growing microbes, isolate microbes independently from environmental, clinical and food and industrial samples, Students could independently handle and operate various microbiological laboratory instruments.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1	Introduction to Microbiology Good Laboratory Practices and Biosafety	3
2	To study the principle and applications of important instruments: Biological safety cabinets, autoclave, incubator, BOD incubator	3
3	To study the principle and applications of important instruments: Hot air oven, light microscope, pH meter) used in the Microbiology laboratory	3
4	Sterilization of glassware, medium using autoclave and assessment for sterility	3
5	Sterilization of heat sensitive material by membrane filtration and assessment for sterility	3
6	Preparation of Nutrient broth a Nutrient agar medium	3
7	Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air	3
8	Microscopic observation of morphological characteristics of Protozoa/Yeast using compound microscope	3
9	Study of bacterial motility by hanging drop techniques	3
10	Preparation of culture media for microbes (bacteria, fungal, algal cultivation)	3

Course outcome:

CO-1: To learn to prepare media for bacteria, fungi, and algae
CO-2: To learn to isolate microbes from air, water, and soil
CO-3: To learn to have prior information about the basic instruments which are routinely used in a microbiology laboratory
CO-4: To learn techniques relevant to microbiology

Reference Books:

Title	Authors	Publisher
Microbiology	Prescott	McGraw-Hill
Microbiology	Peleczar	Tata McGraw-Hill
General Microbiology	Stanier RY, Ingraham JL, Wheelis ML, and Painter PR	5th edition. McMillan (2005)
Experiments in Microbiology, Plant Pathology and Biotechnology	Aneja	New Age Publisher
Microbiology Introduction	Tortora Gerad	Benjamin Cumming

Course Name:	Physics-I
Course Code:	SSCH1040
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of course is to apply and illustrate the concepts of electricity and magnetism through experiments, the concepts of optics through experiments, the concepts of properties of matter through experiments, the principles of electronics through experiments.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**General Physics** Definition, unit, resolution of forces, Newton's law of motion, types of motion, force of gravity and center of gravity, reaction forces, equilibrium, determination of equilibrium of body, work, power, energy, torque. Force of friction, laws of static and dynamic friction, limits of friction, friction a necessity and evil.	07	20
2	**LASER & FIBER OPTICS** Introduction, Characteristics of laser radiation, Spontaneous and stimulated mission, Working of LASER with basic idea about Population Inversion, Pumping mechanism, Optical Resonators, Nd:YAG LASER , Applications of LASER. Introduction of Optical Fiber Advantages of Optical Fiber, Total Internal Reflection, Numerical Aperture and Acceptance angle, Modes of Propagation, Types of Optical Fiber, Applications of optical fiber.	08	25
Section-II			
3	**Properties of matter** Stress and strain, Hooke's law, factors affecting elasticity, three types of elasticity, equivalence of a shear to a compression and an extension at right angles to each other, shearing stress equivalence to an equal linear tensile stress and an equal linear compressive stress straight angles to each other, deformation of a cube-bulk modulus, modulus of rigidity, Young's modulus, relation connecting elastic constants, Poisson's ratio. Torsional pendulum, determination of the coefficient of rigidity η.	07	25

4	**Electrostatics** The electric field, electric field lines, the electric field due to a point charge, Gauss' law and Coulomb's law, Electric current, current density, resistance and resistivity, Ohm's law, RC circuits. Introduction to Semiconductors, intrinsic and extrinsic Semiconductors, Types of Diodes, Advantages of Semiconductor devices, Transistors, Types of transistors, Bipolar Junction Transistor, junction field effect transistor	08	30%

Course outcome:

CO-1: To carry out experiments to understand the laws and concepts of Physics.
CO-2: To learn about Laser and Fiber optics
CO-3: To learn about properties of matter.

Reference Books:

Title	Authors	Publisher
Engineering Physics	B.K. Pandey & S. Chaturvedi	CENGAGE Learning
Electronic Principles	Malvino, A.P.	Tata McGraw Hill, 1999.
Fundamentals of Physics	Halliday, Resnick and Walker	Wiley
Principal of Electronics	Mehta and Mehta	S. Chand

Course Name:	Physics Practical-I
Course Code:	SSCH1040
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	2	0	1	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of course is to apply and illustrate the concepts of electricity and magnetism through experiments, the concepts of optics through experiments, the concepts of properties of matter through experiments, the principles of electronics through experiments.

Course Contents:

Module	Name of Practical/Tutorial	Hours
1.	Error analysis	2
2.	Planck's constant	4
3.	Numerical aperture and Acceptance angle of an optical fiber	2
4.	Hall effect	4
5.	Hysteresis loop	2
6.	Young's Modulus	4
7.	LED I-V Characteristic	4
8.	Capacitor and Resister in series and parallel.	4
9.	RLC Circuit	4

Course outcome:

CO-1: To carry out experiments to understand the laws and concepts of Physics.
CO-2: To learn about Laser and Fiber optics
CO-3: To learn about properties of matter.

Reference Books:

Title	Authors	Publisher
Engineering Physics	B.K. Pandey & S. Chaturvedi	CENGAGE Learning
Electronic Principles	Malvino, A.P.	Tata McGraw Hill, 1999.
Fundamentals of Physics	Halliday, Resnick and Walker	Wiley
Principal of Electronics	Mehta and Mehta	S. Chand
Elementary Linear Algebra (Application Version)	Anton and Rorres	Wiley India Edition

Course Name:	Mathematics-I
Course Code:	SSCH1050
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist the students to analyze functions and their graphs as informed by limits and derivatives, to outline the exponential & logarithm properties and determine a quadratic function's minimum or maximum value, to use determinants and their interpretation as volumes, describe properties of the determinant, to understand the basic ideas of vector algebra: linear dependence and independence

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	Function: Domain, Range, One-one, onto function, composition of functions, Complex number: Algebra of complex number. Quadratic equation and its solution.	06	20
2	Exponential & Logarithmic function: Elementary properties. Trigonometric functions: sine, cosine, tan, cot, cosec, sec and their inverse function. Formulae: cos(A±B), sin(A±B), tan(A±B), sin(2θ), cos(2θ), tan(2θ).	08	26
Section-II			
3	Determinant: 2×2, 3×3 order, Expansion, elementary properties, Matrices: 2×2, 3×3 order, Algebra of matrices (Addition, Scalar product, product of two matrices)	08	27
4	Vector algebra : Vector space R_2 and R_3 Operation : Addition, scalar multiplication and vector multiplication, magnitude of vector, Inner product, Box/Triple product, angle between two vectors.	08	27

Course outcome:

CO-1: To evaluate limits using different methods and standard limits and define continuity of a function in an interval.
CO-2: To utilize the rules of Exponential & logarithmic functions
CO-3: To provide requisite information about Determinants
CO-4: To impart insights of Vector Algebra

Reference Books:

Title	Authors	Publisher
A First Course in Mathematical Analysis	D Somasundaram and B Choudhary	Narosa Publishing House
Functions of a Complex Variable	J. N. Sharma	Krishna Prakashan
Plane trigonometry, Part I and II	S.L. Loney	McMillan & Co. London.
Text book of Matrices	Shantinarayan	S. Chand and Co.
Elementary Linear Algebra (Application Version)	Anton and Rorres	Wiley India Edition

Course Name:	Mathematics Tutorial-I
Course Code:	SSCH1050
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	0	1	1	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist the students to analyze functions and their graphs as informed by limits and derivatives, to outline the exponential & logarithm properties and determine a quadratic function's minimum or maximum value, to use determinants and their interpretation as volumes, describe properties of the determinant, to understand the basic ideas of vector algebra: linear dependence and independence

Course Contents:

Module	Name of Practical/Tutorial	Hours
1.	Function 1	3
2.	Complex Number and Quadratic Equations	3
3.	Exponential and Logarithmic Functions	3
4.	Trigonometric functions 1	3
5.	Trigonometric functions 2	3
6.	Determinant 1	3
7.	Determinant 2	3
8.	Matrices	3
9.	Algebra of Vector spaces R2 and R3	3
10.	Inner Product	3

Course outcome:

CO-1: To evaluate limits using different methods and standard limits and define continuity of a function in an interval.
CO-2: To utilize the rules of Exponential & logarithmic functions
CO-3: To provide requisite information about Determinants
CO-4: To impart insights of Vector Algebra

Reference Books:

Title	Authors	Publisher
A First Course in Mathematical Analysis	D Somasundaram and B Choudhary	Narosa Publishing House
Functions of a Complex Variable	J. N. Sharma	Krishna Prakashan
Plane trigonometry, Part I and II	S.L. Loney	McMillan & Co. London.
Text book of Matrices	Shantinarayan	S. Chand and Co.
Elementary Linear Algebra (Application Version)	Anton and Rorres	Wiley India Edition

Sem-2

Course Name:	Ecology & Ecosystem I
Course Code:	SSES1100
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to understand the properties and difference between living and nonliving things, to know the core concepts and methods from ecological science and their application in environmental problem-solving, to express knowledge of the relationships between plants, animals and humans' influence on the surrounding environment, to analyze the impact of predation, competition and interdependence among living things.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Introduction** Basic concepts and definitions: ecology, landscape, habitat, ecozones, biosphere, ecosystems, ecosystem stability, resistance and resilience; autecology; synecology; major terrestrial biomes.	5	15
2	**Ecology of individuals** Ecological amplitude; Liebig's Law of the Minimum; Shelford's Law of Tolerance; phenotypic plasticity; ecotypes; ecoclines; acclimation; ecological niche; types of niche: Eltonian niche, Hutchinsonian niche, fundamental niche, realized niche; niche breadth; niche partitioning; niche differentiation; thermoregulation; strategies of adaptation in plants and animals.	10	20
Section-II			
3	**Ecology of populations** Concept of population and meta-population; r- and K-selection; characteristics of population: density, dispersion, natality, mortality, life tables, survivorship curves, age structure; population growth: geometric, exponential logistic, density-dependent; limits to population growth	6	30
4	**Ecology of communities** Discrete versus continuum community view; community structure and organization: physiognomy, sociability, species associations, periodicity, biomass, stability, keystone species, ecotone and edge effect; species interactions: mutualism, symbiotic relationships, commensalism, amensalism, proto cooperation, predation, competition, parasitism, mimicry, herbivory; ecological succession: primary and secondary successions, models and types of	9	35

	successions, climax community concepts, examples of succession.		

Course outcome:

CO-1: To make the students aware of the real-life interaction of components of the ecosystem.
CO-2: To learn about the various factors involved in the development of the ecosystem
CO-3: To understand ecosystem science and ecosystem-based management systems
CO-4: To understand how Earth's major ecosystem function

Reference Books:

Title	Authors	Publisher
Fundamentals of Ecology	Odum, E.P. 1971	W.B. Sounders.
Ecology, Environment and Resource Conservation	Singh, J.S., Singh, S.P. & Gupta, S.R. 2006	Anamaya Publications.
The Ecology of Plants	Gurevitch, J., Scheiner, S. M., & Fox, G. A. 2002	Sinauer associates incorporated.
Physical Geography	Savindra Singh S	Prayag Pustak Bhavan, Allahabad
Geology, Environment and Society	Valdiya K.S	University press

Course Name:	Physical Environment
Course Code:	SSES1110
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to know about the various types of environments, fundamental understanding of the atmosphere and the dynamical and physical processes that control weather and climate, to describe the movement of the Sun, Moon, and Earth in the Solar System, the effect of solar energy on the Earth's climate.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Introduction to Environment:** Concept and types of environment: Physical, Biological and Cultural - Environment as perceived by different sciences. Earth & the Solar System - Movements of the earth, Kepler's laws of motion, Newton' law of gravitation, moment of inertia, Coriolis force. Earth's magnetic field- Magnetic field intensity, magnetic lines of force, magnetic induction. magnetic field around a current carrying conductor, Biot- savart's law, Tangent Galvanometer Solar energy and heat balance Controls over heating and cooling-land and water differences Heating processes-radiation, green house effect, conduction, compression, condensation Cooling processes-evaporation, expansion, advection, temperature inversions	15	40
2	**Atmosphere**: Composition of the atmosphere Air- composition, density, thermal structure and stratification Factors affecting global distribution of insolation : Causes and effects of: insolation; pressure & winds; monsoon system; humidity phenomena; air masses; precipitation; types of clouds.	10	35
Section-II			
3	**Marine & Submarine Environment** Coastal Zone Classification. Characteristic physical features of coastal areas Ocean floor deposits and coral reefs. Ocean water- temperature, salinity, circulation	05	25

Course outcome:

CO-1: To understand the basic subject of the physical environment.
CO-2: To learn to improve understanding of components of the atmosphere
CO-3: To learn about nature of physical systems.
CO-4: To learn about the Marine and submarine environment

Reference Books:

Title	Authors	Publisher
Fundamentals of Ecology	Odum, E.P. 1971	W.B. Sounders.
Ecology, Environment and Resource Conservation	Singh, J.S., Singh, S.P. & Gupta, S.R. 2006	Anamaya Publications.
The Ecology of Plants	Gurevitch, J., Scheiner, S. M., & Fox, G. A. 2002	Sinauer associates incorporated.
Physical Geography	Savindra Singh S	Prayag Pustak Bhavan, Allahabad
Geology, Environment and Society	Valdiya K.S.	University press

Course Name:	Ecology & Physical Environment Practical
Course Code:	SSES1120
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to help the students to learn various factors involved in the development of the ecosystem and basic physics involved in the solar system.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1	Kepler‘s law of planetary motion	10
2	Newton‘s law of gravitation	10
3	Population ecology	10
4	Characteristics of population	10
5	Species richness	10
6	Solar energy budget	10

Course outcome:

CO-1: The students will have in-depth knowledge of Climatic, Physiographic, and Biotic factors that involve the ecosystem.
CO-2: Students will understand a different kind of laws including Kepler's law of planetary motion and Newton's law of Gravitation.
CO-3: Students can calculate the amount of Solar radiation come to the earth every day.
CO-4: Students will understand different kinds of laws including Kepler's law of planetary motion and Newton's law of Gravitation.

Reference Books:

Title	Authors	Publisher
Fundamentals of Ecology	Odum, E.P. 1971	W.B. Sounders.
Ecology, Environment and Resource Conservation	Singh, J.S., Singh, S.P. & Gupta, S.R. 2006	Anamaya Publications.

The Ecology of Plants	Gurevitch, J., Scheiner, S. M., & Fox, G. A. 2002	Sinauer associates incorporated.
Physical Geography	Savindra Singh S	Prayag Pustak Bhavan, Allahabad
Geology, Environment and Society	Valdiya K.S.	University press

Course Name:	Organic Chemistry
Course Code:	SSCH1060
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to learn about aliphatic hydrocarbons, aromatic hydrocarbons, fundamental of organic chemistry, and Basic of stereochemistry.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Aliphatic hydrocarbons** Definitions (Bond distances, Bond angles, Torsion angle, Isomers) (i) Alkanes: nomenclature, sources, methods of formation, Physical properties and chemical reactions. (ii) Alkenes: Nomenclature, method of preparation, Physical properties, Reactions of alkenes. (iii) Dienes: nomenclature, classification of dienes methods of formation of Butadiene chemical reactions 1,2 and 1,4 additions, polymerization, Diels-Alder Reaction. (iv) Alkynes: nomenclature, Isomerism, methods of formation, Physical properties, chemical reactions, electrophilic and nucleophilic addition reactions of acetylene.	8	27
2	**Aromatic hydrocarbons** Introduction, Nomenclature of aromatic compounds, Source of aromatic compound, Arenes, Monocyclic Arens, Aromaticity, Modern Theory of Aromaticity, Hückel's rule, Nomenclature, Method of preparation of benzene, Physical properties, Electrophilic aromatic substitution: halogenation, nitration, Sulphonation and Friedel-Craft's alkylation/acylation with their mechanism, Aromatic addition reactions, Applications of benzene	8	27
Section-II			
3	**Fundamentals of Organic Chemistry** Introduction, Homolytic and Heterolytic fission with suitable examples, Electronic Displacements, Inductive, Electromeric, Resonance and mesomeric effects, hyperconjugation and their applications, Dipole moment, types of arrow, Electrophiles and Nucleophiles, Leaving groups, Basic idea about Carbocations, Carbanions, Free radicals and	6	20

	Carbenes and their stability, Types of organic reactions and their mechanism: Substitution reactions Elimination and, Addition, Rearrangement reactions, Beckmann rearrangement, Aldol condensation.		
4	**Basic of Stereochemistry** History and introductions of stereochemistry **Molecular Projections**: Fischer Projections, Characteristics and Limitations, Sawhorse Projections, Newman Projections, Interconversions of Fischer-Sawhorse-Newman Projections. **Geometrical Isomerism**: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules. **Optical Isomerism:** Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration, Comparison between D, L and R, S Nomenclature.	8	26

Course outcome:

CO-1: To explain Nomenclature, synthesis methods, physical properties and chemical reactions of alkane, alkene, alkyne and dienes.
CO-2: To introduce aromatic compounds and its' theory, benzene synthesis with various chemical reactions and physical properties.
CO-3: To explain basic knowledge of organic chemistry, reaction mechanism such as carbocations, carbanions, carbenes, Inductive effect, Resonance and mesomeric effect and name reactions
CO-4: To describe stereochemistry of organic compounds with molecular projection, geometrical isomerism, optical isomerism perspective.

Reference Books:

Title	Authors	Publisher
Advanced organic chemistry	Arun Bahl and B S Bahl	S. Chand
Stereochemistry	Ranjit S. Dhillon, Inder Pal Singh, Chinnappan Baskar	Narosa Publishing House
Essentials of Physical Chemistry	A. Bahl, B. S. Bahl and G. D. Tuli	S. Chand Publishing
Atkins' Physical Chemistry 10th Edition	Peter Atkins and Julio de Paula	Oxford University Press
Organic Chemistry 7th Edition	Robert Neilson Boyd, Saibal Kanti Robert, Thornton Morrison	Pearson
Advanced Practical Physical Chemistry	J. B. Yadav	Krishna Prakashan Media
Comprehensive Practical Organic Chemistry: Qualitative Analysis	V.K. Ahluwalia, S. Dhingra	Universities Press

Course Name:	Physical Chemistry – II
Course Code:	SSCH1070
Prerequisite:	Physical Chemistry – I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist students to study about solution and colligative properties, Thermodynamics, chemical kinetics, adsorption phenomenon.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Solutions and Colligative Properties** Dilute solutions; lowering of vapour pressure, Raoult's law, Real solution, elevation of boiling point, freezing point depression, Osmotic pressure, Isotonic solutions, Reverse Osmosis, colligative properties of electrolytes, Relation between van't hoff factor and degree of dissociation, Henry's Laws and their applications.	6	20
2	**Thermodynamics** Introduction, scope and limitation of thermodynamics, System, boundary, surroundings, homogeneous and heterogeneous systems, Types of thermodynamic systems, Intensive and extensive properties, state of system, Equilibrium and non– equilibrium states, Process, Types of processes: Isobaric, Isochoric, Isothermal, adiabatic, reversible and irreversible process, Heat and work, pressure-volume work, Isothermal reversible expansion and reversible expansion work of an ideal gas, Internal energy, Sign conversations and units, First law of thermodynamics, enthalpy of system, Relation between ΔH and ΔE, Heat capacity, Specific and molar heat capacities, Concept of entropy, Entropy, Statement of the second law of thermodynamics, Statement of the third law, Units of entropy, Zeroth law of thermodynamics.	8	27
Section-II			
3	**Chemical Kinetics** Introduction, reaction rate, units of rate, rate laws, order of a reaction, molecularity of a reaction, Molecularity of a complex reaction, Differences between order and molecularity, Psuedo order reactions, zero order reaction, Derivation rate constant equation for zero order reaction, First order reaction, Derivation rate constant equation for first order reaction, Units of rate constant, Half -life of a reaction,	8	27

	Calculation of half-life of a first order reaction, Collision theory of reaction rates, Discuss postulates of the collision theory, Effect of temperature on reaction rate, Limitations of the collision theory.		
4	**Adsorption** Introduction, Types of adsorption, Adsorption of gases by solids, Comparison of physical adsorption and chemisorption, Adsorption isotherms, Freundlich adsorption isotherms and its limitations, Langmuir adsorption isotherms at high & low pressure and its limitations, Applications of adsorption, Ion– exchange adsorption, Applications of ion–exchange adsorption.	8	26

Course outcome:

CO-1: To study Henry's law, Raoult's law, colligative properties of electrolytes and its' applications.
CO-2: To intense study of Thermodynamics with introduction to its limitations.
CO-3: To introduce rate of reactions of chemical kinetics and its' parameters, collision theory.
CO-4: To describe introduction of adsorption, theories, properties and its application.

Reference Books:

Title	Authors	Publisher
Advanced organic chemistry	Arun Bahl and B S Bahl	S. Chand
Stereochemistry	Ranjit S. Dhillon, Inder Pal Singh, Chinnappan Baskar	Narosa Publishing House
Essentials of Physical Chemistry	A. Bahl, B. S. Bahl and G. D. Tuli	S. Chand Publishing
Atkins' Physical Chemistry 10th Edition	Peter Atkins and Julio de Paula	Oxford University Press
Organic Chemistry 7th Edition	Robert Neilson Boyd, Saibal Kanti Robert, Thornton Morrison	Pearson
Advanced Practical Physical Chemistry	J. B. Yadav	Krishna Prakashan Media
Comprehensive Practical Organic Chemistry: Qualitative Analysis	V.K. Ahluwalia, S. Dhingra	Universities Press

Course Name:	Organic & Physical Chemistry Practical
Course Code:	SSCH1080
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to gain practical knowledge of Organic chemistry as well as Physical chemistry.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1	Introduction to laboratory, Safety rules during practical, Calibration and use of apparatus/common glassware and their uses. precautions during experiment and titrations.	**6**
2	Purification of organic compounds by crystallization (solvents: Water, Alcohol, Alcohol-Water)	**6**
3	Determine melting point, boiling point, and solubility of various organic compounds.	**6**
4	Identify hydrocarbons (aliphatic and aromatic) by chemical tests.	**6**
5	Qualitative Analysis of Organic Compounds (Single component).	**6**
6	To determine the specific optical rotation of glucose by polarimeter	**6**
7	To determine the molar mass of an unknown solid using freezing point depression.	**6**
8	Determination of cloud point of a surfactant in the presence of salts.	**6**
9	To study the monomolecular reaction in the hydrolysis of methyl acetate in 0.5 NH_4Cl at different initial concentrations.	**6**
10	To study the adsorption of given organic acid by animal charcoal.	**6**

Course outcome:

CO-1: To purify Organic compounds by crystallization, Check their M.P. and B.P. as well as check their solubility

CO-2: To learn polarimeter, determination of molar mass, cloud points, hydrolysis of methyl acetate, and adsorption phenomenon.

CO-3: Qualitative analysis of organic compound,

Reference Books:

Title	Authors	Publisher
Advanced organic chemistry	Arun Bahl and B S Bahl	S. Chand
Stereochemistry	Ranjit S. Dhillon, Inder Pal Singh, Chinnappan Baskar	Narosa Publishing House
Essentials of Physical Chemistry	A. Bahl, B. S. Bahl and G. D. Tuli	S. Chand Publishing
Atkins' Physical Chemistry 10th Edition	Peter Atkins and Julio de Paula	Oxford University Press
Organic Chemistry 7th Edition	Robert Neilson Boyd, Saibal Kanti Robert, Thornton Morrison	Pearson
Advanced Practical Physical Chemistry	J. B. Yadav	Krishna Prakashan Media
Comprehensive Practical Organic Chemistry: Qualitative Analysis	V.K. Ahluwalia, S. Dhingra	Universities Press

Course Name:	Cell Biology-I
Course Code:	SSBT1040
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to get knowledge about the cell evolution and cell theory, the basic structure and components of prokaryotic and eukaryotic cells, the structure of membrane and transport of molecules across the membrane, the structure and functions of cell organelles.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	Discovery of cells, Basic properties of cells, Fundamental classes of cells: Prokaryotic (Bacterial cell, Archaeal cell), Eukaryotic cells (Plant and Animal), Viruses	10	20
2	Structure and various models of biological membranes, Organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.	12	25
Section-II			
3	Structure, composition and functions of: a) Membrane Vacuolar system, and cytoskeleton b) Endoplasmic reticulum c) Golgi complex	13	30
4	Structure, composition and functions of: a) Lysosomes b) Ribosomes c) Mitochondria d) Chloroplasts e) Nucleus	10	25

Course outcome:

CO-1: To know the evolution of cell & cell theory
CO-2: To learn about structure of prokaryotic and eukaryotic cell
CO-3: To gain the knowledge about cell membrane structure
CO-4: To know the structure and functions of cell organelles

Reference Books:

Title	Authors	Publisher
Cell and Molecular Biology: Concepts and Experiments.	Karp, G. 2010.	6th Edition. John Wiley & Sons. Inc.
Cell and Molecular Biology.	De Robertis, E.D.P. and De Robertis, E.M.F. 2006.	8thedition. Lippincott Williams and Wilkins, Philadelphia
Cell Biology	Bhatia KN	Trueman
The Cell: A Molecular Approach	Geoffrey M. Cooper, Robert E. Hausman	Sinauer

Course Name:	Cell Biology -II
Course Code:	SSBT1050
Prerequisite:	Cell Biology-I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, the cellular components underlying mitotic and meiotic cell division, to apply their knowledge of cell biology.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	The Cell cycle and its Regulation via various Checkpoints	10	25
2	Mitosis: cell division of somatic cell, Various Phases (Prophase, Prometaphase, Metaphase, Anaphase, Telophase), Forces required for Mitotic Movements, Cytokinesis	12	25
Section-II			
3	Meiosis: cell division of gametic cell, Various Phases in Meiosis I and Meiosis II**,** Genetic recombination during Meiosis	13	25
4	Oncology: study of Cancer, types and molecular basis of cancer, Programmed cell death (PCD)	10	25

Course outcome:

CO-1: To learn basic concepts and Distinguish between the structure of prokaryotic and eukaryotic cell.
CO-2: Functions of various organelles of cell and cell cycle events
CO-3: Gains insight of cell cycle and specific event involved
CO-4: Compare and contrast the events of cell cycle and its regulation

Reference Books:

Title	Authors	Publisher
Cell and Molecular Biology: Concepts and Experiments.	Karp, G. 2010.	6th Edition. John Wiley & Sons. Inc.
Cell and Molecular Biology.	De Robertis, E.D.P. and De Robertis, E.M.F. 2006.	8th edition. Lippincott Williams and Wilkins, Philadelphia
Cell Biology	Bhatia KN	Trueman
The Cell: A Molecular Approach	Geoffrey M. Cooper, Robert E. Hausman	Sinauer

Course Name:	Cell Biology practical
Course Code:	SSBT1060
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to understand different types of cell organelles present in plant and animal cells, to differentiate prokaryotic and eukaryotic cells, to understand basic processes like diffusion, osmosis, dialysis and plasmolysis, compare different cellular events happen during cell division, to learn the estimation of reducing sugar, protein and amino acids

Course Contents:

Section-I		
Module	**Content**	**Hours**
1	Study of structure of Prokaryotic and Eukaryotic cells	3
2	To study osmosis	3
3	Demonstration of dialysis	3
4	To study of plasmolysis and de-plasmolysis	6
5	To study various Cell division stages in onion root tip	3
6	Estimation of reducing sugar by Cole's method	3
7	Estimation of reducing sugar by Folin-lowry's method	3
8	Quantitative estimation of amino-acids by Ninhydrin method	3
9	Microscopic observation of Drosophila compound eyes	3

Course outcome:

CO-1: To learn the structure of cells and cell organelles in prokaryotes and eukaryotes
CO-2: To understand fundamental processes occurring in a cell
CO-3: To gain knowledge of the cell cycle and cell division
CO-4: To know the estimation of basic biomolecules of the cell

Reference Books:

Title	Authors	Publisher
Cell and Molecular Biology: Concepts and Experiments.	Karp, G. 2010.	6th Edition. John Wiley & Sons. Inc.
Cell and Molecular Biology.	De Robertis, E.D.P. and De Robertis, E.M.F. 2006.	8thedition.Lippincott Williams and Wilkins, Philadelphia
Cell Biology	Bhatia KN	Trueman
The Cell: A Molecular Approach	Geoffrey M. Cooper, Robert E. Hausman	Sinauer

Course Name:	Physics-II
Course Code:	SSCH1090
Prerequisite:	Physics-I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to apply knowledge of magnetism to explain natural physical processes and related technological advances, basic methods and topics that are relevant in practical applications of acoustics and ultrasound, formulate and understand theories explaining the behavior of the solid-state physics, demonstrate and interpret the concepts electromagnetic induction.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Magnetic Materials:** Magnetic moment, Magnetic dipole, Magnetic Field strength, Magnetic flux density, Intensity of magnetization, Magnetic dipole moment, Magnetic Field intensity, Magnetic permeability, magnetic susceptibility, Bohr magnetron, Classification of Magnetic Materials on the basis of magnetic moment, Soft and Hard Magnetic Materials, Anti-ferromagnetic materials, Ferrites	07	20
2	**Acoustic and ultrasonic:** Introduction, Classification and Characteristics of sound Sabine's formula for reverberation (Without Derivations) Introduction of Absorption co-efficient Sound absorbing materials Factors affecting the acoustics of building and their remedies Sound Insulation. Properties of ultrasound Generation of ultrasound by (1) piezoelectric method and (2) Magnetostriction method Methods for Ultrasound Velocity measurement Applications of ultrasound	08	25%
Section-II			
3	**Crystal Structure Solids:** Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Types of Bonds. Ionic Bond. Covalent Bond. Van der Waals Bond. Diffraction of x-rays by Crystals. Bragg's Law.	07	25%
4	**Electromagnetic Induction:** Definition Faradays Laws, Fleming's right hand rule, Lenz's Law,		

	Statically and dynamically induced emf. Self-inductance, mutual inductance and coefficient of coupling. Energy stored in magnetic field. Force on current carrying conductor placed in a magnetic field, Fleming's left-hand rule**.**	08	30%

Course outcome:

CO-1: To provide an adequate exposure about the behavior of Magnetic materials and magnetism
CO-2: To impart basics of the acoustic of building and ultrasonic waves.
CO-3: To give basic understanding of Solid-state physics and the physical properties of solids.
CO-4: To understand the different kinds of laws in electromagnetism.

Reference Books:

Title	Authors	Publisher
Engineering Physics	V Rajendran	Tata McGraw Hill Education
Engineering Physics	Khan B. H	Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006

Course Name:	Physics Practical-II
Course Code:	SSCH1090
Prerequisite:	Physics Practical-I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	2	0	1	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to apply knowledge of magnetism to explain natural physical processes and related technological advances, basic methods and topics that are relevant in practical applications of acoustics and ultrasound, formulate and understand theories explaining the behavior of the solid-state physics, demonstrate and interpret the concepts electromagnetic induction.

Course Contents:

Module	Name of Practical/Tutorial	Hours
1.	To study the Hysteresis loss.	**4**
2.	Determination of the velocity of ultrasonic waves in liquid by ultrasonic interferometer.	**4**
3.	Study of CRO & Measurement of Voltage Amplitude & Frequency	**4**
4.	Basic understanding of step up and down transformer.	**4**
5.	To use a Multimeter for measuring (a) Resistances, (b) A/C and DC Voltages, (c) AC and DC Currents, (d) Capacitances, and (e) Frequencies.	**4**
6.	Understanding the basic logic gates AND, OR, NOT.	**4**
7.	Faraday's Law	**4**
8.	Introduction to virtual lab (Amrita Vishwa Vidyapeetham Virtual Lab)	**2**

Course outcome:

CO-1: To provide an adequate exposure about the behavior of Magnetic materials and magnetism
CO-2: To impart basics of the acoustic of building and ultrasonic waves.
CO-3: To give basic understanding of Solid-state physics and the physical properties of solids.
CO-4: To understand the different kinds of laws in electromagnetism.

Reference Books:

Title	Authors	Publisher
Engineering Physics	V Rajendran	Tata McGraw Hill Education
Engineering Physics	Khan B. H	Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006

Course Name:	Mathematics-II
Course Code:	SSCH1100
Prerequisite:	Differentiation and Basics of Matrices

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to study of analyze functions and their graphs as informed by limits and derivatives, understand the idea of differentiation from first principles and differentiate power functions, examine various techniques of integration and apply them to definite and improper integrals, recognize importance of differentiation and integration for solving problems.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	Function and Limit Function: Concept and Examples, Limit: Concept of Limit, Standard Formulae and related Examples.	06	20
2	Differentiation Definition, Rules of, Sum, Product, Quotient of Functions, Chain Rule, Derivative of Implicit functions and Parametric functions, Logarithmic Differentiation. Successive Differentiation up to second order	09	30
Section-II			
3	Integration Concept, Integral of Standard Functions, Working Rules of Integration, Integration by Parts, Integration by Substitution Method, Definite Integral and its properties.	09	30
4	Application of Differentiation and Integration Velocity, Acceleration, Maxima & Minima. Area and Volume	06	20

Course outcome:

CO-1: Introductory concepts of Functions & limits
CO-2: Comprehensive coverage of Differentiation
CO-3: Comprehensive coverage of Integration
CO-4: Application of Differentiation & Integration

Reference Books:

Title	Authors	Publisher
Engineering Mathematics (third edition)	Anthony croft and others	Pearson Education,2012
Polytechnic Mathematics	Prakash D S	S Chand
Calculus I: Differentiation and Integration	Dan Hamilton	Hamilton Education Guides

Course Name:	Mathematics Tutorial-II
Course Code:	SSCH1100
Prerequisite:	Mathematics Practical-I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	0	1	1	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to study of analyze functions and their graphs as informed by limits and derivatives, understand the idea of differentiation from first principles and differentiate power functions, examine various techniques of integration and apply them to definite and improper integrals, recognize importance of differentiation and integration for solving problems.

Course Contents:

Module	Name of Practical/Tutorial	Hours
1.	Function and Limit 1	3
2.	Function and Limit 2	3
3.	Differentiation 1	3
4.	Differentiation 2	3
5.	Differentiation 2	3
6.	Integration 1	3
7.	Integration 2	3
8.	Integration 3	3
9.	Application of Differentiation and Integration 1	3
10.	Application of Differentiation and Integration 2	3

Course outcome:

CO-1: Introductory concepts of Functions & limits
CO-2: Comprehensive coverage of Differentiation
CO-3: Comprehensive coverage of Integration
CO-4: Application of Differentiation & Integration

Reference Books:

Title	Authors	Publisher
Engineering Mathematics (third edition)	Anthony croft and others	Pearson Education,2012
Polytechnic Mathematics	Prakash D S	S Chand
Calculus I: Differentiation and Integration	Dan Hamilton	Hamilton Education Guides

Course Name:	Linguistic Proficiency (A1 Elementary)
Course Code:	CFLS1010
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To help learners to

- Raise, or ask questions about surrounded information and give answers about themselves and family.
- Understand very simple and daily routine information.
- Read and understand the very simple texts.
- Form simple sentences.
- Identify the usage of grammar and vocabulary

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Grammar & Vocabulary** **Grammar** • Present tense (Simple, Continue, Perfect) • Past tenses (Simple, to be) • Future (Simple) • Modals (Can, could, may, might, must, should, would) • -ing and the infinitive (Verbs + to + infinitive and verbs + -ing) • Identification of parts of speech • there and it • Questions and word Order **Vocabulary** • Numbers (cardinal/ordinal) and money • Countries, nationalities and languages • Times • Days, dates, months, years and seasons • Shops and places • Interests, sports and activities • Jobs • Rooms and furniture • Colours • Size and weight • Body parts and appearance • Food, meals, cooking • Weather • Transport • Health • Feelings and emotions • Street directions • Clothes (any 4 of these)	09	20
2	**Listening** • Listening to my last holiday • Listening to my family, • Listening to my flat,	04	20

	• Listening to daily routine • Listening to shopping habits		
3	**Speaking** • **Giving and taking** introductions, personal information and family, getting to know each other, greetings, asking for directions and giving directions • Raising or asking and answering simple questions	06	20
4	**Reading** • **Reading of the content of the simpler texts** like labels, posters, catalogs, ads, menus, schedules, and guess the unknown words on a contextual basis. • **Reading of information around us** such as announcements, simple advertising, places and activities, job vacancies, etc.	04	20
5	**Writing** • Write about themselves • Form basic sentences • Write about hobbies • Writing short personal letters	07	20

Course outcomes:

At the end of the teaching, the students will be able to:

- understands familiar words and phrases that are directly related to everyday communication situations (family, shopping, home, work), when people speak slowly and clearly
- understands short, simple texts and personal messages, can find information from simple daily texts (labels, posters, directories, ads, job offers, menus, schedules)
- can ask questions about others and answer questions on themselves, can communicate in a simple language, if a partner helps her/him, can describe her/his family and other people, living conditions, education and work in a very simple way
- can write a very simple personal message or sentences

Assessment methods. Assessment criteria:

- **Listening –** understands the simplest questions and the core of the information hears when the conversation partner speaks slowly and clearly and is ready to repeat.
- **Reading –** understands the content of the simpler texts (labels, posters, catalogs, ads, menus, job offers, schedules), guesses the unknown words on a contextual basis.
- **Speaking –** can answer questions about her/himself, speaks about her/himself, family, place of residence food using simple sentences.
- **Writing –** can write a short message or sentence
- **Grammar and Vocabulary** – can identify tenses and parts of speech

Course Name:	Linguistic Proficiency (A2)
Course Code:	CFLS1010
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To help learners to

- Communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar topics and activities.
- Handle very short social exchanges.
- Read and understand the main ideas of simple texts.
- Structure ideas logically in writing.
- Develop accuracy in the usage of grammar and vocabulary.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Grammar & Vocabulary** **Grammar** • Asking Questions—Question forms • Present simple vs present continuous • Past simple—Form and use • However, although, because, so, and time connectors • Will vs be going to—future • Present perfect or past simple? • Much, many, little, few, some, any—quantifiers • Subject and object pronouns, possessive pronouns and adjectives • Prepositions of movement **Vocabulary** Families, Restaurants and leisure venues, Personality, Biographical information, Buildings and monuments, Weather, Clothes and accessories, Large numbers, Hobbies, sports and interests, Education, Life changes and events, Animals, Descriptions of people, health, fitness, and illnesses (any 4 of these)	09	20
2	**Listening** • Listening to factual information, • Listening to the weather forecast, • Listening to the content of guidelines,	04	20

	• Listening to everyday communication situation of the family, shopping, home, work, • Listening to simple pair or group talks		
3	**Speaking** • **Giving and taking** introductions, personal information and family, getting to know each other, simpler personal information, greetings, asking for directions and giving directions, accommodation establishments, booking a room, describing weather, seasons, birds, animals, plants • **Descriptions of Food and drink** including Cafes, restaurants, and other catering establishments; booking a table, ordering, etc.	06	20
4	**Reading** • **Reading of the content of the simpler texts** like labels, posters, catalogs, ads, menus, job offers, schedules, and guess the unknown words on a contextual basis. • **Reading of information around us** such as announcements, advertising, places and activities, job vacancies, etc.	04	20
5	**Writing** • Description of the day • Writing messages & experiences • Writing on familiar topics • Writing short personal letters	07	20

Course outcomes:

At the end of the teaching, the students will be able to:

- Understand main points or phrases or ideas on everyday communication situations.
- Understand common, basic or job-related language, events, short simple texts, personal letters and can find information from simple daily texts.
- Can handle everyday typical communication tasks, can take and give introductions, can contribute to the conversation, and can describe themselves, their family, other people, food & drink.
- Can write short messages, notes, & personal letters and can also write on simply about familiar topics.
- Show an adequate degree of grammatical control and do not make major mistakes and show an understanding of sufficient vocabulary to conduct routine, everyday communications involving used to situations and topics.

Assessment methods. Assessment criteria:

- **Listening** – understands the simplest questions and the core of the information hears when the conversation partner speaks slowly and clearly and is ready to repeat.
- **Reading** – understands the content of the simpler texts (labels, posters, catalogs, ads, menus, job offers, schedules), and guesses the unknown words on a contextual basis.
- **Speaking** – can answer questions about her/himself, speaks about her/himself, family, place of residence food using simple sentences.
- **Writing** – can write a short message.
- **Grammar and Vocabulary** – can use basic grammar and understand sufficient vocabulary of everyday communications situations.

Course Name:	Linguistic Proficiency (B1)
Course Code:	CFLS1010
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To help learners to

- Demonstrate a greater knowledge of linguistic styles and norms.
- Read and understand the main ideas of a variety of texts.
- Structure ideas logically in writing.
- Write clearly and in detail about a wide range of subjects.
- Develop accuracy in the usage of grammar and vocabulary

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Grammar & Vocabulary** **Grammar** • Functional use of parts of speech • Questions—different types • Auxiliary verbs • Comparatives using the…the… • Narrative tenses—all past tenses • Position of adverbs and adverb phrases • Gerund or infinitive—verb patterns **Vocabulary** Buildings, Appliances, Clothes, Education, Entertainment, Environment, Food and drink, Nature, Personal Feelings, Technology, Weather, Sport (any 3 of these)	09	20
2	**Listening Skills** • Note Taking & Making • Audio Comprehension • Movie Clips, News, documentaries	04	20
3	**Speaking Skills** • Speaking in various contexts: • Expressing Result, talking about People/Place/Thing in Relation to Something, • Expressing Manner of an Action, • Making Supposition about an Action,	06	20

	• Describing the process, Connecting Information, Offering Suggestion/Advice, • Expressing Choice and Alternative Choice		
4	**Reading Skills** • Reading Newspaper, Books • Summarizing • Paraphrasing	04	20
5	**Writing Skills** • Technical Writing: Application, Report Writing, Dialogue Writing, Movie Review, Book Review, Letter Writing	07	20

Course outcomes:

At the end of the teaching, the students will be able to:

- Speak confidently and discuss the familiar topics with native speakers in brief.
- Understand lengthy speech and lectures and follow complex arguments of the familiar topic.
- Understand most TV news, the majority of films and current affairs programs in common accents.
- Read articles and reports about common topics, read literature in English
- Write clearly and in detail about a wide range of subjects as well as essays, reports, and letters

Assessment methods. Assessment criteria:

- **Listening** – understands the dialogues, instructions, and narration.
- **Reading** – understands the content of analytical writing, books, newspaper, and magazines
- **Speaking** – narrate the event, describe the cause and process, and give a short speech on a familiar topic.
- **Writing** – can write letters, event reports, narrative writing
- **Grammar and Vocabulary** – can use grammar and vocabulary in the tasks assigned.

Course Name:	Linguistic Proficiency (B2)
Course Code:	CFLS1010
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To help learners to

- Read and understand the main ideas of a variety of texts.
- Structure ideas logically in writing.
- Write clearly and in detail about the given topic.
- Develop accuracy in the usage of grammar and vocabulary.
- Create, organize and defend effective oral presentations.
- Clearly arrange paragraphs with main ideas and topic sentences.
- Logically sequence the ideas.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Grammar & Vocabulary** **Grammar** • Clauses of contrast, purpose, reason, and result • Reflexive and reciprocal pronouns • 'There and it' – preparatory subjects • Speculation and deduction – modal verbs and expressions • Conditionals • Gerunds and infinitives • Functions **Vocabulary** Travel and Tourism, Health and Medicine, Crime and Law, Education, Personality Adjectives, Collocations and Phrases (any 3 of these)	09	20
2	**Listening Skills** • Understanding the difference between Hearing and Listening and Critical Listening. • Understanding the various texts in the context of the tone and emotion they portray. • Exploring domain-general audio clips and deriving an understanding of the embedded message. • Developing the ability to understand the context of a given situation in a conversation/audio clip.	04	20

3	**Speaking Skills** • Exploration of various forms of speech like extempore, elocution, short speech, etc. • Conversational Role Plays and Skits. • Elocution to express one's opinion on various subjects given by the Teacher. • Collaborative discussion to generate different opinions and responses. • Sustaining an interaction; exchanging ideas, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, evaluating, reaching a decision through negotiation, etc.	06	20
4	**Reading Skills** • Introduction to Reading Vs Critical Reading. • Reading and discussion of Short Prose with different writing styles. • Understanding vivid descriptions of texts • Description of genres and writing styles that showcase the varying tones and features. • Develop an understanding to read between the lines.	04	20
5	**Writing Skills** • Summarizing vs. Paraphrasing • Understanding the various texts in the context of the tone and emotion they portray. • Understanding the various forms of written documentation like reports and summary. • Writing activities that assist students in expressing their emotions and feelings. • Writing tasks to generate contrasting ideas, letters for suggestions, letters for the recommendation, essays.	07	20

Course outcomes:

At the end of the teaching, the students will be able to:

- use writing and reading for inquiry, learning, thinking, and communicating.
- develop knowledge and understanding of Grammar.
- develop abilities to make use of the grammar in own writing and speaking English.
- enhance competencies in writing essays and gist of the passage in own words/ language.
- develop an understanding of specific information, text organization features, tone, and text structure.
- develop an ability to write regular/common/casual text types such as an article, an essay, a letter, an email, a report, a review, or a short story, with a focus on advising, apologizing, comparing, describing, explaining, expressing opinions, recommending, suggesting.
- demonstrate an understanding of attitude, detail, function, genre, gist, main idea, opinion, place, purpose, situation, specific information, relationship, topic, agreement, etc.

Assessment methods. Assessment criteria:

- **Listening** – Analyzing audio clips to understand the crux of the clip, A series of short unrelated extracts from monologues or exchanges between interacting speakers. The learners are expected to decode the information given like Details, specific information, stated opinion, etc.
- **Reading** – Comprehension Passage Test to help the students establish structure coherence of the given prose/passage, Evaluation of various reading strategies like Skimming and Scanning, Cloze Test, Understanding the structure of different write-ups to visualize descriptions, Critically analyze and draw

reports, Matching the mismatched sentence order from the provided text, A text or several short texts preceded by 15 multiple-matching questions, Developing a short story based on a similar genre taught on one's own self.

- **Speaking** – Individual speaking assignments to develop general interactional and social language, Ability to organize a larger unit of conversation; comparing, describing, expressing opinions, Group Discussions on issues of importance, A two-way conversation between the students. The students are given spoken instructions with written and visual stimuli, which are used in a decision-making task, Expressing and justifying opinions, agreeing and/or disagreeing, Setting up interviews like mock testing system.
- **Writing** – Developing existing written texts into alternative texts via paraphrasing, Developing summaries of provided extracts, Essay and Article Writing based on the assigned genre, Exploring understanding of various genres of writing, Writing for specific occasions and events, Developing a vocabulary for writing different genres, Visualizing and then writing about certain incidents, memories, trips, visits, etc., Expressing emotions in various contexts and situations, Writing for special occasions and circumstances.

Sem-3

Course Name:	Inorganic Chemistry-II
Course Code:	SSCH2011
Prerequisite:	Inorganic Chemistry – I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist the students to understand in depth about bioinorganic molecules, importance of chelation in medicine, the concept of secondary valency in metals, creation of complex compounds and various methods associated with it. The course also offers detailed information about inorganic polymers with special reference to silicones, phosphazenes, Boron, Silicate, etc.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Bio-inorganic Chemistry** Metal ions present in biological systems, classification of elements according to their action in biological system, Geochemical effect on the distribution of metals, Sodium / K-pump, carbonic anhydrase and carboxypeptidase, Excess and deficiency of some trace metals, Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine. Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron.	14	47%
2	**Co-ordination Chemistry** Werner's theory, Experimental evidence of Werner's theory, Electronic interpretation of co- ordination, Effective Atomic Number (EAN), valence bond theory (Examples of Octahedral, Tetrahedral and Square Planar complexes, electroneutrality principle and back bonding. Concept in co-ordination chemistry, Ligands, Types of Ligands, Coordination number, complex ions, Classification of complex compounds, IUPAC rules, nomenclature of coordination compounds, isomerism in coordination compounds, Stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers, factor that influence complex formation, polynuclear complexes, importance of Polynuclear complexes, Detection of complex formation in solutions, Stability constant, Methods for determination of stability constant (Job's Method and Molar ratio method)	10	34%
Section-II			
3	**Inorganic Polymers** Introduction, Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones,	6	19%

	phosphazenes, Boron, Silicate, Organometallic, Co-Ordination Polymers.		

Course outcome:

CO-1: To study about the metal ions and their role in biological systems.
CO-2: To discuss about Co-ordination Chemistry.
CO-3: To provide knowledge about inorganic polymers

Reference Books:

Title	Authors	Publisher
Advanced Inorganic Chemistry	Cotton and Wilkinson	John Wiley
Inorganic Chemistry	Purcell, K.F & Kotz, J.C.	W.B. Saunders Co, 1977.
Principles of Bioinorganic Chemistry	Lippard, S.J. & Berg, J.M.	Panima Publishing Company 1994

Course Name:	Periodic properties of s & d block elements
Course Code:	SSCH2030
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to enhance the basic understanding about s and d block elements with a special reference to the chemistry of transition metals.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Chemistry of s-block elements-I** Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behavior of first member of each group. Allotropy and catenation. Complex formation tendency of *s* block elements. Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.	8	27%
2	**Transition Elements:** General group trends with special reference to Metallic Character, Melting and Boiling Points, Atomic and Ionic radii, Atomic Volume, electronic configuration, Variable Oxidation states, Nature of compounds in different Oxidation states, colour, variable magnetic and catalytic properties, and ability to form complexes. Comparison of first transition series with second and third transition series.	12	40%
Section-II			
3	**Chemistry of 3d metals** Oxidation states displayed by Cr, Fe, Co and Ni. A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$,, $Na_3[Co(NO_2)_6]$.	10	33%

Course outcome:

The students will learn
CO-1: The special features of s-block elements and their complex forming tendency.
CO-2: The chemistry of transition metal elements with a detailed study on their physical and chemical properties and complex forming tendency.
CO-3: The variable valence of transition elements and synthesis and properties of transition metal compounds.

Reference Books:

Title	Authors	Publisher
Advanced Inorganic Chemistry	Cotton and Wilkinson	John Wiley
Inorganic Chemistry	Purcell, K.F & Kotz, J.C.	W.B. Saunders Co, 1977.
Principles of Bioinorganic Chemistry	Lippard, S.J. & Berg, J.M.	Panima Publishing Company 1994

Course Name:	Inorganic Chemistry Practical
Course Code:	SSCH2050
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to shed light on synthesis of cuprous chloride, enhance knowledge on complex composition and identification of cations and anions in inorganic mixtures.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1	Synthesis of Cuprous Chloride	**06**
2.	Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodometrically)	**06**
3.	Determination of Composition of Complexes using Job Method	**06**
Inorganic Qualitative Analysis:		
4.	Inorganic Qualitative analysis of single component (7 compounds) Fe, Al, Cr, Zn, Mn, Co, Ni, Ba, Sr, Ca, Mg, Na, K, Cl, Br, I, NO_3^{-1}, NO_2^{-1}, SO_4^{-2}, PO_4^{-3}, CO_3^{-2}	**42**

Course outcome:

CO-1: To give comprehensive insight of complex.
CO-2: To exercise the estimations
CO-3: To learn about the qualitative analysis of single component

Reference Books:

Title	Authors	Publisher
Advanced Inorganic Chemistry	Cotton and Wilkinson	John Wiley
Inorganic Chemistry	Purcell, K.F & Kotz, J.C.	W.B. Saunders Co, 1977.
Principles of Bioinorganic Chemistry	Lippard, S.J. & Berg, J.M.	Panima Publishing Company 1994

Course Name:	Biomolecules
Course Code:	SSCH2070
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist the students to learn about the chemical structures of carbohydrate, and their structural and metabolic role in cellular system, to study the structure, properties and function of amino acids, peptides and proteins, to learn about the functions, properties and structure of triacylglycerol and other lipids, action of different classes of enzymes and their inhibition.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Carbohydrates** Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosaccharides, structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.	10	33%
2	**Amino Acids, Peptides and Proteins** Amino acids, Peptides and their classification. α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis.	8	27%
Section-II			
3	**Enzymes** Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance	6	20%
4	**Lipids** Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.	6	20%

Course outcome:

The students will learn
CO-1: To learn about carbohydrates.
CO-2: To gain knowledge about proteins and their building blocks.
CO-3: To introduce the Enzymes.
CO-4: To learn about structure and functions of lipids

Reference Books:

Title	Authors	Publisher
Organic Chemistry	Morrison, R. T. & Boyd, R. N.	Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
Organic Chemistry (Volume 1),	Finar, I. L.	Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
Organic Chemistry	Graham Solomons, T.W.	John Wiley & Sons, Inc.

Course Name:	Functional group in Organic Chemistry
Course Code:	SSCH2090
Prerequisite:	Organic Chemistry

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to understand reactions, Preparation, structure of different type of carbonyl compounds such as aldehyde and ketone; To learn nomenclature, properties and uses of different type of alcohols, phenols, ether and epoxides. Students are able to know about all types of carboxylic acid and their derivative along with their preparation and role in different name reaction. Students can write preparation of dicarboxylic acid, tricarboxylic acid and their related reactions.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Carbonyl compounds (Aldehydes and Ketones)** Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition- elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction, α -substitution reactions, oxidation and reduction (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$,); Addition reactions of unsaturated carbonyl compounds: Michael addition.	10	33%
2	**Alcohols, Phenols, Ethers and epoxides** **Alcohols:** preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement; **Phenols**: Structure, Nomenclature, Preparation and properties; Acidity, salt formation and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism; **Ethers and Epoxides:** Structure, Nomenclature, Preparation, Physical properties and reactions, Uses of Ethers.	10	33%
Section-II			

3	**Carboxylic Acids and their Derivatives:** Monocarboxylic acid: Structure, Nomenclature, Preparation, physical properties, acidity of carboxylic acids, Influence of substituents on Acidity, and reactions of monocarboxylic acids, Dicarboxylic acid: Nomenclature, Physical properties, Preparation and Typical reactions of dicarboxylic acid hydroxyl acids and unsaturated acids: oxalic, malonic, succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group-Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.	10	34%

Course outcome:

The students will learn

CO-1: To study of carbonyl carbon, related compound and their related name reaction & mechanism.
CO-2: To Understand different types of alcohols, phenols, ether and epoxides.
CO-3: To study different reaction and types of carboxylic acids and their derivatives**.**

Reference Books:

Title	Authors	Publisher
Organic Chemistry	Morrison, R. T. & Boyd, R. N.	Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
Organic Chemistry (Volume 1),	Finar, I. L.	Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
Organic Chemistry	Graham Solomons, T.W.	John Wiley & Sons, Inc.

Course Name:	Organic Chemistry Practical
Course Code:	SSCH2110
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to learn different estimation to check purity of the compounds like ester, glycine and aspirin, The students can separate the given organic binary mixture and identify individual compound and also do crystallization for confirmation followed by derivatization.

Course Contents:

Section-I		
Module	**Content**	**Hours**
Organic Estimation:		
1.	To determine the percentage purity of ester in the given sample	**06**
2.	To determine the percentage purity of glycine in the given sample	**06**
3.	To determine the percentage purity of aspirin in the given sample	**06**
Organic Spotting:		
4.	Organic Spotting (7 compounds) Benzoic acid, Salicylic acid, P-Nitro benzoic acid,B-Naphthol, alpha Naphthol, Resorcinol, Aniline, p-Nitroaniline, dimethylaniline, Glucose, Toluene, acetone.	**42**

Course outcome:

CO-1: To determine percentage purity of different organic compounds.
CO-2: To know about organic separation and identification of organic compounds.

Reference Books:

Title	Authors	Publisher
Organic Chemistry	Morrison, R. T. & Boyd, R. N.	Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
Organic Chemistry (Volume 1),	Finar, I. L.	Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
Organic Chemistry	Graham Solomons, T.W.	John Wiley & Sons, Inc.

Course Name:	Concepts in Physical Chemistry - I
Course Code:	SSCH2130
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist the students to differentiate the theories of reaction rates and point out the type of complex reaction and the role of temperature in controlling the rate of reaction. To study the mechanism of catalytic action, enzyme catalysis and different physical properties of gases and express the Maxwells distribution in evaluating the molecular velocities.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Chemical Kinetics-II** Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.	15	50%
2	**Catalysis:** Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.	5	17%
Section-II			
3	**Gaseous State** Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure.	10	33%

	Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities		

Course outcome:

CO-1: To Understand the basics of chemical kinetics: determination of order, molecularity, and understanding theories of reaction rates, determination of rate of opposing/parallel/chain reactions with suitable examples, application of steady state kinetics, Steady-state approximation.
CO-2: To Understand in depth about catalysts, their types and Michaelis-Menten mechanism which explains Enzyme kinetics.
CO-3: To Understand the behavior of real gases, its deviation from ideal behavior, equation of state, isotherm, and law of corresponding states.

Reference Books:

Title	Author/s	Publisher
Physical Chemistry 9th Ed.,	Peter Atkins & Julio De Paula	Oxford University Press (2010).
Physical Chemistry,	Castellan, G. W.	4th Ed., Narosa (2004).
Physical Chemistry	Ball, D. W.	Cengage India (2012).
Physical Chemistry 3rd Ed.,	Mortimer, R. G.	Elsevier: NOIDA, UP (2009).
Physical Chemistry 6th Ed.,	Levine, I. N.	Tata McGraw-Hill (2011).
Physical Chemistry 2nd Ed.,	Metz, C. R.	Tata McGraw-Hill (2009).

Course Name:	Concepts in Physical Chemistry -II
Course Code:	SSCH2150
Prerequisite:	Concepts in Physical Chemistry -I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course that **s**tudents to learn about Radioactivity and memorize about the types of nuclear reactions, to study about chemical equilibrium, deep knowledge of Le chatelier's principle and the effect of controlling factors such as pressure, temperature and concentration on the chemical equilibrium, importance of Phase Diagrams, explain the basic definitions and terms in a phase diagram.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Nuclear chemistry** Radioactivity, types of radiations, properties of radiations, detection and measurement of radioactivity, types of radioactive decay, the group displacement law, radioactive disintegration series, rate of radioactive decay, half-life, radioactive dating, nuclear reactions, nuclear, fission reactions, nuclear fusion reactions, nuclear equations, artificial radioactivity, nuclear isomerism, mass defect, nuclear binding energy, nuclear fission process, nuclear chain reaction, nuclear energy, nuclear reactor, nuclear fusion process, solar energy, fusion as a source of, energy in 21st century	15	50%
Section-II			
2	**Chemical equilibrium** Reversible reactions, Nature of chemical, Equilibrium: its definition, Characteristics of Chemical equilibrium, Law of mass action, Equilibrium constant: Equilibrium law, Equilibrium constant, Expression in terms of Partial pressures, Calculations involving kp, Units of equilibrium Constant; Liquid systems, Heterogeneous equilibria, Le chatelier's principle, Effect of a change in Concentration, Effect of a change in Pressure, Effect of change of Temperature	10	33%
3	**Phase Rule** Phase, components, Degrees of freedom; Derivation of Phase rule, Advantage and disadvantage of Phase rule, one–component system phase diagrams, polymorphism, experimental determination of transition point, the water system, the Sulphur system two–component systems, the silver–lead system.	05	17%

Course outcome:

CO-1: To familiarize with the fundamentals of Nuclear Chemistry.
CO-2: To understand the dynamic nature of Chemical equilibrium, equilibrium constant and application of Le-Chatelier's Principle.
CO-3: To understand phases, components, Gibb's phase rule and its applications, construction of phase diagram of different systems, the application of phase diagram.

Reference Books:

Title	Author/s	Publisher
Physical Chemistry 9th Ed.,	Peter Atkins & Julio De Paula	Oxford University Press (2010).
Physical Chemistry,	Castellan, G. W.	4th Ed., Narosa (2004).
Physical Chemistry	Ball, D. W.	Cengage India (2012).
Physical Chemistry 3rd Ed.,	Mortimer, R. G.	Elsevier: NOIDA, UP (2009).
Physical Chemistry 6th Ed.,	Levine, I. N.	Tata McGraw-Hill (2011).
Physical Chemistry 2nd Ed.,	Metz, C. R.	Tata McGraw-Hill (2009).

Course Name:	Physical Chemistry Practical
Course Code:	SSCH2170
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist the students to design and carry out scientific experiments as well as accurately record and analyse the results of experiments. The students will learn the laboratory skills needed to design, safely conduct and interpret chemical reactions for advanced courses, will realize the need of calibration and importance of error free measurements for advanced courses.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1.	Determination of partition coefficient of benzoic acid between water and kerosene.	**06**
2.	To determine the dissociation constant of weak monobasic acid pH metrically.	**06**
3.	To determine the Vaniline content in Vanilla essence conductometrically.	**06**
4.	To determine the triangular phase diagram of acetic acid, chloroform and water.	**06**
5.	To Determine the relative strength of two acids studying the hydrolysis of ester (Chemical Kinetics).	**06**
6.	Measurement of the specific rotation of an organic compound and determination of the unknown concentration of the compound by polarimetry method.	**06**
7.	Determination of concentration of HCl conductometrically using standard NaOH solution.	**06**
8.	Determination of the equilibrium constant of the reactions: I_2 + KI gives KI_3	**06**
9.	To determine the specific refractivities of the given liquids A, B and their mixtures containing 20%, 40% and 60% and unknown liquid by volume.	**06**
10.	Determine the effect of H_2SO_4 (Catalyst) on Reaction Rate of H_2O_2.	**06**

Course outcome:

CO-1: To impart to the student knowledge and skills for the Preparation and standardization of solutions, Kinetic studies of a reaction, Construction of a phase diagram of a two/three component system

CO-2: To learn the principle and handling of pH meter, Potentiometer, conductivity meter, colorimeter, viscometer, etc.

CO-3: To learn the importance of calibration of instruments

Reference Books:

Title	Authors	Publisher
Physical Chemistry 9th Ed.,	Peter Atkins & Julio De Paula	Oxford University Press (2010).
Physical Chemistry,	Castellan, G. W.	4th Ed., Narosa (2004).
Physical Chemistry	Ball, D. W.	Cengage India (2012).
Physical Chemistry 3rd Ed.,	Mortimer, R. G.	Elsevier: NOIDA, UP (2009).
Physical Chemistry 6th Ed.,	Levine, I. N.	Tata McGraw-Hill (2011).
Physical Chemistry 2nd Ed.,	Metz, C. R.	Tata McGraw-Hill (2009).

Course Name:	Creativity, Problem Solving & Innovation
Course Code:	SEPD4010
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
3	0	0	3	100	00	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To help learners to

- achieve expertise with the technicalities of creativity and problem solving.
- advance an assertiveness for innovation.
- advance creative thinking skills using shaft of learning components leading to understanding of plans of creativity, problem solving and innovation
- discuss uses of the concepts of creativity and problem-solving skills in personal, social, academic, and profession life

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Introduction to Creativity, Problem Solving and Innovation** • Definitions of problem solving, Creativity and Innovation • Need for Problem Solving and Innovation & Scope of creativity • Types and Styles of Thinking • Strategies to develop Creativity, Problem Solving and Innovation skills	8	17
2	**Questioning and Learning** • Introduction to questioning, learning and visualization and its strategies • Sources and methods of questioning and learning • Finding perspective, Visualizing thinking • Mind Mapping	7	16
3	**Creative Thinking and Problem Solving** • Need of creative thinking • Cracking Creativity - Reversals, Reversing Perspective, seeing all sides, Looking in other world • Finding what you are not looking for and following up • Fishbone diagram • SCAMPER Technique	8	17
Section-II			
4	**Logic and Reasoning** • Basic concept of Logic • Divergent Vs Convergent Thinking, Inductive Vs	8	17

	• Deductive thinking Fusion of ideas for problem solving • Moral Reasoning • Improvisation		
5	**Practices of Playing** • Collaboration and Brainstorming • The Spirit of Koinonia • QFT Model • Connecting the unconnected • Making novel combinations	7	16
6	**Review Strategies for Creative problem-solving methods** • A Heuristic technique • Problem-Solving Strategies: Why Bother? • Five building blocks as per Fogler & LeBlanc. • Strategy for critical thinking for Choosing • Lateral Thinking • Six thinking hats by Edward de Bono • Design Thinking	7	17

Text Book(s):

Title	Authors	Publisher
Thinker Toys	Michael Michalko	Random House Publication 2006
Crackling Creativity, The Secrets of Creative Genus	Michael Michalko	Ten Speed Press 2001

Reference Book(s):

Title	Author/s	Publication
Zig Zag, The Surprising Path to Greater Creativity	R Keith Sawyer	Jossy-Bass Publication 2013
De Bono's Thinking Course	Edward De Bono	Penguin Publication 1994
Six Thinking Hats	Edward De Bono	Penguin Publication 1999
How to Mind Map	Tony Buzan	Thorsons Publication 2002
The Myths of Innovation	Scott Berkum	Berkun Publication 2010
Creative confidence: Unleashing the creative Potential within Us all	Tom Kelly and David Kelly	William Collins Publication 2013
The all Laughed	Ira Flatow	Harper Publication 1992
The Ultimate Lateral & Critical Thinking Puzzle book	Paul Sloane, Des MacHale & M.A. DiSpezio	Sterling Publication 2002

Course Evaluation:

Section	Module No.	Evaluation Criteria	Marks
1	1	Group Activity on Brainstorming	15
	2	Mind Mapping Activity	10
	3	Chart Preparation on 'Practicality of Fishbone Diagram'	15
		Group presentation on 'SCAMPER Technique & its applications'	10
2	1	Group Presentation on Critical Analysis of a Govt. scheme/ policy/ budget (merit/ demerit, pros/cons etc.)	15
	2	Group Discussion/ Debate/ Elocution	10
	3	Problem Solving Activity (Individual)	10
		Presentation (Learning Outcomes)	15
Grand Total			100

Course Outcome(s):

After completion of the course, the student will be able to -

- Establish creativity in their day-to-day actions and educational output
- Solve all types of problems with an optimistic and an impartial attitude
- Reflect innovatively and work towards problem solving in a tactical way
- Initiate different and advanced practices in their selected field of profession

Course Name:	Foreign Language 1
Course Code:	CFLS3010
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	02	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To help learner to

- develop and integrate the use of the four language skills i.e. listening, speaking, reading and writing.
- use the language effectively and appropriately on topics of everyday life situations.
- develop an interest in the appreciation of German.
- develop an intercultural awareness.
- enhance the ability of the candidates to express their ideas and feelings in their own wordsand for them to understand the use of correct language.
- appreciate the language as an effective means of communication.
- understand language when spoken at normal conversational speed in everyday lifesituations.
- understand the basic structural patterns of the language, vocabulary and constructions.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to German** • Alphabets • German accents • German Numbers • What are the similarities and differences between English and German? • Greetings	2	15
2.	**German Time** • Basic Introduction	2	08
3.	**Vocabulary part-1** • The days of the week	2	05

	• The months of the year • Seasons • Directions & Weather		
4.	**Vocabulary part-2** • Family • Colors and Shapes • Day/time indicators • Body parts • Clothing	2	07
5.	**Vocabulary Part-3** • Food and Meals • Fruits, Vegetables and Meats • Sports and Hobbies	2	05
6.	• Transportation • House and Furniture	2	05
7.	• School Subject • Places • Common Expressions	2	05
Section II			
Module No.	Content	Hours	Weightage in %
1.	**German grammar** • Verb Sein (to be) • Verb Haben (to have) • Introduction of Regular verbs and Irregular verb • Konjugation of Regular verb • First group verbs('EN' group)	2	10
2.	• Konjugation of Regular verbs • Second group verbs('Ten/Den' group) • Konjugation of Irregular verbs • Third group verbs (Stem change verb) • Fourth group verbs (Spell Change Verb)	2	10
3.	• Nicht trennbare und trennbare Verben • Die Modalverben • Personalpronomen-Nominativ	2	10
4.	• W-Frage • Ja/Nein-Fragen • Nomen und Artikel-Nominativ • Die Anrede	2	10

5.	• Nomen-Genusregein • Adjektiv • Nomen und Artikel-Akkusativ • Personalpronomen-Akkusativ	2	10
6.	• Practice of Writing • Practice of Speaking	2	-
7.	• Practice of Listening	2	-
8.	• Practice of Reading	2	-

Text Book(s):

Title	Author/s	Publication
Namaste German	Yoshita Dalal	Yoshita Dalal

Reference Book(s):

Title	Author/s	Publication
Fit In Deutsch	**Hueber**	**Goyal Publication**

Web Material Links:

- https://www.youtube.com/watch?v=iGovllrEsF8&list=PLRps6yTcWQbpoqIOCmqMeI1HLn LIRmO_t
- https://www.youtube.com/watch?v=GwBfUzPCiaw&list=PL5QyCnFPRx0GxaFjdAVkx7K9Tf EklY4sg

Course Evaluation:

Theory:

- Continuous Evaluation consists of a Test of 30 marks and 1 hour of duration.
- German Speaking Exam consists of 10 marks.
- End Semester Examination will consist of 60 marks Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- demonstrate speaking, reading, writing and listening in German.
- understand German Technology.
- communicate easily in four Language and they can get good job in German Company.
- demonstrate the level of proficiency necessary to enable them to function in an environmentwhere German is used exclusively.

Course Name:	Integrated Personality Development Course (IPDC-I)
Course Code:	SEPD3040
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	1	100	00	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of course is to gain a greater sense of social responsibility, marketable hard and soft skills that would directly apply to their future careers, greater insight and ability to navigate their family, social, and professional relationships along with difficult situations which may arise in their life, a broader sense of self-confidence and a defined identity, To have greater value for living a moral and ethical life based on principles taught in the course.

Course Contents:

Section-I			
Lecture No.	**Content**	**Hours**	**Weightage (%)**
1	Remaking Yourself - Restructuring Yourself	2	50
2	Remaking Yourself - Power of Habit	2	
3	Remaking Yourself - Developing Effective Habits	2	
4	Learning from Legends - Tendulkar and Ratan Tata	2	
5	From House To Home - Affectionate Relationship	2	
6	Facing Failures - Failures are not Always Bad	2	50
7	Facing Failures - Insignificance of Failures.	2	
8	Facing Failures - Insignificance of Failures	2	
9	Facing Failures - Failures can be Overcome	2	
10	Learning from Legends - Yogiji Maharaj and Nelson Mandela.	2	

Course Evaluation:

Theory:

- Continuous Evaluation consists of 40 marks. There will be a mid-term exam which will assess the current progress of students, it assessed out of 20 marks and will be equivalent to 20 marks of the Continuous Course Evaluation (CCE). There will be a submission consisting 10 marks as per the guidelines of course coordinator and average of the attendance consisting 10 marks (minimum 60 percentage attendance is required).
- End semester exam (ESE) part A 30 marks and part B 30 marks.

Course Outcome(s):

CO-1: To provide students with a holistic education – focused on increasing their intelligence quotient, physical quotient, emotional quotient and spiritual quotient IP.
CO-2: To provide students with hard and soft skills, making them more marketable when entering the workforce
CO-3: To educate students on their social responsibilities as citizens of India
CO-4: To provide students with a value-based education that will enable them to be successful in their family, professional, and social relationships.
CO-5: To teach self-analysis and self-improvement exercises to enhance the potential of the participants.

Course Name:	Global Communication Skills
Course Code:	CFLS1020
Prerequisite:	Linguistic Proficiency

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To help learners to

- hone basic communication skills by exposing them to the key communication techniques.
- improvise comprehension and expressional skills which are required for personal, social, academic and professional environment.
- sharpen communication skills with reference to organizational structure.
- show the importance of team work and give practice in group communication with reference to group dynamics.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Introduction to Communication Skills** • Concept and Process of Communication • Types of Communication • Principles of Effective Communication • Barriers to Communication	05	33
2	**Interpersonal Organizational Communication** • Styles and Flows of Communication • Essentials of Organizational Communication • Kinesics, Proxemics and Chronemics	03	20
3	**Team/ Group Dynamics and Leadership** • Types of Groups and Essentials of Group Work and Networking • Concept and Types of Leadership • Traits of an Effective Leader	03	20
4	**Presentation Skills** • Modes, Means and Purposes of Presentation • Audience Analysis and Content Organization • Visual aids and Nuances of Delivery • Non-Verbal Cues for Effective Presentation	04	27
5	**Writing Skills** • Technical Writing: Application, Report Writing, Dialogue Writing, Movie Review, Book Review, Letter Writing	07	20

Text Book(s):

Title	Author/s	Publication
Practical Techniques to Develop Communication Skills	ParulPopat& Kaushal Kotadia	PothiPrakashan, 2015

Reference Book(s):

Title	Author/s	Publication
Communication Skills	ParulPopat& Kaushal Kotadia	Pearson, 2015
Communication Skills, Second Edition	Sanjay Kumar, PushpLata	Oxford University Press,2015
Communication Skills for Engineers	Sunita Mishra	Pearson, 2011
Effective Interpersonal and Team Communication Skills for Engineers	Clifford Whitcomb, Leslie E. Whitcomb	John Wiley & Sons, 2012

Web Material Link (s):

- http://www.mindtools.com/page8.html
- http://techpreparation.com/soft-skills.htm?gclid=CJf34fyQv5wCFdMtpAodjjX_tA
- http://lorien.ncl.ac.uk/ming/Dept/Tips/present/comms.htm

Course Evaluation:
Theory:

- Continuous Evaluation consists of 40 marks. This carries two tests/ presentations/group discussions each of 20 marks.
- End Semester Examination comprising of 60 marks will carry application based and skill testing questions.

Course Outcome(s):
Students will be able to

- follow the process of communication and its components in organizational context.
- express themselves and to participate in the classroom discussions and other such academic activities.
- comprehend whatever they receive from Informal Interactions with the family, teachers and friends; and from Formal Communications taking Place in Lectures, Laboratories and the like.
- enhance the teamwork and collaborative attitude.
- communicate effectively using suitable styles and techniques.
- able to participate in the group discussions and other such academic or academic support activities.
- use language effectively with reference to communication in groups and group behavior.

Sem-4

Course Name:	Inorganic Chemistry-III
Course Code:	SSCH2022
Prerequisite:	Inorganic Chemistry-II

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to learn about the dual nature of electrons and various principles associated with it, quantum chemistry through various postulates, and wave equations, Theories such as VBT, CFT, LFT; metal ores, isolation, extraction and purification of metals.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Structure of Atom - Wave Mechanical Approach** Wave mechanical concept of atom, Derive de Broglie equation, Applications of de Broglie concept, Wave nature of electron, Davison and Germers Experiment, Heisenberg's Uncertainty Principle, Mathematical relation of Heisenberg equation, Applications of Uncertainty principle, Examples of Uncertainty principle.	6	20
2	**Quantum Chemistry** Postulates of wave mechanics, Derivation of Schrödinger's wave equation, Significance of ψ and ψ^2, eigen value and eigen function, Normalization, Orthogonality, Degeneracy, Forbidden transition, Definition and derivation (Operators, Linear Operators, Commutator Operators, Laplacian Operators, Hamiltonian Operators, Hermition Operators	8	26
Section-II			
3	**Co-Ordination Chemistry – II** Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal Field Theory (CFT), Theoretical principles of CFT, CFT of weak and strong field compounds: Splitting pattern in (i) Octahedral (Oh), (ii) Tetrahedral (Td), and (iii) Square planar Factor affecting on 10 Dq or Δ, measurement of 10 Dq (Δo), Application of Crystal Field Theory (including Jahn Teller effects and distortions in on Complexes), failures of CFT, comparison of VB and CFT theory, Ligand Field Theory (LFT), Application of Co-ordination compounds	8	27
4	**Metallurgy** Introduction to study of metal, Physical & Chemical properties of metals, Metallic bond, Occurrence of Metals in nature, Ores, Concentration of		

	Ores, Fluxes, Furnaces, Smelting, Methods of extraction of Metals from their Ores, Methods of reduction of the processed ore, Goldschmidt Thermite process, Methods of purification of metals by Thermal and Electrolytic refining, Alloy, Importance of alloy preparation, Method of preparation of alloy, Examples of some important alloys.	8	27

Course outcome:

CO-1: To study about atomic structure wave mechanically
CO-2: To give introductory information about quantum chemistry.
CO-3: To enhance the knowledge about co-ordination chemistry
CO-4: To study about metallurgy

Reference Books:

Title	Authors	Publisher
Advance Inorganic Chemistry (volume I)	Gurdeep Raj	GOEL pub
Engineering Chemistry (16^{th} Edition)	P.C. Jain and Monika Jain	Dhanpat Rai publishing company
Shriver and Atkins' Inorganic Chemistry (5^{th} ed.)	P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller, and F.A. Armstrong	Oxford University Press
Advanced Inorganic Chemistry, 6^{th} ed.	F. A. Cotton, G. Wilkinson, C. Murillo and M. Bochman	John Wiley, New York
Concise Inorganic Chemistry	J. D. Lee	Blackwell Science

Course Name:	Chemistry of *p*-block elements
Course Code:	SSCH2040
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to study about P- Block elements, unique features of nitrogen, phosphorous and sulphur, to understand role of halogens in molecules, their general characteristics, electronic nature, oxidizing power, and inter-halogen compounds. Molecular shapes of noble gases, occurrence, properties and preparation will also be known.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Chemistry of Group 13 & 14 elements** Chemistry of boron – Borane, higher boranes- carboranes- borazines and boron nitrides. Aluminium-amphoteric behavior- aluminates. Group 14 (carbon group)- catenation and hetero-catenation - allotropy of carbon- carbides salt- like carbides interstitial carbides- covalent carbides. Chemistry of silicon – silanes- higher silanes- multiple bonded systems- disilanes- silicon nitrides- siloxanes and silicates, P-N compounds- cyclophosphazenes and cyclophosphazanes, S-N compounds –S_4N_4, $(SN)_x$.	8	27
2	**Chemistry of Groups 15 & 16 Elements** General characteristics- unique features of nitrogen- a comparative study of hydrides- preparations- properties and uses of N_2H_4 - NH_2OH- HN_3 - oxo acids of nitrogen - nitric acid- oxidizing properties - structures of oxides and oxoacids of phosphorus and nitrogen -halides of phosphorus -phosphazenes. Gradient in properties, oxidation state- differences between oxygen and other elements- chemistry of ozone and H_2O_2– oxides of sulphur thionyl and sulphuryl chlorides-oxoacids of sulphur- sulphuric- permono- perdisulphuric acid SF_6 - SCl_2 - S_2Cl_2 - preparation- properties and structures.	12	40
Section-II			
3	**Chemistry of Halogen and Noble gas Elements** **Halogen elements** General characteristics of halogen with reference to electronegativity- electron affinity- oxidation states and oxidizing power, Peculiarities of fluorine, hydrides, oxides and oxo acids of halogens, Inter halogen compounds and pseudo halogens- Basic nature of iodine.	10	33

	Noble gases Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2, XeF_4 and XeF_6 Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds (VSEPR theory).		

Course outcome:

CO-1: To study the chemistry of group 13 and 14 elements.
CO-2: To learn the chemistry of group 15 and 16 elements.
CO-3: To introduce the chemistry of halogen and noble gases.

Reference Books:

Title	Authors	Publisher
Advance Inorganic Chemistry (volume I)	Gurdeep Raj	GOEL pub
Engineering Chemistry (16^{th} Edition)	P.C. Jain and Monika Jain	Dhanpat Rai publishing company
Shriver and Atkins' Inorganic Chemistry (5^{th} ed.)	P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller, and F.A. Armstrong	Oxford University Press
Advanced Inorganic Chemistry, 6^{th} ed.	F. A. Cotton, G. Wilkinson, C. Murillo and M. Bochman	John Wiley, New York
Concise Inorganic Chemistry	J. D. Lee	Blackwell Science

Course Name:	Inorganic Chemistry Practical – II
Course Code:	SSCH2061
Prerequisite:	Inorganic Chemistry Practical

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist the students to understand about quantum chemistry, volumetric and gravimetric analysis, and Qualitative analysis of the mixture of 4 radicals.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1.	Quantum chemistry Dry lab: Build organic component model and calculate bond length, bond order, bond angle, Dihedral Angles and steric energy.	**6**
2.	Quantum chemistry Dry lab: Calculate energy of minimization, stretch, Bend, Torsion and 1, 4 van der walls.	**6**
Section-II		
3.	Volumetric exercise: To determine the amount of Copper by EDTA	**6**
4.	Volumetric exercise: To determine the amount of Nickel by EDTA	**6**
5.	Gravimetric determination of Ba^{+2} as $BaSO_4$	**6**
6.	Qualitative Analysis: Analysis of Mixture containing 4 radicals	**6**
7.	Qualitative Analysis: Analysis of Mixture containing 4 radicals	**6**
8.	Qualitative Analysis: Analysis of Mixture containing 4 radicals	**6**
9.	Qualitative Analysis: Analysis of Mixture containing 4 radicals	**6**
10.	Qualitative Analysis: Analysis of Mixture containing 4 radicals	**6**

Course outcome:

CO-1: To build model organic components.
CO-2: To perform volumetric and gravimetric titrations.
CO-3: To perform qualitative analysis

Reference Books:

Title	Authors	Publisher
Advance Inorganic Chemistry (volume I)	Gurdeep Raj	GOEL pub
Engineering Chemistry (16th Edition)	P.C. Jain and Monika Jain	Dhanpat Rai publishing company
Shriver and Atkins' Inorganic Chemistry (5th ed.)	P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller, and F.A. Armstrong	Oxford University Press
Advanced Inorganic Chemistry, 6th ed.	F. A. Cotton, G. Wilkinson, C. Murillo and M. Bochman	John Wiley, New York
Concise Inorganic Chemistry	J. D. Lee	Blackwell Science

Course Name:	Nitrogen containing functional group and polyaromatic hydrocarbon in organic chemistry
Course Code:	SSCH2080
Prerequisite:	Functional group in Organic Chemistry

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to gain the knowledge of nomenclature, preparation, and stability factor; physical and chemical properties of Nitroalkanes, Diazoalkanes and Azides. Classification, preparation of amines and separate them and some specific reaction about alkyl amine and aryl amine, The students can understand the importance of diazotization and the condition to do it. To know about the reaction of diazonium salt, Nomenclature and preparation of the Naphthalene, anthracene, phenanthrene. Also know about different derivatives preparation and uses of them.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Nitroalkanes, Diazoalkanes and Azides** Nomenclature, Isomerism, Structure, Preparation, physical properties and chemical reactions of nitroalkanes, Application of Nitroalkanes, Distinguish Nitroalkane and alkyl nitrites, Introduction to Diazoalkanes, Structure of Diazomethane, Physical properties of Diazomethane, Synthesis of Diazomethane, Azide, Structure of Azide, Physical properties of Azide, Synthesis of Azide	6	20
2	**Amines**: **Aliphatic Amines** Classification of amines, Nomenclature, Isomerism, Structure, Methods of preparation of primary, secondary and tertiary amines, how to separate mixtures of amines, Physical and chemical properties of amine **Aromatic Amines** Introduction and structure of aromatic amines, Nomenclature, Methods of preparation of mono- secondary and tertiaryamines, Physical and chemical properties of amine, Reactions involving the benzene ring (Bromination, Nitration, Sulphonation, Hofmann-Martins Rearrangement)	10	33
Section-II			
3	**Diazonium Salts**: Mechanism of diazotization, reagents for checking completion of diazotization, Nomenclature of Diazonium salts, Reactions of Diazonium salts, replacement reactions in which nitrogen is eliminated, its application in the synthesis of aromatic compounds, reaction in which nitrogen atom are retained, Benzidine rearrangement	4	13

4	**Polynuclear Aromatic Hydrocarbons (PAH)** **Naphthalene** Nomenclature and Derivatives, Structure of Naphthalene, Synthesis of Naphthalene, Physical Properties of Naphthalene, Chemical reaction of Naphthalene, Uses of Naphthalene, Substitution in Naphthalene Derivatives, Important derivatives of naphthalene (α-Naphthol, β-Naphthol) Synthesis, Physical properties, Chemical properties, Reactions and Uses of α-Naphthol and β-Naphthol. **Anthracene** Introduction, Structure of anthracene, Synthesis of anthracene, Physical and chemical properties of Anthracene, Uses, Important derivatives of anthracene (Only 9,10-Anthraquinone), Preparation of 9,10-Anthraquinone, Physical and chemical properties of 9,10-Anthraquinone, Reactions of 9,10-Anthraquinone, Uses. **Phenanthrene** Introduction, Structure, Synthesis of Phenanthrene, Physical, Chemical properties and Reactions of phenanthrene	10	34

Course outcome:

CO-1: To study different reaction and types of Nitroalkanes, Diazoalkanes and Azides and their derivatives
CO-2: To know about alkyl amine and aryl amine and their reactions and uses.
CO-3: To well aware with very useful diazotization reaction
CO-4: To study the Polynuclear Hydrocarbon like Naphthalene, anthracene and phenanthrene.

Reference Books:

Title	Authors	Publisher
Advanced organic chemistry	Arun Bahl and B S Bahl	S. Chand
Organic Chemistry (7th Ed.)	Robert Neilson Boyd, Saibal Kanti Robert, Thornton Morrison	Pearson
Basic principles of organic chemistry (2nd Ed.)	John D. Roberts, Marjorie C. Caserio	Imprint unknown
Organic Chemistry (3rd Ed.)	Dr. David Klein	Wiley
Organic Reaction Mechanisms (4th Ed.)	V. K. Ahluwalia, R. K. Parashar	Narosa
Reaction Mechanisms in Organic Synthesis	Rakesh Kumar Parashar	A John Wiley and Sons Ltd.

Course Name:	Reaction Intermediates in Organic Chemistry
Course Code:	SSCH2100
Prerequisite:	Functional group in Organic Chemistry

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to understand all concept of carbocation such as generation, stability comparison of carbocation etc. The students will be aware with all concept of carbanion, relative stability of free radicals, reaction mechanism etc. and generation, reactions of carbene.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Carbocation** Stability, Generation, Reactions and applications of Carbocations	8	27
2	**Carbanion** Stability, Generation, Reactions of Carbanion.	8	27
Section-II			
3	**Free radicals** Stability, Generation, Reactions, Mechanism and applications of Carbocations	8	27
4	**Carbenes** Stability, Generation, Reactions of Carbenes	6	19

Course outcome:

CO-1: To explain stability of carbocation of primary, secondary and Tertiary, application of carbocation.
CO-2: To Discuss about generation of carbanions and their various chemical reactions
CO-3: Short lived radicals to be discussed with various point of view
CO-4: To explain detailed information of carbene

Reference Books:

Title	Authors	Publisher
Advanced organic chemistry	Arun Bahl and B S Bahl	S. Chand
Organic Chemistry (7^{th} Ed.)	Robert Neilson Boyd, Saibal Kanti Robert, Thornton Morrison	Pearson
Basic principles of organic chemistry (2^{nd} Ed.)	John D. Roberts, Marjorie C. Caserio	Imprint unknown
Organic Chemistry (3rd Ed.)	Dr. David Klein	Wiley
Organic Reaction Mechanisms (4^{th} Ed.)	V. K. Ahluwalia, R. K. Parashar	Narosa
Reaction Mechanisms in Organic Synthesis	Rakesh Kumar Parashar	A Jhon Wiley and Sons Ltd.

Course Name:	Organic Chemistry Practical – II
Course Code:	SSCH2121
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to assist the students to do practical of determination and find %purity with calculation, type determination and learn how to separate binary mixture of different types such as Acid+Base, Acid + Phenol, Acid + Neutral etc.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1.	Organic estimations: To determine the amount of Acetamide in the given solution	**6**
2.	Organic estimations: To determine the amount of Glucose in the given solution by hypoiodite	**6**
3.	Preparation of thallic anhydride from thallic acid.	**6**
4.	Preparation of 2-hydroxybenzoic acid from methyl 2-hydroxybenzoate and identify with	**6**
Section-II		
5.	Organic spotting (mixture of 2 substances) & preparation of derivative (6 compounds * 6 hrs.) Acid+ Base Acid+ Phenol Base + Neutral Neutral+ Neutral	**36**

Course outcome:

CO-1: To give practical knowledge of determination and find %purity with calculation
CO-2: To explain how to determine the type of organic binary mixture. After of type how to seperate it

Reference Books:

Title	Authors	Publisher
Advanced organic chemistry	Arun Bahl and B S Bahl	S. Chand
Organic Chemistry (7^{th} Ed.)	Robert Neilson Boyd, Saibal Kanti Robert, Thornton Morrison	Pearson

Basic principles of organic chemistry (2nd Ed.)	John D. Roberts, Marjorie C. Caserio	
Organic Chemistry (3rd Ed.)	Dr. David Klein	Wiley
Organic Reaction Mechanisms (4th Ed.)	V. K. Ahluwalia, R. K. Parashar	Narosa
Reaction Mechanisms in Organic Synthesis	Rakesh Kumar Parashar	A Jhon Wiley and Sons Ltd.

Course Name:	Electrochemistry
Course Code:	SSCH2140
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is that the students to recall their concepts on Electrochemistry. To describe "oxidation" and "reduction" and the functions of the various components of simple voltaic and electrolytic cells. To apply Electrochemistry for various applications.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Electrolysis and Electrical Conductance** Mechanism of electrolysis, Electrical units, Faraday's laws of Electrolysis, Faraday's first law, Faraday's second law, Importance of the first Law of electrolysis, Importance of the second, Law of electrolysis, Conductance of Electrolytes, Specific conductance, Equivalent conductance, Summary of Electrochemical, Quantities Strong electrolytes, Weak electrolytes, Measurement of Electrolytic conductance, Determination of the cell Constant.	7	23
2	**Electrolytic Dissociation** Arrhenius theory of Ionisation, Migration of ions, mobilities and their determinations, Relative speed of ions, Transport Number, Determination of Transport number using Hittorf's method and Moving boundary Method, Kohlrausch's law, Applications of Kohlrausch's law, Conductometric Titrations, Advantages of Conductometric titrations, Differences between conductometric and volumetric titrations.	7	23
Section-II			
3	**Electrochemical Cell** Cell terminology (Current, Electrode, Anode, Cathode, Electrolyte, Anode compartment, Cathode compartment, Half-cell), Rules of oxidation/reduction of ions based on half-cell potentials, Production of current via chemical reaction, Voltaic cell, Danial Cell, Cell potential or Electromotive force, Cell diagram or Representation of a Cell, Sign of emf value, Measurement of EMF of cell, Reversible cell, Relation between emf and free energy, Single electrode potential, Standard emf of a cell, Determination of emf of a half-cell, Use of standard potentials, Nernst equation, Calculation of Equilibrium constant for the cell reaction, Reference electrodes (Standard Silver-Silver Electrode,	16	54

	Calomel electrode, Using of SCE instead of SHE, Merits and demerits, Glass electrodes, Using of glass electrodes, Merits and demerits of Glass electrode, quinone-hydroquinone, Using of Quinhydrone electrode, Merits and demerits of Quinhydrone electrode, Determination of pH of a solution, Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation), and Examples		

Course outcome:

CO-1: To establish and develop the principles those are used to explain and interpret many of the physical and chemical observations.
CO-2: To explain many of the proposed hypotheses in terms of fundamental concepts.
CO-3: To provide a clear and incisive treatment of fundamental principles at the level of post-graduation.
CO-4: To impart correctness and depth of sophistication of conceptual arguments in Physical Chemistry.

Reference Books:

Title	Authors	Publisher
Essentials of Physical Chemistry	A. Bahl, B. S. Bahl and G. D. Tuli	S. Chand Publishing
Atkins' Physical Chemistry 10th Edition	Peter Atkins and Julio de Paula	Oxford University Press
Engineering Chemistry (16th Edition)	P.C. Jain and Monika Jain	Dhanpat Rai publishing company
Principles of Polymer Science	P Bahadur, N. V. Sastry	Narosa
Polymer Science	V. R. Gowariker, N. V. Viswanathan, J. Sreedhar	New Age International
Physical Chemistry 3rd Ed.,	T. Engel & P. Reid	Prentice-Hall
Advanced Practical Physical Chemistry	J. B. Yadav	Krishna Prakashan Media

Course Name:	Physical Chemistry – III
Course Code:	SSCH2160
Prerequisite:	Concepts in Physical Chemistry -II

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to design and development of solid materials with pre-required properties based on the structure of solids. Analyze the physical-chemical, unique optical, electrical, magnetic, thermal, and mechanical properties of solids, Students will recognize the general properties of macromolecules. The student will obtain required knowledge for understanding material science problems. With knowledge on thermochemistry, students will learn about the required conditions for carrying out a reaction and basic information on heat of reactions.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Solid State** Nature of the solid state, law of constancy of interfacial angles, law of rational indices, elementary ideas of symmetry, symmetry elements and symmetry operations, Miller indices, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices, Cubic unit cell, Coordination number of a crystal lattice, X-ray diffraction, Bragg's law, Derivation of Bragg equation, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl and CsCl, Lattice energy of an ionic crystal (Born- Haber Cycle), Defects in crystals, liquid crystals, Types and applications, Examples.	10	40
2	**Polymers** Introduction, Classification of polymers, Nomenclature of polymers, Isomerism in polymer chains, Different Types of polymerization: Addition, Condensation and Coordination polymerization, Phase systems in polymerization, Characterization of polymer, Determination of Molecular Weight of polymers by End group analysis, Colligative properties, Viscometer, and GPC methods.	10	33
Section-II			
3	**Thermochemistry** Introduction, Internal Energy, Unit of Energy, Enthalpy of reaction, Endothermic and Exothermic reactions, Sign and Calculation of ΔH and ΔE, Variation of heat (or enthalpy) of reaction with temperature, Heats of reactions: standard states; enthalpy of formation of molecules and	10	27

	ions and enthalpy of combustion and its applications; Heat of Solution, Neutralization, Fusion, Vaporization, Sublimation, Bond energy, calculation of bond energy, bond dissociation energy, experimental measurement of the heat of reaction by calorimeter and examples.		

Course outcome:

CO-1: To describe general principles and classification of solids, Illustrate the optical, magnetic and electrical properties of solids

CO-2: To understand the fundamentals of biological macromolecules and describe the various process of polymerization reaction. Identify the repeat units of particular polymers and specify the isomeric structures which can exist for those repeat units.

CO-3: To learn and define various common terms in Thermochemistry.

Reference Books:

Title	Authors	Publisher
Essentials of Physical Chemistry	A. Bahl, B. S. Bahl and G. D. Tuli	S. Chand Publishing
Atkins' Physical Chemistry 10th Edition	Peter Atkins and Julio de Paula	Oxford University Press
Engineering Chemistry (16th Edition)	P.C. Jain and Monika Jain	Dhanpat Rai publishing company
Principles of Polymer Science	P Bahadur, N. V. Sastry	Narosa
Polymer Science	V. R. Gowariker, N. V. Viswanathan, J. Sreedhar	New Age International
Physical Chemistry 3rd Ed.,	T. Engel & P. Reid	Prentice-Hall
Advanced Practical Physical Chemistry	J. B. Yadav	Krishna Prakashan Media

Course Name:	Physical Chemistry Practical – III
Course Code:	SSCH2180
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to gain knowledge of scientific experiments as well as accurately record and analyses the results of experiments.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1.	Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.	**6**
2.	Conductometric titrations of Mixture of strong acid and weak acid vs. strong base	**6**
3.	Potentiometric titrations of strong acid vs. strong base	**6**
4.	To determine the amount of HCl and HAc in the given mixture of solutions by pH metrically	**6**
5.	Determine the dissociation constant of a given dibasic acid pH-metrically.	**6**
6.	Potentiometry: To determine the normality of given HCl solution using 0.5N NaOH.	**6**
7.	Potentiometry: To determine the solubility and solubility product of sparingly soluble salt AgCl by the titration of $AgNO_3$ and NaCl.	**6**
8.	Preparation of Phenol/urea formaldehyde.	**6**
9.	Determination of molecular weight of a polymer by Oswald viscometer.	**6**
10.	To determine the Heat of solution of organic acid (benzoic acid, phthalic acid) by finding the solubility of the acid at two different temp.	**6**

Course outcome:

CO-1: To interpret the experimental results obtained by refractometer, spectrophotometer, Ph meter, potentiometer.
CO-2: To conduct the experiment on various instrumental techniques.
CO-3: To describe the principles behind the experiment performed in the laboratory.
CO-4: To impart training in operating different instruments used in the analysis of various chemical constituents

Reference Books:

Title	Authors	Publisher
Essentials of Physical Chemistry	A. Bahl, B. S. Bahl and G. D. Tuli	S. Chand Publishing
Atkins' Physical Chemistry 10th Edition	Peter Atkins and Julio de Paula	Oxford University Press
Engineering Chemistry (16th Edition)	P.C. Jain and Monika Jain	Dhanpat Rai publishing company
Principles of Polymer Science	P Bahadur, N. V. Sastry	Narosa
Polymer Science	V. R. Gowariker, N. V. Viswanathan, J. Sreedhar	New Age International
Physical Chemistry 3rd Ed.,	T. Engel & P. Reid	Prentice-Hall
Advanced Practical Physical Chemistry	J. B. Yadav	Krishna Prakashan Media

Course Name:	Introduction to Industries
Course Code:	SSCH2200
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	100	0	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to understand the importance of industries and their working. Students will be able to improve their presentation skills. Exposure to industries will be an opportunity to realize the actual methods used in industries for bulk and their relation to the small-scale experiments conducted in chemical laboratories.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Food Based Industries** A visit to Food based industry and acquaintance with instruments/ equipment's/ processes/ technology employed.	6	25
2	**Pharmaceutical Industries** A visit to pharmaceutical industry and acquaintance with instruments/ equipment's/ processes/ technology employed.	8	25
Section-II			
3	**Agriculture/Dairy based Industries** A visit to Agriculture based industry and acquaintance with instruments/ equipment's/ processes/ technology employed.	8	25
4	**Chemical Industries** A visit to Chemical industry and acquaintance with instruments/ equipment's/ processes/ technology employed	8	25

Course outcome:

CO-1: To prepare a presentation with complete information on a selected type of industry.
CO-2: To develop the skill of communication in presentation
CO-3: To get in-depth information on industry and go on industrial tour for exposure

Course Evaluation:

Theory:

- Continuous Evaluation consists of 100 marks with a detailed bifurcation of marks as shared below. There will be a mid-term exam which will assess the current progress of students, it assessed out of 100 marks.

Section	Module No.	Evaluation Criteria	Marks
1	1	Case study based detailed research on a specific industrial product or technology in relevance to the current societal needs,	30
	2	Submission of Chapter wise preparation including History of Technology/product, raw materials, process, applications. etc.	30
	3	Submission of assignment (Individual experience during industrial visit and learning outcome)	10
		Presentation (Learning Outcomes)	30
Grand Total			100

Reference Books:

Title	Authors	Publisher
Seven Crisis of Business Strategies for Survival & Growth	V.G. Patel	EDI Ahmedabad
"Small Business Management	Ramchandran	Himalaya Publication

Course Name:	Foreign Language 2
Course Code:	CFLS3021
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	02	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To help learner to

- develop and integrate the use of the four language skills i.e. listening, speaking, reading and writing.
- use the language effectively and appropriately on topics of everyday life situations.
- develop an interest in the appreciation of German.
- develop an intercultural awareness.
- enhance the ability of the candidates to express their ideas and feelings in their own wordsand for them to understand the use of correct language.
- appreciate the language as an effective means of communication.
- understand language when spoken at normal conversational speed in everyday lifesituations.
- understand the basic structural patterns of the language, vocabulary and constructions.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to German** • Alphabets • German accents • German Numbers • What are the similarities and differences between English and German? • Greetings	2	15
2.	**German Time** • Basic Introduction	2	08
3.	**Vocabulary part-1** • The days of the week	2	05

	• The months of the year • Seasons • Directions & Weather		
4.	**Vocabulary part-2** • Family • Colors and Shapes • Day/time indicators • Body parts • Clothing	2	07
5.	**Vocabulary Part-3** • Food and Meals • Fruits, Vegetables and Meats • Sports and Hobbies	2	05
6.	• Transportation • House and Furniture	2	05
7.	• School Subject • Places • Common Expressions	2	05
Section II			
Module No.	Content	Hours	Weightage in %
1.	**German grammar** • Verb Sein (to be) • Verb Haben (to have) • Introduction of Regular verbs and Irregular verb • Konjugation of Regular verb • First group verbs('EN' group)	2	10
2.	• Konjugation of Regular verbs • Second group verbs('Ten/Den' group) • Konjugation of Irregular verbs • Third group verbs (Stem change verb) • Fourth group verbs (Spell Change Verb)	2	10
3.	• Nicht trennbare und trennbare Verben • Die Modalverben • Personalpronomen-Nominativ	2	10
4.	• W-Frage • Ja/Nein-Fragen • Nomen und Artikel-Nominativ • Die Anrede	2	10

5.	• Nomen-Genusregein • Adjektiv • Nomen und Artikel-Akkusativ • Personalpronomen-Akkusativ	2	10
6.	• Practice of Writing • Practice of Speaking	2	-
7.	• Practice of Listening	2	-
8.	• Practice of Reading	2	-

Text Book(s):

Title	Author/s	Publication
Namaste German	Yoshita Dalal	Yoshita Dalal

Reference Book(s):

Title	Author/s	Publication
Fit In Deutsch	**Hueber**	**Goyal Publication**

Web Material Links:

- https://www.youtube.com/watch?v=iGovllrEsF8&list=PLRps6yTcWQbpoqIOCmqMeI1HLn LIRmO_t
- https://www.youtube.com/watch?v=GwBfUzPCiaw&list=PL5QyCnFPRx0GxaFjdAVkx7K9Tf EklY4sg

Course Evaluation:

Theory:

- Continuous Evaluation consists of a Test of 30 marks and 1 hour of duration.
- German Speaking Exam consists of 10 marks.
- End Semester Examination will consist of 60 marks Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- demonstrate speaking, reading, writing and listening in German.
- understand German Technology.
- communicate easily in four Language and they can get good job in German Company.
- demonstrate the level of proficiency necessary to enable them to function in an environmentwhere German is used exclusively.

P P Savani University
School of Sciences
Syllabus, Teaching and Examination Scheme

Course Name:	Integrated Personality Development Course 2 (IPDC-2)
Course Code:	SEPD3050
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	1	100	00	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of the course is to study of to see PPSU students: To have gained a greater sense of social responsibility, marketable hard and soft skills that would directly apply to their future careers, greater insight and ability to navigate their family, social, and professional relationships along with difficult situations which may arise in their life, broader sense of self-confidence and a defined identity, greater value for living a moral and ethical life based on principles taught in the course.

Course Contents:

Lecture No.	Content	Hours
1.	Remaking Yourself - Restructuring Yourself	02
2.	Essentials of Profession -Writing A Resume	02
3.	Financial Wisdom -Basics of Financial Planning.	02
4.	Financial Wisdom -Financial Planning Process.	02
5.	From House To Home -Listening & Understanding.	02
6.	From House To Home -Forgive & Forget.	02
7.	From House To Home –Bonding The Family.	02
8	Soft Skills -Networking, Decision making & Leadership	02
9	Soft Skills -Teamwork, Harmony & Adaptability	02
10	Mass Management – Project Management	02
11	My India My Pride -Glorious Past (Part -1)	02
12	My India My Pride -Glorious Past (Part -2)	02
13	My India My Pride –Present Scenario.	02
14	My India My Pride -An Ideal Citizen-1	02
15	My India My Pride -An Ideal Citizen-2	02

Course Evaluation:

Theory:

- Continuous Evaluation consists of 40 marks. There will be a mid-term exam which will assess the current progress of students, it assessed out of 20 marks and will be equivalent to 20 marks of the Continuous Course Evaluation (CCE). There will be a submission consisting 10 marks as per the guidelines of course coordinator and average of the attendance consisting 10 marks (minimum 60 percentage attendance is required).
- End semester exam (ESE) part A 30 marks and part B 30 marks.

Course Outcome(s):

CO-1: To provide students with a holistic education – focused on increasing their intelligence quotient, physical quotient, emotional quotient and spiritual quotient IP
CO-2: To provide students with hard and soft skills, making them more marketable when entering the workforce
CO-3: To educate students on their social responsibilities as citizens of India
CO-4: To teach self-analysis and self-improvement exercises to enhance the potential of the participants.

Sem-5

Course Name:	Inorganic Chemistry-VI
Course Code:	SSCH3010
Prerequisite:	Periodic properties of s and d block elements

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
3	0	0	3	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To Introduce molecular symmetry, symmetry elements, point groups, as well as to know about non-aqueous solvents and a detailed study on Lanthanides series and Actinides series is included.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Molecular Symmetry** Introduction and importance of symmetry, symmetry elements and symmetry operations, classification of molecules into symmetry point groups. point group of simple molecules like CO_2, HCl, H_2O, NH_3, BF_3, $[PtCl_4]$ 2-, PF_5, Cis- and Trans-dichloro ethylene ($C_2H_2Cl_2$), Staggered and Eclipsed-Ethane (C_2H_6), C_6H_6, $C_5H_5^-$, CH_4 and SF_6. Construction of multiplication table for C_2v, C_2h and C_3v point group.	10	30%
2	**Non-Aqueous Solvents** Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2.	05	20%
Section-II			
3	**Lanthanides** Introduction, electronic structure, Oxidation states, separation of lanthanide elements, Chemical properties of +III compounds, Oxidation state +IV, Oxidation state + II, Solubility, Color and spectra, magnetic properties, Lanthanide contraction, complexes	08	25%
4	**Actinides** Introduction, electronic structure and position in periodic table, Oxidation states, general properties, Uranium (Occurrence, extraction, nuclear fission, chemical properties, hydrides, oxides, halides).	07	25%

Course outcome:

CO-1: The students are able to identify symmetry in molecules and identify symmetry elements in each molecule. They are able to generate point group and multiplication table like C_2V, C_2h and C_3V

CO-2: The learners are well aware about different types of solvent other than water like liquid NH_3 and liquid SO_2.

CO-3: The Students are able to draw electronic structure, Oxidation states, separation and Chemical properties of Lanthanide series. They are also able to check Solubility, Color and spectra, magnetic properties and Lanthanide contraction & complexes for the same.

CO-4: The Students are able to draw electronic structure, Oxidation states, separation and Chemical properties of Actinides series. They are also able to know their general properties and information on their occurrence is also gained.

Reference Books:

Title	Author/s	Publisher
Application of group theory to chemistry	P.K. Bhattacharya	Himalaya Publishing House, Mumbai.
Inorganic Chemistry	Purcell, K.F &Kotz, J.C.	W.B. Saunders Co, 1977.
Advanced Inorganic Chemistry.	Cotton and Wilkinson	John Wiley& Sons
Basic Inorganic Chemistry	Cotton and Wilkinson.	John Wiley & Sons
A Text book of Inorganic Chemistry	P.L. Soni.	Sultan Chand & Sons
Coordination Chemistry.	D. Banerjea	Asian Books private limited
College Inorganic Chemistry (T.Y.B.Sc.) 17th Ed.	Laxmi Devi, Patel and Dhume	Himalaya Publishing House, Mumbai.

Course Name:	Inorganic Chemistry-VII
Course Code:	SSCH3030
Prerequisite:	Inorganic Chemistry-VI

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To study Mass spectroscopy, molecular spectroscopy, rotational spectroscopy and vibrational spectroscopy, along with Organometallic complexes

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1.	**Mass spectroscopy:** Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).	10	33%
Section-II			
2.	**Molecular spectroscopy** Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. **Rotation spectroscopy:** Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. **Vibrational spectroscopy:** Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.	12	40%
3.	**Organometallic compounds** Definition, Classification, Importance of Organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn. Metal carbonyls: 18 electron rule, preparation, structure and nature of bonding in the mononuclear carbonyls.	08	27%

Course outcome:

CO-1: The students will learn in depth about mass spectrometry and its applications.
CO-2: The students can analyze different material with the help of different spectroscopy and their special uses via interpretation of the spectra.
CO-3: The students will gain knowledge about organometallic compounds, their preparation, classification, bonding and structure.

Reference Books:

Title	Author/s	Publisher
Application of group theory to chemistry	P.K. Bhattacharya	Himalaya Publishing House, Mumbai.
Inorganic Chemistry	Purcell, K.F &Kotz, J.C.	W.B. Saunders Co, 1977.
Advanced Inorganic Chemistry.	Cotton and Wilkinson	John Wiley& Sons
Basic Inorganic Chemistry	Cotton and Wilkinson.	John Wiley & Sons
A Text book of Inorganic Chemistry	P.L. Soni.	Sultan Chand & Sons
Coordination Chemistry.	D. Banerjea	Asian Books private limited
College Inorganic Chemistry (T.Y.B.Sc.) 17th Ed.	Laxmi Devi, Patel and Dhume	Himalaya Publishing House, Mumbai.

Course Name:	Inorganic Chemistry Practical
Course Code:	SSCH3050
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To study Gravimetric Estimations, Volumetric Estimations, Inorganic Qualitative Analysis of mixture and Estimation of alloy.

Course Contents:

Module	Name of the practical	Hours
	Gravimetric Estimations:	
1.	Gravimetric Estimation of Fe^{+2} as Fe_2O_3 from $FeSO_4(NH_4)2SO_4$ +$CuSO_4$	**06**
2.	Gravimetric Estimation of Ba^{+2} as $BaSO_4$ from $BaCl_2$ + $FeCl_3$	**06**
	Volumetric Exercise:	
3.	To determine the amount of Ferric by EDTA	**06**
4.	To determine the amount of Cobalt using Xylenol Orange indicator	**06**
	Inorganic Qualitative Analysis:	
5.	Inorganic Qualitative analysis of mixture containing 3 cations and 3 anions (4 mixtures) They may be soluble in water or dilute hydrochloric acid or concentrated hydrochloric acid including Chromate and Borate. List of Inorganic Chemicals used for Inorganic Qualitative Analysis is as follows: CHLORIDES: Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Ba^{2+}, Sr^{2+}, Na^{+}, K^{+}, NH_4^{+} BROMIDES: Sr^{2+}, Na^{+}, K^{+}, NH_4^{+} IODIDE: K^{+} NITRATE: Pb^{+2}, Bi^{+3}, Co^{+2}, Ni^{+2}, Ba^{+2}, Sr^{2+}, Na^{+}, K^{+}, NH_4^{+} NITRITE: Na^{+} SULPHITE: Na^{+} SULPHIDE: Zn^{+2}, Sb^{+3} SULPHATE: Cu^{+2}, Cd^{+2}, Al^{+3}, Fe^{+2}, Zn^{+2}, Mn^{+2}, Co^{+2}, Ni^{+2}, Mg^{+2}, Na^{+}, K^{+}, NH_4^{+} CARBONATE: Pb^{+2}, Bi^{+3}, Cu^{+2}, Cd^{+2}, Zn^{+2}, Mn^{+2}, Co^{+2}, Ni^{+2}, Ca^{+2}, Ba^{+2}, Sr^{2+}, Mg^{+2}, Na+, K+, NH_4^{+} PHOSPHATE : Cu^{+2}, Al^{+3}, Fe^{+3}, Zn^{+2}, Mn^{+2}, Co^{+2}, Ni^{+2}, Ca^{+2}, Ba^{+2}, Sr^{2+}, Mg^{+2}, Na^{+}, K^{+} , NH_4^{+} BORATE: Boric Acid CHROMATE: Na^{+}, K^{+} OXIDE: As^{+3}, Sb^{+3}	**30**
	Estimation of alloy:	

6.	Brass	
	(i) Gravimetric estimation of Zn^{+2} as $Zn_2P_2O_7$	**06**
	(ii) Volumetric estimation of Cu^{+2} Iodometrically	**06**

Course outcome:

CO-1: The students are able to estimate ions like Fe^{+2} and Ba^{+2} via Gravimetric method.
CO-2: The learners are able to estimate ferric and cobalt using Volumetric method.
CO-3: The students will learn about separation of inorganic mixtures through a series of tests.
CO-4: The learners can perform estimation of brass alloy via volumetric and gravimetric method.

Reference Books:

Title	Authors	Publisher
Application of group theory to chemistry	P.K. Bhattacharya	Himalaya Publishing House, Mumbai.
Inorganic Chemistry	Purcell, K.F &Kotz, J.C.	W.B. Saunders Co, 1977.
Advanced Inorganic Chemistry.	Cotton and Wilkinson	John Wiley& Sons
Basic Inorganic Chemistry	Cotton and Wilkinson.	John Wiley & Sons
A Text book of Inorganic Chemistry	P.L. Soni.	Sultan Chand & Sons
Coordination Chemistry.	D. Banerjea	Asian Books private limited
College Inorganic Chemistry (T.Y.B.Sc.) 17th Ed.	Laxmi Devi, Patel and Dhume	Himalaya Publishing House, Mumbai.

Course Name:	Organic Chemistry-VI
Course Code:	SSCH3070
Prerequisite:	Functional group in Organic Chemistry

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
3	0	0	3	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

This course is designed to introduce green chemistry and its importance is conveyed through examples of green synthesis. Detailed study on Heterocyclic compounds with a specific reference to organosulphur compounds is included.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1.	**Introduction to Green Chemistry** What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.	06	20%
2.	**Green Synthesis** Green Synthesis of the following compounds: adipic acid, catechol, BHT, methyl methacrylate, urethane, aromatic amines (4-aminodiphenylamine), benzyl bromide, acetaldehyde, disodium iminodiacetate (alternative to Strecker synthesis), citral, ibuprofen, paracetamol, furfural. **Microwave assisted reactions in water:** Hofmann Elimination, Hydrolysis (of benzyl chloride, benzamide, n-phenyl benzamide, methylbenzoate to benzoic acid), Oxidation (of toluene, alcohols). **Microwave assisted reactions in organic solvents:** Esterification, Fries rearrangement, Orthoester Claisen Rearrangement, Diels-Alder Reaction, Decarboxylation.	08	27%
Section-II			
3.	**Heterocyclic compounds** Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure	10	33%

	elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction. Derivatives of furan: Furfural and furoic acid.		
4.	**Organosulphur Compounds** Nomenclature, structural formation, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and Sulphaguanidine.	06	20%

Course outcome:

CO-1: The students have awareness about green chemistry, hazardousness of red chemistry and the obstacles faced in green synthesis

CO-2: Learned various examples of green route synthesis like incorporation of microwave method than traditional heating and its advantages.

CO-3: Basic understanding about heteroatoms and heterocyclic compounds will be enhanced. Moreover, students will come to know about five-membered and six-membered heterocyclic synthesis

CO-4: Students will understand about the organosulphur compounds like sulphonamides and sulphaguanidines which are used in medication therapies

Reference Books:

Title	Author/s	Publisher
Green Chemistry : Environmentally Bening Reactions	V.K.Ahluwalia	Ane Books pvt Ltd
Advances in Green and Sustainable Chemistry)	Bela Torok, Christian Schaefer	Elsevier Science Publishing Co Inc
Microwave-Assisted Organic Synthesis: A Green Chemical Approach	Chetna Ameta	Apple Academic Press Inc.
Heterocyclic Compounds	Dr. Rashmi Jain	Pragati Prakashan
An Introduction to the Chemistry of Heterocyclic Compounds	R. Morrin Acheson	Wiley India Pvt Ltd
Organic Compounds of Sulphur, Selenium, and Tellurium	D R Hogg	Royal Society of Chemistry

Course Name:	Organic Chemistry-VII
Course Code:	SSCH3090
Prerequisite:	Organic Chemistry-VI

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

This course is designed to provide knowledge of multiple topics like photochemistry, terpenoids, drugs, vitamins and hormones.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1.	**Photochemistry** Introduction, Difference between photochemical and thermo chemical reactions, Laws of Photochemistry, Grotthus-Drapper Law, Einstein's Law of Photochemical equivalence, Quantum yield, causes for high and low quantum yield, primary and secondary process, Consequence of light absorption by atoms and molecules, Jablonski diagram, Fluorescence, phosphorescence, quenching of fluorescence, Chemiluminescence, related numerical.	10	33%
2.	**Terpenoids** Their occurance, classification , isoprene and special isoprene rule , general methods to determine their structure , analytical and synthetic evidences for the structure of Camphor &Citral.	08	27%
Section-II			
3.	**Drugs** Their classification based on their pharmacological action, synthesis and uses of Amyl nitrate, Varapamil, Nalidixic acid, Ibuprofen, Pyrimethamine, Diazepam, Chloramphenicol, Lidocaine, Sulfadoxine, Chloropropamide, Dapsone,	08	27%
4.	**Vitamins & Hormones** Structural determinations of Pyriodoxine, Thyroxine and their synthesis. General introduction, structural determination of Riboflavin (Lactoflavin) and its synthesis.	04	13%

Course outcome:

CO-1: Students will be able to distinguish between thermochemical and photochemical reactions, energy transitions through Jablonski diagram will also be known.
CO-2: Through this topic students will be introduced to natural products and will gain knowledge about isoprenes, camphor and citral
CO-3: Students will be familiar to therapeutic science. They will be able to identify the potential of pharmaceutical chemistry by knowing about some basic drugs
CO-4: Learning this topic students will understand about the essential biochemicals for the human body and their structural determination and synthesis

Reference Books:

Title	Author/s	Publisher
Advanced organic chemistry	Arun Bahl and B S Bahl	S. Chand.
Organic Chemistry (7th Ed.)	Robert Neilson Boyd, Saibal Kanti Robert, Thornton Morrison	Pearson
Medicinal Chemistry	W.A.Foye	Wolters Kluver
Organic Chemistry (3rd Ed.)	Dr. David Klein	Wiley
Vitamins and Hormones	Gerald Litwack	Academic Press
Organic Chemistry Natural Products	O.P. Agarwal	Krishna Prakashan Media (P) Ltd
Stereochemistry and the Chemistry of Natural Products (v. 2) (Organic Chemistry)	I.L. Finar	Longman

Course Name:	Organic Chemistry Practical
Course Code:	SSCH3110
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

This course is designed to identify the unknown organic compounds given in the mixture. To identify the amount of chemicals in given solution with chromatographic separation and distillation.

Course Contents:

Module	Name of the practical	Hours
	Organic Estimations	
1.	Determination of amount of Formaldehyde in given solution	**06**
2.	Determination of amount of Ethyl acetate in the given solution	**06**
3.	Determination of saponification value of an oil	**06**
	Separation of binary mixtures (any 5)	
4.	i)Benzoic Acid + β-naphthol ii) Salicylic Acid + P- nitro aniline iii) β-naphthol + Acetanilide iv) p-toluidine + Naphthalene v) α-naphthol + diphenyl amine vi) Cinnamic Acid + Naphthalene vii) Salicylic Acid + Naphthalene viii) β-naphthol + m-dinitrobenzene ix) Cinnamic Acid + P- nitro aniline x) Salicylic Acid + β-naphthol	**24**
5.	Chromatographic Separation of amino acid mixture by ascending paper chromatography (any 1) Glycine + Methionine, Alanine + Methionine, Alanine + Valine	**06**
6.	Distillation	**06**

Course outcome:

CO-1: Students will be able to separate and identify the unknown organic mixture which is provided.
CO-2: Students will perform the estimation and will be able to evaluate the amount of the chemical given.
CO-3: Students will explore the chromatographic separation technique of amino acids
CO-4: Students will learn about distillation process.

Reference Books:

Handbook of Organic Analysis: Qualitative & Quantitative	H Clark	Adward Arnold
Vogel's Textbook of Practical Organic Chemistry	W L Jolly	Prentice Hall

Course Name:	Physical Chemistry-VII
Course Code:	SSCH3130
Prerequisite:	Basic Physical Chemistry

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To learn about the classical thermodynamics, physical and mathematical bases of statistical mechanics, statistical thermodynamics concepts of temperature, entropy, Boltzmann and Gibbs factors, partition functions, and distribution functions.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1.	**Classical Thermodynamics** Partial molal free energy (chemical potential), chemical potential in case of a system of ideal gases. Concept of fugacity, fugacity function, fugacity at low pressures, physical significance of fugacity, graphical method for determination of fugacity, fugacity in gaseous mixture, fugacity of Compounds in a mixture of solution, Lewis fugacity rule, Lewis-Randall rule. Concept of activity and activity coefficient, standard state, standard state of liquid, solid and gas, Vapour pressure method of determining activity and activity coefficient (BKS-632), Variation of activity of a gas with pressure and temperature. The Nernst heat theorem (NHT), limitations of NHT, Proof of NHT, The third law of thermodynamics, consequence of third law of thermodynamics, Determination of absolute entropy of gases and liquids, applications of third law of thermodynamics, concept of residual entropy, Exceptions to the third law of thermodynamics, Numerical problems.	15	50%
Section-II			
2.	**Statistical Thermodynamics** Concept of distribution, thermodynamic probability and most probable distribution, ensemble averaging, postulates of ensemble averaging,	15	50%

	canonical, grand canonical and microcanonical ensembles, and corresponding distribution laws (using Langrange's method of undetermined multipliers). Partition functions – Translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions, calculation of thermodynamic properties in terms of partition functions. Applications of partition functions. Heat capacity behavior of solids – Chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Drac statistics, distribution law and applications to metal, Bose-Einstein statistics – distribution law and application to helium.		

Course outcome:

CO-1: Students should be able to understand the fundamentals of thermodynamics from a classical viewpoint.
CO-2: Students should be able to gain clear understanding of laws of thermodynamics and should be able to explain thermodynamic processes based on these laws.
CO-3: Grasp the basis of ensemble approach in statistical mechanics to a range of situations.
CO-4: Analyze important examples of ideal Bose systems and Fermi systems.

Reference Books:

Title	Author/s	Publisher
Physical Chemistry 9thEd.,	Peter Atkins & Julio De Paula	Oxford University Press (2010).
Physical Chemistry,	Castellan, G. W.	4th Ed., Narosa (2004).
Physical Chemistry	Ball, D. W.	Cengage India (2012).
Physical Chemistry 3rd Ed.,	Mortimer, R. G.	Elsevier: NOIDA, UP (2009).
Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis	Rev. by G.H. Jeffery and others	5th Ed. The English Language Book Society of Longman.
Physical Chemistry 6th Ed.,	Levine, I. N.	Tata McGraw-Hill (2011).
Physical Chemistry 2nd Ed.,	Metz, C. R.	Tata McGraw-Hill (2009).
Statistical Thermodynamics	M.C. Gupta	New Age International (2007)

Course Name:	Physical Chemistry-VIII
Course Code:	SSCH3150
Prerequisite:	Physical Chemistry VII

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To gain knowledge about Qualitative and Quantitative aspects of chemical analysis, electrical and magnetic properties of molecules and atoms with the knowledge on salt hydrolysis.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1.	**Qualitative and quantitative aspects of analysis:** Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals. Uncertainty in experimental techniques: Displaying uncertainties, measurements in chemistry, decimal places, significant figures, combining quantities. Uncertainty in measurement: types of uncertainties, combining uncertainties. Statistical treatment. Mean, standard deviation, relative error. Data reduction and the propagation of errors. Graphical and numerical data reduction. Numerical curve fitting: the method of least squares (regression).	12	42%
Section-II			
2.	**Electrical & Magnetic Properties of Atoms and Molecules** Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment and molecular polarizabilities and their measurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement, molecular interpretation.	10	33%

3.	**Salt Hydrolysis** Introduction, Bronsted-Lowry Concept of Hydrolysis, Quantitative aspect of Hydrolysis, Relation between Kh, Kw and Ka, Relation between hydrolysis constant and degree of hydrolysis, Determination of degree of hydrolysis.	08	25%

Course outcome:

CO-1: At the end of this course, students will be able to evaluate the types of errors, their rectification and enumerate problems based on that.
CO-2: Students can apply their knowledge is fabricating smart materials based on the knowledge about the properties of materials acquired from the course.
CO-3: The knowledge on salt hydrolysis can bring awareness in students about the behaviour of different types of electrolytes upon hydrolysis and can plan experiments and design reactions applying this knowledge.

Reference Books:

Title	Author/s	Publisher
Physical Chemistry 9thEd.,	Peter Atkins & Julio De Paula	Oxford University Press (2010).
Physical Chemistry,	Castellan, G. W.	4th Ed., Narosa (2004).
Physical Chemistry	Ball, D. W.	Cengage India (2012).
Physical Chemistry 3rd Ed.,	Mortimer, R. G.	Elsevier: NOIDA, UP (2009).
Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis	Rev. by G.H. Jeffery and others	5th Ed. The English Language Book Society of Longman.
Physical Chemistry 6th Ed.,	Levine, I. N.	Tata McGraw-Hill (2011).
Physical Chemistry 2nd Ed.,	Metz, C. R.	Tata McGraw-Hill (2009).

Course Name:	Physical Chemistry Practical
Course Code:	SSCH3170
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To explain the principle of various instrumental techniques. And to apply previous knowledge for performing experiment scientifically and safety.

Course Contents:

Section-1		
Module	**Name of the practical**	**Hours**
1.	**Chemical Kinetics** (i)To investigate the reaction between $KBrO_3$ and KI. (ii) To investigate the reaction between H_2O_2 and KI.	**12**
2.	To study the effect of addition of an electrolyte NaCl / KCl on the solubility of benzoic acid at room temperature.	**06**
3.	**pH metry** (i)To determine the degree of ionization of HAc and NH_4OH. (ii) To measure the pH of different buffer solutions and to study their buffer capacity.	**12**
Section-2		
4.	**Potentiometry** (i) To determine the solubility and solubility product of a sparingly soluble salt (AgCl) by titration of $AgNO_3$ and NaCl. (ii) To determine the normality of ferrous ammonium sulphate using $K_2Cr_2O_7$ solution.	**12**
5.	**Colorimetry** (i) Determination of indicator constant of phenolphthalein. (ii) Verify Lambert-Beer's law for $KMNO_4$ solution.	**12**
6.	**Viscometry** To determine the molecular weight of a high polymer by using solutions of different concentrations.	**06**

Course outcome:

CO-1: The students will be able to design and carry out scientific experiments as well as accurately record and analyse the results of experiments.
CO-2: The students will learn the laboratory skills needed to design, safely conduct and interpret chemical reactions for advanced courses.
CO-3: Student will realize the need of calibration and importance of error free measurements for advanced courses.

Reference Books:

Advanced Practical Physical Chemistry	J. B. Yadav	Krishna's Publication (2015).
Practical Physical Chemistry	B. Viswanathan, P. S. Raghavan	M.V. Learning Publications

Course Name:	Applied Chemistry- Nanomaterials
Course Code:	SSCH3190
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The aim of this course is to create a foundational knowledge on nanoscience related fields and their applications.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1.	**Introduction to Nanoscience** Definition of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challenges of nanoscience and nanotechnology, Classifications of nanostructured materials, nano particles; quantum dots, nanowires, carbon age-new form of carbon (CNT to Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties: Mechanical, Electronic, Chemical, Optical, Magnetic and Thermal properties.	8	20%
2.	**Synthesis of Nanoparticle** Chemical routes, Electrochemical methods, Vapor growth, Thin films methods: chemical vapor deposition, Mechanical methods: ball milling, mechanical attrition, Sol-gel methods, Special nanomaterials: carbon nanotubes, fullerenes, nanowires, porous silicon.	8	33%
Section-II			
3.	**Types of nanostructure and properties of nanomaterials:** One dimensional, Two dimensional and Three-dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanical-physical-chemical properties.	6	13%
4.	**Application of Nanomaterial:** Nano-electronics, Nano optics, Nanoscale chemical- and bio-sensing, Biological/bio-medical applications, Photovoltaic, fuel cells, batteries and energy-related applications, High strength nanocomposites, Nanoenergetic materials Ferroelectric materials, biological and environmental, membrane-based application.	8	34%

Course outcome:

CO-1: Students will learn about the background on Nanoscience
CO-2: Students will understand the synthesis of nanomaterials and their applications and knowledge on the impact of nanomaterials on environment is provided.
CO-3: Students will apply their learned knowledge to develop nanomaterials.

Reference Books:

Title	Author/s	Publisher
The Physics and Chemistry of NanoSolids	Frank J. Owens and Charles P. Poole Jr,	Wiley-Inter science
Nanomaterials- Synthesis, Properties and Applications	A.S. Edelstein and R.C. Cammarata	Institute of Physics Publishing, London
Nanoparticles: From theory to applications	G. Schmidt	Wiley Weinheim
Fundamentals of Light Microscopy and Electronic Imagine	Douglas B. MurPhy	A JOHN WILEY & SONS
Electron Microscopy (1st Edition)	Dr. Pushpa Viswanathan	MJP Publishers

Course Name:	Applied Chemistry- Microscopy Techniques
Course Code:	SSCH3210
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To introduce the light microscopy, atomic force microscopy, TEM and SEM

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Introduction to light microscopy (LM)** History of Microscopy, Overview of Current Microscopy Techniques, Introduction to Optics (Geometric and Wave), Components of a Light Microscope, Compound Light Microscope and Its Variations, Brightfield, Darkfield, Phase Contrast, Polarized, DIC	6	19%
2	**Atomic Force Microscopy** Introduction, Principle of AFM, concepts of AFM instrumentation, AFM stage, cantilevers and stages, Different types of modes, measuring images and processing, analysis, artifacts, Applications of AFM	8	27%
Section-II			
3	**Transmittance Electron Microscopy (TEM)** Principle, components of TEM, Illumination system, Electron Gun, Resolving power and Resolution, Magnification, Principle of electro lenses, condenser Lens, Contrast, Electron diffraction, Specimen chamber, Interaction between beam and specimen, Damage of specimen, Image forming lens system, Intermediate and Projector Lenses, Recording the Image, viewing chamber, Camera Chamber, Vacuum System, Specimen preparation techniques, artifacts, Advantages and Limitation of Electron microscopy,	8	27%
4	**Scanning Electron Microscopy (SEM)** Introduction, comparison between LM, TEM and SEM, Probing system, specimen preparation and observation techniques, Interaction between beam of electrons and specimen atoms, Detectors, Signal to noise ratio, purposes of the SEM, Image formation in SEM, Magnification and Resolution in SEM,	8	27%

Course outcome:

CO-1: Students will be able to understand various biological scales in living cells
CO-2: Students will understand the role of AFM in investigating the morphologies of the surfaces and its importance in nanomaterials.
CO-3: On understanding TEM analysis students will understand how to create highly magnified images with detailed knowledge on aspects like their components, resolution, magnification and applications.
CO-4: Students will know the difference between SEM and TEM and will learn the importance of SEM.

Reference Books:

Title	Author/s	Publisher
The Physics and Chemistry of NanoSolids	Frank J. Owens and Charles P. Poole Jr,	Wiley-Inter science
Nanomaterials- Synthesis, Properties and Applications	A.S. Edelstein and R.C. Cammarata	Institute of Physics Publishing, London
Nanoparticles: From theory to applications	G. Schmidt	Wiley Weinheim
Fundamentals of Light Microscopy and Electronic Imagine	Douglas B. MurPhy	A JOHN WILEY & SONS
Electron Microscopy (1st Edition)	Dr. Pushpa Viswanathan	MJP Publishers

Course Name:	Applied Chemistry Tutorials
Course Code:	SSCH3230
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To understand the synthesis of nanoparticles and several instrumental techniques required for the characterization, fundamentals of research methodology, refer scientific research articles and reviews as well as via virtual lab the principle and working of SEM, TEM and AFM.

Course Contents:

Module	Name of the practical	Hours
1.	Synthesis of various metal and metal oxide nanoparticles and analysis by UV-Vis spectrophotometer	**6**
2.	Synthesis of transition metal oxide nanoparticle and analysis using UV-Vis spectrometer	**6**
3.	Biosynthesis of Ag NPs using plant/leaf extracts	**6**
4.	Synthesis of aqueous ferrofluid by wet chemical methods	**6**
5.	Synthesis of fluorescent carbon nanoparticles from candle soot	**6**
6.	Synthesize bimetallic (Fe@Au and Fe@Ag) NPs by wet chemical methods.	**6**
7.	Virtual lab and Tutorial: How to use SEM for characterizing of nanomaterials (http://myscope-explore.org/virtualSEM.html)	**6**
8.	Virtual lab and Tutorial: How to use TEM for characterizing of nanomaterials (https://myscope.training/legacy/tem/practice/virtualtem/)	**6**
9.	Virtual lab and Tutorial: How to use AFM for characterizing of nanomaterials (https://wecanfigurethisout.org/VL/easyScan_AFM.htm)	**6**
10.	Visit to CSIR lab/IITs/Industry to demonstrate TEM and AFM and prepare report on it	**6**

Course outcome:

CO-1: At the end of this course, students will learn how to find and refer research articles.
CO-2: The students will be able to understand the synthesis of nanoparticles, their characterization and their different applications.
CO-3: The students will be able to apply the knowledge gained by virtual exposure of SEM, TEM and AFM for practical applications.

Reference Books:

The Physics and Chemistry of NanoSolids	Frank J. Owens and Charles P. Poole Jr,	Wiley-Inter science
Nanomaterials- Synthesis, Properties and Applications	A.S. Edelstein and R.C. Cammarata	Institute of Physics Publishing, London
Nanoparticles: From theory to applications	G. Schmidt	Wiley Weinheim
Fundamentals of Light Microscopy and Electronic Imagine	Douglas B. MurPhy	A JOHN WILEY & SONS
Electron Microscopy (1st Edition)	Dr. Pushpa Viswanathan	MJP Publishers

Sem-6

Course Name:	Industrial Chemistry-I
Course Code:	SSCH3080
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To create awareness about Quality control, Quality assurance and good laboratory practice for Chemical Industries.
To study about use of organometallic compounds, catalyst, Vitamins and fermentation process.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1.	**Quality Control in Chemical Industry** Statistical Quality Control Techniques: Statistical treatment of data. Control charts, Performance Evaluation uncertainties in measurement, Validation of analytical methods, Quality Assurance: Elements of quality Assurance, Quality Management System Quality management concepts and principles: ISO 9001:2000 QMS Case studies on ISO 9001: 2000 in chemical industries. ISO 14000 Series of Standards. TQM in Chemical Industry. Six Sigma Approach to Quality: Applying Six Sigma to chemical Industries, Good Laboratory Practices: Principles of GLP, GMP in Drugs and Pharmaceutical Industries Accreditation of QC laboratories: Tools and Mechanisms ICH Guidelines on Drug substances and Products.	10	33
2.	**Organometallic chemistry and catalysis in industry** Industrial applications of organ transition metal compounds; Important catalytic reactions: Hydrogenation, Wacker process, Ziegler-Natta catalysis; Metal carbonyls compounds; Organometallic reagents in organic synthesis: Principle, preparation and applications of Li, Mg, Hg, Zn, Ni, Pd, Fe, Co and boron compounds in organic synthesis; Medicinal application of organometallic chemistry	8	27
Section-II			
3.	**Vitamin** Introduction, Classification and nomenclature, discuss below properties for all Vitamin (A, A_1, A_2, B_1, B_2, B_3, B_6, B_7, B_{12}, C, E), structure, Occurrence and sources, Isolation, Detection and estimation, Diseases caused by	6	20

	deficiency.		
4.	**Fermentation** Introduction, History, favorable condition for fermentation, Characteristic of enzymes, Different types of fermentation processes, Manufacturing of alcohol, sprit, vinegar. Ethyl alcohol from molasses, Manufacture of starchy and cellulosic materials, Applications.	6	20

Course outcome:

CO-1: The students are able to make documentation related to QC, QA. They are also able to analyse products on the basis of ISO standards as well as knowledge about Accreditation of chemical laboratory.
CO-2: The students are aware about the use of organometallic compounds in different industries specially in pharmaceutical industries, in synthesis. They are also used in catalysis process and use of different catalyst like Ziegler-Natta catalysis.
CO-3: The students can do Classification, nomenclature, discuss properties, sources, Isolation, Detection and estimation as well as Diseases caused by deficiency.
CO-4: The students are able to understand the favorable condition, Characteristic of enzymes, Different types of fermentation processes, formation of alcohol, sprit, vinegar etc.

Reference Books:

Title	Author/s	Publisher
Quality Assurance in Analytical Chemistry	Bernd W. Wenclawiak, Michael Koch, Evsevios Hadjicostas	Springer
Industrial Chemistry	B. K. Sharma	GOEL publishing House
CHEMISTRY: An Industry-Based Laboratory Manual	John Kenkel	LEWIS PUBLISHERS

Course Name:	Industrial Chemistry-II
Course Code:	SSCH3100
Prerequisite:	Industrial Chemistry-I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To know about paints, pigments, dyes, Fertilizers and Detergents.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Paints and Pigments** Discuss following things for Pb, ZnO, and TiO_2 pigments Introduction, Pigments, Manufacture process, Physical properties, Characterization and Applications. Paints Introduction, Classification of paints, Constituents of paints, Manufacture of paints, Requirements of paints, Paint removers, Applications.	7	20
2	**Dye** Introduction, Color and constitution, Nomenclature, Classification of dye (based on chemical composition, mode of applications), Dyeing, Method of dyeing, Applications of dye	8	27
Section-II			
3	**Fertilizers** Introduction, function of nutrient, Classification of Fertilizer, Nitrogen based fertilizer (Ammonium nitrate, Ammonium sulphate, Urea), Manufacture, condition for good yield, Applications. Phosphate fertilizer, superphosphate, triple superphosphate, Applications, Potassium fertilizer, NPK fertilizer, mixed fertilizer, pollution caused by fertilizers.	8	27
4	**Detergent** Soap, History, Limitation of soap, Principle group pf detergent, Introduction of surfactant, classification of surfactants, CMC, Measurement of CMC, Micelles, Factor effect on CMC, Manufacture of surfactants, Applications	7	26

Course outcome:

CO-1: The students will be able to understand the chemical & physical properties, characterization and application of pigment. They are also understanding the classification, constituent, manufactures of paints along with their removal and application.
CO-2: The students are able to classify, synthesize and nomenclature of different dyes. They are also aware about dying methods and application of dyes on clothes.
CO-3: The students can do classification, function of nutrient, preparation of fertilizers. They are also knowing about different fertilizer and pollution caused by them.
CO-4: The students will able to know Limitation of soap & surfactant, CMC, Factor effect on CMC, measurement of CMC and Applications.

Reference Books:

Title	Author/s	Publisher
Quality Assurance in Analytical Chemistry	Bernd W. Wenclawiak, Michael Koch, EvseviosHadjicostas	Springer
Industrial Chemistry	B. K. Sharma	GOEL publishing House
CHEMISTRY: An Industry-Based Laboratory Manual	John Kenkel	LEWIS PUBLISHERS

Course Name:	Industrial Chemistry Practical
Course Code:	SSCH3120
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To understand about data preparation of industrial laboratory, all calculation related to synthesis, CMC, Fermentation process and pigments.

Course Contents:

Module	Name of the practical	Hours
11.	Tutorial: Prepare Laboratory report and data recording for Industry	**6**
12.	Tutorial: Prepare guidelines for the report in Industry	**6**
13.	Synthesis of an ester	**6**
14.	Measure the CMC of surfactant with conductivity.	**6**
15.	Separation of pigments from spinach leaves and calculate the R_f value for each pigment and also measure the absorption spectra using UV-Visible	**6**
16.	Synthesis of Aspirin and calculate % yield in product	**6**
17.	Synthesis of o-chlorobenzoic acid and calculate % yield in product	**6**
18.	Fermentative Production of Ethanol	**6**
19.	Synthesis of 1-(4-hydroxyphenylazo)-2-naphthol azo dye	**6**
20.	Isolation of Caffeine from tea leaves.	**6**

Course outcome:

CO-1: The students will be able to Prepare Laboratory report and data recording for Industry as well as to prepare guidelines SOP for Industries.
CO-2: The students are able to calculate % yields of products in synthesis.
CO-3: The students can measure the CMC of surfactant with conductivity.
CO-4: The students are able to synthesize Ethanol from fermentation process. They are also able to separate pigment and identify them using spectrophotometer.

Reference Books:

Quality Assurance in Analytical Chemistry	Bernd W. Wenclawiak, Michael Koch, EvseviosHadjicostas	Springer
Industrial Chemistry	B. K. Sharma	Goel publishing House
CHEMISTRY: An Industry-Based Laboratory Manual	John Kenkel	Lewis publishers

Course Name:	Analytical methods in chemistry
Course Code:	SSCH3140
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

This course is designed to provide the information about paper chromatography, TLC, gas chromatography (GC), HPLC, with their respective industrial applicability with the information about assessment of the analytical data.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1.	**Planar Chromatography** **Paper Chromatography (PC)** Introduction, Choice of papers and solvents, Types of chromatography, R_f, factor affecting R_f value, Detection and visualization, Applications, Advantage and Disadvantages of PC. **Thin Layer Chromatography (TLC)** Limitation of PC, Introduction, Silica based sorbent selection and layers, Name of the Non-silica-based sorbents, Preparation of TLC plates, Sample development of technique, Detection and visualization, Applications.	8	27
2.	**Gas Chromatography** Principle of GC, Components of GC, Carrier gas and its selection, System for sample introduction, Column and its specifications, Characteristics and classification of Detectors (FID and TCD), Interpretation of GC chromatogram and calculate amount of purity, Applications of GC, Limitations of GC.	8	27
Section-II			
3.	**Liquid Chromatography** Limitations of conventional liquid Chromatography, Principle and diagram of instrument, Components of instrument, Column of HPLC, Detectors (UV absorption, RI detector), Interpretation of HPLC chromatogram, Applications of HPLC.	8	26
4.	**Assessment of Analytical Data**	6	20

	Accuracy, Precision, Errors, Classification of Errors, Absolute and Relative Error, Minimization of Error, Uncertainty, Propagation of Uncertainty, Significant figure, Rounding off, Mean, Median, Mode, Range, Deviation, Standard Deviation, Relative Standard Deviation, Distribution of measurements, Normal distribution curve, Reliability of Results (Q-test), Comparison of Results: Student's t-test, Numerical based on above topics.		

Course outcome:

CO-1: The most important separation and identification techniques for compounds available in mixtures can be briefed to understand the importance of chromatographic techniques.
CO-2: Students will understand about the industrial applicable gas chromatography with their components and applications
CO-3: From the current unit students will come to know about the widely used HPLC system with instrumentation, interpretation and applications.
CO-4: As data assessment is an essential and important part students can come to know about it by going through the current unit

Reference Books:

Title	Author/s	Publication
Principles of Instrumental Analysis (6th Edition)	Douglas A. Skoog, F James Holler, Stanley R. Crouch	Brooks Cole
Fundamental of Analytical Chemistry	Douglas A. Skoog, Donald M. West, F James Holler, Stanley R. Crouch	Cengage
Analytical Chemistry for Technicians (4th Edition)	John Kenkel	CRC press, Taylor & Francis group
Modern Analytical Chemistry	David Harvey	McGraw-Hill Higher Education
Industrial Chemistry	B. K. Sharma	GOEL publishing House
Water and wastewater Engineering	Metcalf and Eddy	

Course Name:	Environmental Chemistry
Course Code:	SSCH3160
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

This course is designed to provide the information about waste water, to prevent the waste water, to improve the insight on water analysis, and to aware the students about disinfectants.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Introduction of wastewater** Characteristics of water and wastewater, Source of water, Quality of natural water, criteria of drinking water, types of treatment, conventional water and wastewater treatment	6	20
2	**Primary Treatment of water and wastewater** Coagulation and Flocculation: Colloid characteristics, chemistry of metallic coagulants, polyelectrolytes as coagulant, mixing of co-agulants, Flocculation: Types of flocculation, types of flocculators	6	20
Section-II			
3	**Water Analysis** Chemical and Physical examination of water (turbidity, odor, taste, temperature, pH, conductivity, solid suspension, Acidity, Alkalinity, Free gases, toxic metals), Hardness, DO, COD, BOD, Biological examination of water and removal process.	10	33
4	**Disinfection** Purposes, Characteristics of ideal disinfection, Disinfection methods and mechanisms, Factors affecting, Disinfection with chlorine, chlorine dioxide, ozone, ultraviolet radiation	8	27

Course outcome:

CO-1: As the topic is related with our daily life students will understand about the characteristics of water and waste water with the treatment plan of waste water.
CO-2: Students will understand the basics of coagulation and flocculation process with their types and examples

CO-3: Through the explanation of this topic students will come to know about various analytical parameters of water (turbidity, taste, temperature, pH, conductivity, solid suspension, Acidity, Alkalinity, Free gases, toxic metals)
CO-4: Students will be aware of disinfection with their methods, mechanisms, factors by appropriate examples

Reference Books:

Title	Author/s	Publication
Principles of Instrumental Analysis (6th Edition)	Douglas A. Skoog, F James Holler, Stanley R. Crouch	Brooks Cole
Fundamental of Analytical Chemistry	Douglas A. Skoog, Donald M. West, F James Holler, Stanley R. Crouch	Cengage
Analytical Chemistry for Technicians (4th Edition)	John Kenkel	CRC press, Taylor & Francis group
Modern Analytical Chemistry	David Harvey	McGraw-Hill Higher Education
Industrial Chemistry	B. K. Sharma	GOEL publishing House
Water and wastewater Engineering	Metcalf and Eddy	

Course Name:	Analytical methods in chemistry & Environmental Chemistry Practical
Course Code:	SSCH3180
Prerequisite:	Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	4	0	2	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

- The present contents elaborate students' knowledge about different types analysis techniques.
- The present study gives students' knowledge about waste water, its characteristic and how to purify it.

Course Contents:

Module	Name of the practical	Hours
21.	Separation of amino acid by ascending paper chromatography and measure the R_f value	**6**
22.	Separation of metal cation by paper chromatography and measure the R_f value	**6**
23.	Separation of amino acid by Thin Layer Chromatography and measure the R_f value	**6**
24.	Identification of unknown analgesic drug using Thin Layer Chromatography	**6**
25.	Tutorial: Data analysis and graph plotting by Open-source software like Libra office or Microsoft office tool	**6**
26.	To determine the Dissolved Oxygen of water sample collected from local source	**6**
27.	To determine pH, moisture content and TDS of the sample.	**6**
28.	To determine the BOD of the water sample collected from local source.	**6**
29.	To determine the COD of the water sample collected from local source.	**6**
30.	Flame photometric determination of Na^+ ion.	**6**

Reference Books:

Title	Author/s	Publication
Principles of Instrumental Analysis (6^{th} Edition)	Douglas A. Skoog, F James Holler, Stanley R. Crouch	Brooks Cole
Fundamental of Analytical Chemistry	Douglas A. Skoog, Donald M. West, F James Holler, Stanley R. Crouch	Cengage
Analytical Chemistry for Technicians (4^{th} Edition)	John Kenkel	CRC press, Taylor & Francis group
Modern Analytical Chemistry	David Harvey	McGraw-Hill Higher Education
Industrial Chemistry	B. K. Sharma	GOEL publishing House
Water and wastewater Engineering	Metcalf and Eddy	

Considering that some students choose academics and research as their career while others prefer industrial jobs, the students shall get two options to meet their specific need – (i) **Plan A: Research-based curriculum**, and (ii) **Plan B: Industry-based curriculum**.

The program coordinator and placement officer shall conduct an orientation session in semester 6 so that the students can take informed decision to choose between the two options.

PLAN A: Research-based curriculum

Course Name:	Dissertation
Course Code:	SSCH3200
Prerequisite:	None

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	30	0	15	40	60	100

Objective(s) of the Course:

- To help students learn about the research in state-of-the-art research institutions. This will also provide the students an opportunity to practically use their Biotechnology-based skills in a typical research environment

Course Outline:

Content	Duration
The students shall carry out 2-months dissertation in an academic or research institution of national/international repute. They must prepare a thesis on a specific template provided by the School of Sciences. Upon completion of the dissertation, students are required to present their work before the expert committee. Students must submit four copies of their thesis to the department.	2 months

PLAN B: Industry-based curriculum

Course Name:	Dissertation
Course Codee:	SSCH3200
Prerequisite:	None

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	30	0	15	40	60	100

Objective(s) of the Course:

- To help students learn about the application of Biotechnology in modern Biotech industries. This will also provide the students an opportunity to practically use their Biotechnology-based skills in a life-science industry.

Course Outline:

Content	Duration
The students shall carry out 2-months internship in an industry of national/international repute. They must prepare an internship report on a specific template provided by the School of Sciences. Upon completion of the dissertation, students are required to present their work before the expert committee. Students must submit four copies of their internship report to the department.	2 months