G.Venkataswamy Naidu College, Kovilpatti – 628 502

(Autonomous)

(Re-Accredited by NAAC with 'A' Grade)

(DBT STAR College Scheme)

Department of Chemistry

(For those admitted from the academic year 2021-22 and onwards)

VISION

- Envisions to empower young learners with the State of the Art Chemistry Education and enable them to attain global standards so that they can contribute to National Development as active researchers, academicians, industrialists and entrepreneurs.

MISSION

- ✓ Developing basic knowledge in Chemistry by providing practical experience.
- ✓ Imparting knowledge for holistic development by inculcating social orientation and ethics.
- ✓ Instilling scientific zeal, leadership skills and employable skills in students to meet
- ✓ contemporary challenges.
- ✓ Making the students self-reliant by starting their own business through in-plant trainings and mini projects.

PROGRAMME OUTCOMES:

Upon successful completion of the three year degree programme in Chemistry, the student will have an ability to

PO-1: understand, demonstrate, analyse and apply the major concepts in all disciplines of Chemistry and will be able to nurture the needs of the industries/ laboratories related to Chemistry and Allied fields.

PO-2: understand the basic principle of instruments/equipments used in Chemistry lab, carry out experiments, observe and interpret the results and make necessary inferences/ conclusions and also apply the experimental results to improve the chemical processes.

PO-3: explore the vast field of theoretical and experimental Chemistry by employing Scientific knowledge, evidence based scientific approach, scientific inquiry and critical thinking

PO-4: demonstrate skills in the safe handling of chemicals, considering their physical and chemical properties including any specific hazards associated with their use.

PO-5: follow the ethical principles and responsibilities of a Chemist to serve the Society by following the alternate green routes for Chemical reactions for sustainable development.

PO-6: demonstrate a good working knowledge in the use of computers and will be able to increase the core competency by constantly upgrading skills with independent life long learning via e-resources

PO-7: assimilate chemical information from various sources and present it to an audience both orally and in writing and demonstrate problem solving, decision making and leadership skills and will be able to work in teams.

PROGRAMME EDUCATIONAL OBJECTIVES

After successful completion of the three year degree programme in Chemistry, the student will have an ability to

PEO-1: demonstrate technical competency in various disciplines of Chemistry and will be successful in his / her chosen careers.

PEO-2: demonstrate commitment towards sustainable development for the benefit of Society

PEO-3: demonstrate professional excellence, ethics, soft skills and leadership qualities.

PROGRAMME SPECIFIC OUTCOMES

After successful completion of the three year degree programme in Chemistry, the student will have an ability to

PSO-1: apply various concepts and principles of organic, inorganic, physical chemistry in day to day life.

PSO-2: design, execute /conduct / experiments and handle equipments in Chemistry for industries.

PSO-3: execute new ideas in the field of research and development using principles and techniques of Chemistry learned through activities such as expert lecturers, workshops, seminars and project

GRADUATE ATTRIBUTES:

The three year under-graduate programme in Chemistry develops transferable life skills such as

1) Discipline knowledge

The Graduates will be able to demonstrate an in-depth knowledge and understanding of essential facts, concepts and basic principles of Chemistry and have ability to acquire new knowledge and apply it to find solutions to problems encountered in day to day activities

2) Experimental Skills

The Graduates will acquire skills required for the conduct of documented evidence based laboratory experiments, make observations, draw inferences from the observations and apply the results to improve the processes

3) Critical thinking

The Graduates will be able to employ scientific knowledge and critical thinking to analyse the experimental results and draw a conclusion based on scientific evidence

4) Safe handling of Chemicals

The Graduates will be able to identify the hazardous chemicals by knowing their physical and chemical properties and will be aware of the safe handling techniques

5) Ethical and Social values

The Graduates will be aware of the ethical and social implications and obligations of

Chemistry and will be able to find out pollution free green routes to chemical reactions for sustainable development

6) Digital Literacy and Life long learning

The graduates will be able to demonstrate good working knowledge in the use of computers and able to upgrade skills by independent life long learning via e-learning resources.

7) Soft Skills

The Graduates will be able to gather and present information and demonstrate effective communication skills, problem solving, decision making and leadership skills and will be able to work in teams

Revised Course Structure for B.Sc. Chemistry Degree programme

Part	Course Category	No, of Courses	Credit Distribution	Contact Hours	Total Credits
Part I	Tamil / Hindi	4	4+4+4+4	6+6+6+6	16
Part II	English	4	4+4+4+4	6+6+6+6	16
Part III	Core	-	-	-	68
	Core Elective	2	4+4	5+5	8
	Elective Generic	4	4+4+4+4	6+6+6+6	16
	Comprehension in Core	3	1+1+1	-	3
	Institutional Training/Minor Project	1	3	-	3
	Major Project(Group) & Viva	1	6	5	6
Part IV	AECC	2	2+2	2+2	4
	EEC	2	2+2	2+2	4
	SEC	2	2+2	2+2	4
	Open Elective(Self Study Course)	1	3	-	3
	Foundation Course	1	1	2	1
Part V	General Studies	1	1	-	1
	MOOC / Spoken Tutorial	1	2	-	2
	Extension Activities	1	1	-	1
				Total	156

Category	Credits
Part I	16
Part II	16
Part III	104
Part IV	16
Part V	4
Total credits	**156**
Total marks	**4300**

Revised Course Structure for B.Sc. (Chemistry) Degree Programme

(For those admitted from the academic year 2021-22 and onwards)

Category	Course Type	Course Code	Course Title	Contact Hours	Exam Hours	Marks			Credits
						CIA	**ESE**	**Total Marks**	
Semester-1									
PART-I	Language	U21TA1L1	Tamil –I	6	3	25	75	100	4
PART-II	English	U21EN1L1	English for Enrichment– I	6	3	25	75	100	4
PART-III	Core – 1	U21CH101	Inorganic Chemistry – I	4	3	25	75	100	4
	Core – 2	U21CH102	Physical Chemistry – I	4	3	25	75	100	4
	Core Practical – 1	U21CH2P1	Inorganic Quantitative Analysis(Volumetric Method)	2	-	-	-	-	-
	Additional Core-1	U21PS1PE	Professional English for Physical Sciences-I	-	3	25	75	100	4
	Elective Generic – 1 (Allied)	U21MA1A1	Theory of Equations and Matrices	4	3	25	75	100	3
		U21ZO1A1	Cell Biology, Genetics, Animal Physiology & Ecology	4	3	25	75	100	3
	Elective Generic Practical –1 (Allied)	U21MA2AP	Statistics for Physical Sciences-I	2	-	-	-	-	-
		U21ZO2AP	Cell Biology, Genetics, Animal Physiology, Ecology & Economic Zoology	2	-	-	-	-	-
PART-IV	Ability Enhancement: 1	U21AE101	Environmental Studies	2	2	-	50	50	2
TOTAL				**30**				**650**	**25**
Semester-II									
PART-I	Language	U21TA2L2	Tamil-II	6	3	25	75	100	4
PART-II	English	U21EN2L2	English for Enrichment– II	6	3	25	75	100	4
PART-III	Core – 3	U21CH203	Inorganic Chemistry – II	4	3	25	75	100	4
	Core – 4	U21CH204	Organic Chemistry – I	4	3	25	75	100	4
	Core Practical - 1	U21CH2P1	Inorganic Quantitative Analysis(Volumetric Method)	2	3	40	60	100	2
	Additional Core-2	U21PS2PE	Professional English for Physical Sciences-II	-	3	25	75	100	4
	Elective-Generic-2 (Allied)	U21MA2A2	Vector Calculus	4	3	25	75	100	3
		U21ZO2A2	Economic Zoology	4	3	25	75	100	3
	Elective Generic Practical –1 (Allied)	U21MA2AP	Statistics for Physical Sciences-I	2	3	40	60	100	2
		U21ZO2AP	Cell Biology, Genetics, Animal Physiology, Ecology & Economic Zoology	2	3	40	60	100	2
	Comprehension - I (Self Study Course- Online Examination)	U21CH2C1	Comprehension in Chemistry – I	-	1	-	50	50	1
PART-IV	Foundation Course	U21FC201	Yoga & Value Education	2	-	50	-	50	1

TOTAL				**30**				**900**	**29**
Semester-III									
PART-I	Language	U21TA3L3	Tamil-III	6	3	25	75	100	4
PART-II	English	U21EN3L3	English for Enrichment– III	6	3	25	75	100	4
PART-III	Core – 5	U21CH305	Organic Chemistry – II	6	3	25	75	100	4
	Core Practical -2	U21CH4P2	Inorganic Qualitative Analysis	2	-	-	-	-	-
	Elective Generic – 3 (Allied)	U21PH3A3	Allied Physics – I	4	3	25	75	100	3
	Elective Generic Practical – 2 (Allied)	U21PH4AP	Allied Physics Practical – I	2	-	-	-	-	-
PART-IV	Employability Enhancement: 1	U21CH3EEA	Applied Chemistry	2	-	50	-	50	2
		U21CH3EEB	Agro Chemistry						
	Ability Enhancement:2	U21AE302	Media and Information Literacy Communication	2	2	-	50	50	2
TOTAL				**30**				**500**	**19**
Semester-IV									
PART-I	Language	U21TA4L4	Tamil-IV	6	3	25	75	100	4
PART-II	English	U21EN4L4	English for Enrichment– IV	6	3	25	75	100	4
PART-III	Core – 6	U21CH406	Inorganic Chemistry-III	4	3	25	75	100	4
	Core – 7	U21CH407	Physical Chemistry-II	4	3	25	75	100	4
	Core Practical - 2	U21CH4P2	Inorganic Qualitative Analysis	2	3	40	60	100	2
	Elective Generic - 4 (Allied)	U21PH4A4	Allied Physics – II	4	3	25	75	100	3
	Elective Generic Practical - 2 (Allied)	U21PH4AP	Allied Physics Practical – II	2	3	40	60	100	2
	Comprehension – II (Self Study Course- Online Examination)	U21CH4C2	Comprehension in Chemistry – II	-	1	0	50	50	1
	Core Institutional Training / Minor Project	U21CH5IT	Institutional Training/ Minor Project	-	-	-	-	-	
PART-IV	Employability Enhancement –2	U21CH4EEA	Chemistry of Food, Nutrition and Preservation	2	-	50	-	50	2
		U21CH4EEB	Water Management						

PART-V	Extension Activities - NSS, NCC, YRC, Physical Education, Consumer Club, Youth Welfare, Nature Club & Electoral Literacy Club / Swachh Bharath (Department Extension Activity)			-	-	-	-	Completion	1
TOTAL				**30**				**800**	**27**
Semester-V									
Part III	Core - 8	U21CH508	Inorganic Chemistry IV	5	3	25	75	100	4
	Core – 9	U21CH509	Organic Chemistry – III	5	3	25	75	100	4
	Core – 10	U21CH510	Physical Chemistry –III	5	3	25	75	100	4
	Core Practical - 3	U21CH6P3	Inorganic Quantitative Analysis (Gravimetric Method & Inorganic Preparations)	3	-	-	-	-	-
	Core Practical - 4	U21CH6P4	Organic Analysis, Organic Preparations & Determination of Physical Constants	3	-	-	-	-	-
	Core 5 Practical - 5	U21CH6P5	Physical Chemistry Experiments	2	-	-	-	-	-
	Core Elective - 1	U21CH5E1A	Advance Analytical Chemistry	5	3	25	75	100	4
		U21CH5E1B	Green Chemistry						
		U21CH5E1C	Nano Chemistry						
	Core Institutional Training / Minor Project	U21CH5IT	Institutional Training / Minor Project	-	-	40	60	100	3
PART-IV	Skill Enhancement :1	U21SE5S1	Women Studies	2	2	-	50	50	2
PART-V	Proficiency Enhancement Courses - Self Study Courses	General Studies		Completion					1
TOTAL				**30**				**550**	**22**
Semester-VI									
PART-III	Core – 11	U21CH611	Organic Chemistry –IV	5	3	25	75	100	4
	Core – 12	U21CH612	Physical Chemistry –IV	5	3	25	75	100	4
	Core Practical - 3	U21CH6P3	Inorganic Quantitative Analysis (Gravimetric Method) & Inorganic Preparations	3	6	40	60	100	3
	Core Practical – 4	U21CH6P4	Organic Analysis, Organic Preparations & Determination of Physical Constants	3	6	40	60	100	3
	Core- Practical - 5	U21CH6P5	Physical Chemistry Experiments	2	6	40	60	100	2
	Core Elective -2	U21CH6E2A	Polymer Chemistry	5	3	25	75	100	4
		U21CH6E2B	Pharmaceutical Chemistry						

		U21CH6E2C	Industrial Chemistry						
	Major Group Project & Viva	U21CH6MP	Major Group Project & Viva	5	3	40	60	100	6
	Comprehension - III (Self Study Course- Online Exam)	U21CH6C3	Comprehension in Chemistry – III	-	1	-	50	50	1
PART-IV	Skill Enhancement – 2	U21CH6S2	Computers for Chemists	2	2	-	50	50	2
	Extra Department Course Open Elective - Self Study Course	**To be selected from the Courses offered by other Departments**		-	3	-	100	100	3
PART-V	MOOC/Spoken Tutorial (Self Study Course - Online)			Completion					**2**
TOTAL				**30**				**900**	**34**

Open Electives offered by Departments: (Extra Department Course)

S.No	Name of the Department	Course Title	Course Code
1.	Mathematics	Mathematical Logic	U21MASSC
2.	Physics	Physics in Everyday Life	U21PHSSC
3.	Chemistry	Chemistry in day to day Life	U21CHSSC
4.	Botany	Organic Farming	U21BOSSC
5.	Computer Science	MS-Office	U21CSSSC
6.	Electronics	Electronic Gadgets and Home Appliances	U21ELSSC
7.	Costume Design & Fashion	Basic Illustration	U21CFSSC
8.	Information Technology	Fundamentals of Computer and Networking	U21ITSSC
9.	Statistics	Applied Statistics	U21STSSC
10.	English	Practical English	U21ENSSC
11.	Business Administration	Inspiring Leaders	U21BBSSC
12.	Commerce	Fundamentals of Stock Market	U21COSSC
13.	Professional Accounting	Indian Business Environment	U21PASSC

Part-III B.Sc. Chemistry/ Semester – I / <u>Core – 1 : Inorganic Chemistry - I</u>

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Core – 1	U21CH101	Inorganic Chemistry I	55	5	-	4

Contact hours per Semester: 60
Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
First	**First**	**25**	**75**	**100**

Preamble

The Course is designed to equip the students with the basic knowledge of atomic structure, arrangement of elements in the periodic table and various theories of bonding. It also gives an insight into the general characteristics, preparation and properties of s- and p-block elements.

Course Outcomes (COs)

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	recall the basic concepts of atomic structure, periodic table, periodic properties, chemical bonding and properties of s amd p block elements	K1
CO2	understand the arrangement of elements in the periodic table, the periodicity in properties, principles of bonding and the general characteristics and properties of s and p block elements	K2
CO3	apply Pauli's exclusion principle, Hunds rule and Aufbau principle to filling up of atomic orbitals. the concept of hybridization to geometry of molecules, VBT, MOT and VSEPR theory to molecules	K3
CO4	analyse various atom models, theories of chemical bonding, the position of elements in the P.T., the general characteristics of s block and p block elements and their preparation and properties	K4
CO5	Evaluate and justify the position of elements in the P.T.	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	1	1	2	2
CO2	2	2	1	1	1	2	2

CO3	2	2	1	1	1	2	2
CO4	2	2	1	2	1	2	2
CO5	2	2	1	1	1	2	2
Total Contribution of COs to POs	**10**	**10**	**5**	**6**	**5**	**10**	**10**
Weighted Percentage of COs Contribution to POs	**66.6**	**66.6**	**33.3**	**40**	**33.3**	**66.6**	**66.6**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT
INORGANIC CHEMISTRY – I

UNIT I – ATOMIC STRUCTURE (L -11 hrs, T-1 hr)

Atom models – Bohr's atom model, orbit and orbital, **Dual nature of matter** – de Broglie equation (verification not required), Schrodinger wave equation and its applications (no derivation), **Eigen value and Eigen function** - significance of Ψ and Ψ^2, **quantum numbers and their significance** - principles governing the occupancy of electrons in various quantum levels, probability distribution of electron around the nucleus, radial probability distribution, Pauli's Exclusion principle, Hund's rule, Aufbau principle, Stability of half-filled and fully filled orbitals

UNIT II – PERIODIC TABLE AND PERIODIC PROPERTIES (L -11 hrs, T- 1 hr)

Long form of periodic table - classification as s, p, d and f block elements - **periodicity in properties** -variation of atomic and ionic radii, electron affinity, ionisation energy and electronegativity along periods and groups – **various scales of electronegativity:** Pauling, Mullikan and Allred Rochow's scale of electronegativity – factors affecting the magnitude of electronegativity – applications of electronegativity

UNIT III – CHEMICAL BONDING (L -11 hrs, T- 1 hr)

Properties of ionic compounds - Lattice energy: definition, Born - Lande equation (derivation not required), factors affecting lattice energy, **Born-Haber cycle** - enthalpy of formation of ionic compounds and stability. **Covalent character in ionic compounds**- polarization and Fajan's rule. **Valence bond theory** – hybridization of atomic orbitals and geometry of molecules – sp, sp^2, sp^3, sp^3d, sp^3d^2 and sp^3d^3 hybridisation with examples. **VSEPR theory**- shapes of simple inorganic molecules. **MO theory** - applications of MOT to O_2, F_2, HF and CO, Paramagnetism of O_2, comparison of VBT and MOT.

UNIT IV – S- BLOCK ELEMENTS (L -11 hrs, T- 1 hr)

Occurrence, General characteristics of s block elements, Position of Hydrogen in the periodic table, Chemistry of Li and Be - their anomalous behaviour and diagonal relationship, **Hydrides**- classification, general methods of preparation and salient features, hydration energies, solvation and complexation tendencies of alkali and alkaline-earth metals.

UNIT V – p - BLOCK ELEMENTS (L -11 hrs, 1-hrs)

Occurence, General characteristics of p block elements, **Group study of 13-18 group elements**- anomalous behaviour and diagonal relationship. **Compounds such as hydrides, halides, oxides and oxyacids**-. Preparation, properties, bonding and structure of diborane, borazine and alkali metal borohydrides. Preparation, properties and technical applications of carbides and fluorocarbons. **Silicones and silicates** (structures only)-.**Interhalogen compounds.**

Tutorial Topics:

UNIT I (1 hour)
Application of the concepts of Pauli's Exclusion principle - Hund's rule, Aufbau principle, and identifying the stabilities of half -filied and completely filled orbitals.

UNIT II (1 hour)
Periodicity in properties - variation of atomic and ionic radii, electron affinity, ionisation energy and electronegativity along periods and groups, applications of electronegativity.

UNIT III (1 hour)
Hybridization of atomic orbitals and geometry of molecules, VSEPR theory- shapes of simple Inorganic molecules-comparison of VBT and MOT.

UNIT IV (1 hour)
Position of Hydrogen in the periodic table - Chemistry of Li and Be - their anomalous behaviour and diagonal relationship

UNIT V (1 hour) : Group study of 13-18 group elements

Text books:

1. P.L. Soni, Mohan Katyal, Text book of Inorganic Chemistry, Sultan Chand & Sons, 20th Edition, 2015.
2. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand and Co., Delhi, 1996.

Reference Books:

1. R. D. Madan, Modern Inorganic Chemistry, S. Chand Publishing House, Revised Edition, 2019.
2. J. D. Lee, Concise Inorganic Chemistry, 5th Edition, Blackwell Science, London, 1998.
3. F. A. Cotton, G. Wilkinson, C. Murillo and M. Bochman, Advanced Inorganic Chemistry, Wiley India, 6th Edition, 2008.

Web References:

1. https://byjus.com/jee/atomic-structure/
2. https://www.thoughtco.com/periodic-properties-of-the-elements-608817
3. https://byjus.com/jee/chemical-bonding/
4. https: chem.libretexts.org/Bookshelves/Inorganic Chemistry/ Modules_ and_ Websites_ (Inorganic_Chemistry)/ Descriptive_ Chemistry /Elements_ Organized_ by_ Block1_ s-Block_ Elements
5. https://books .google.co.in/ books?id=Mtth5g59dEIC& printsec=frontcover&source=gbs _ gesummarr&cad=0#v = onepage&q&f=false

Part - III B.Sc. Chemistry / Semester – I / Core – 2 : Physical Chemistry - I

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Core – 2	U21CH102	Physical Chemistry I	55	5	-	4

Contact hours per Semester: 60
Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
First	**First**	**25**	**75**	**100**

Preamble

The Course is formulated to provide the students knowledge about the gaseous state. It also gives an understanding of various photochemical processes. It gives an insight into natural and artificial radioactivity, crystal structure of solid state molecules and colligative properties of dilute solutions

Course Outcomes (COs)

On successful completion of the Course, the learners should be able to

CO#	Course Outcomes	KL
CO1	recall, define and describe thebasic concepts in gaseous state, photochemistry,nuclear chemistry, solid state and dilute solutions	K1
CO2	differentiate between thermal and photochemical reactions, nuclear fission and fusion, fertile and fissile isotopes and amorphous and crystalline solids, demonstratethe postulates of kinetic theory of gases, the types of molecular velocities, mean free path and heat capacities, laws of photochemistry, various photophysical processes, types and uses of lasers, crystal lattices, crystal systems, laws of crystallography, colligative properties, osmotic pressure and its laws, vapour pressure and its lowering, cryoscopic and ebulioscopic constants and Vant-hoff factor	K2
CO3	calculate RMS, mean and average velocities, mean free path, molar heat capacities, quantum yield of photochemical reactions and interplanar distance, draw Jablonski diagram,determine the molecular weight of a non-volatile solute by elevation of boiling point and depression of freezing point, find out the half-life period, mean life, rate of radioactive decay, packing fraction, mass defect , binding energy, age of old samples and explain the principles of radioactivity	K3
CO4	analyse the crystal structures of NaCl, KCl and ZnS, crystal defects in solids, age of samples, age of earth, derive and deduce Maxwell's distribution law, mean free path,	K4

	Beer- Lambert law, photochemical rate law, kinetics of decomposition of HI, photochemical combination of H_2 and Cl_2, expressions for decay constant, $t_{1/2}$, Born-Lande equation, Bragg's equation, thermodynamic derivation of relation between concentration and ΔT_b, thermodynamic derivation for depression of freezing point by a non-volatile solute	
CO5	compare thermal and photochemical reactions, amorphous and crystalline solids,explain the various photophysical processes, discuss Maxwell's distribution law and the effect of temperature on molecular velocities, degrees of freedom, principle of equipartition of energy, molecular velocities and their inter relation, quantum yield and its experimental determination, abnormal quantum yields, Jablonski diagram, kinetics of photochemical combination of H_2 and Cl_2 and decomposition of HI, the applications of radio isotopes, nuclear reactor and nuclear models, imperfections in crystals, elements of symmetry, cubic and hexagonal packing, structure of NaCl, KCl and ZnS, the experimental methods to determine various colligative properties	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	1	1	1	1	1	1
CO2	1	2	1	1	1	1	1
CO3	2	3	2	2	1	1	2
CO	2	2	2	1	1	3	2
CO5	2	2	2	2	1	1	1
Total Contribution of COs to POs	**8**	**10**	**8**	**7**	**5**	**5**	**9**
Weighted Percentage of COs Contribution to POs	**53.3**	**66.66**	**53.33**	**46.6**	**33.33**	**33.3**	**60**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT
PHYSICAL CHEMISTRY -I

UNIT I – GASEOUS STATE (L - 11 hrs, T- 1 hr)

Behaviour of ideal gases- gas laws- ideal gas equation - postulates of kinetic theory of gases (no derivation), **Types of molecular velocities and their inter relations** - Mean, RMS, Most Probable Velocities - Calculation of Most Probable Velocity, Average Velocity and Root Mean Square velocity.

Maxwell's Distribution of Molecular Velocities- Statement of equation and explanation (no derivation), Graphical representation - effect of temperature on velocity distribution. Collision diameter, Collision number, Collision freqeuency, Mean free path. **Degrees of freedom of gaseous molecules**- principle of equipartition of energy - heat capacity and molecular basis. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity

UNIT - II PHOTO CHEMISTRY (L -11 hrs, T- 1 hr)

Introduction to Photochemistry- **Laws of photochemistry** – Beer- Lambert's law, Grotthus - Draper law, Stark - Einstein law - **Quantum efficiency** – experimental determination of quantum yield. primary and secondary processes. **Energy transfer in photochemical processes** – Jablonski diagram: radiative and non-radiative transitions, internal conversion, intersystem crossing - **qualitative description of fluorescence, phosphorescence, chemiluminescence, bioluminescence, thermoluminescence**. **photosensitization** and **quenching**, **photochemical reactions** - kinetics of photochemical combination of hydrogen and chlorine and decomposition of HI. **Lasers** – principle, types and uses- Difference between thermal and photochemical reactions

UNIT - III NUCLEAR CHEMISTRY (L -11 hrs, T- 1 hr)

Natural radioactivity **- detection and measurement of radioactivity.** Geiger- Nuttal rule **- rate of disintegration and half-life period - average life period -** nuclear stability**, n/p ratio, magic numbers, mass defect and binding energy – Nuclear shell structure theory- liquid drop model, shell model - isotopes, isobars, isotones and nuclear isomers.** Artificial radioactivity **- nuclear fission and nuclear fusion –applications - differences –** Stellar energy **- nuclear reactors - hazards of radiations - fertile and fissile isotopes.** Applications of radioisotopes **– C^{14} dating, rock dating, neutron activation analysis and isotope as tracers - study of reaction mechanism**

UNIT – IV SOLID STATE (L -11 hrs, T-1 hr)

Crystalline and amorphous solids - isotropy and anisotropy - Crystal lattices – Lattice energy.- Born equation - **Laws of crystallography** – Elements of Symmetry- **Crystal Systems** - unit cell, space lattice, Bravais lattices, Miller indices - **cubic and hexagonal packing** – radius ratio rule, tetrahedral and octahedral voids. **Bragg's equation**- derivation and applications. **Determination of structure of crystals by X- ray diffraction methods** - rotating crystal and powder method, structure of NaCl, KCl and ZnS. **Imperfections in crystals** - Schottky defect, Frenkel defect, Non-stoichiometric defects. use of crystallographic data for the determination of Avogadro number and molecular mass

UNIT - V DILUTE SOLUTIONS (L -11 hrs, T- 1 hr)

Colligative properties of dilute solutions- relative lowering of vapour pressure, elevation of boiling point, Ebullioscopic constant - depression of freezing point. . Cryoscopic constants- **Osmosis** - osmotic pressure, laws - **osmotic pressure and concentration of solute** - Experimental methods for determining various colligative properties, Gottrell's method, Rast method- Degree of dissociation and association of solutes. **Abnormal molecular mass** – Van't Hoff factor.

Tutorial Topics:

UNIT I (1 hour)

Collision diameter - collision number - collision freqeuency - mean free path – Degrees of freedom of gaseous molecules.

UNIT - II (1 hour)

Chemiluminescence, bioluminescence, thermoluminescence, photosensitization and quenching.

UNIT - III (1 hour)
Magic number, C^{14} dating, rock dating

UNIT – IV (1 hours)
Structure of NaCl, KCl and ZnS.

UNIT V- (1 hours)
Abnormal molecular mass – Van't Hoff factor.

Text Books:

1. P.L. Soni. Text Book of Physical Chemistry, Sultan Chand and Sons, 9th Edition, 1983.
2. B. R. Puri, Madan S. Pathania, Principles of Physical Chemistry, Millennium Edition, Vishal Publishing Co, 2019.

Reference books:

1. Peter Atkins, Julio de Paula, Physical Chemistry, Oxford University Press, 11th Edition, 2018.
2. Gurdeep Raj, Advanced Physical Chemistry - Goel Publishing House, 34th Edition, 2008.
3. G.M.Barrow, Physical Chemistry, Tata McGraw Hill, 6th Edition, 2007.
4. Samuel Glastone, Source book of Atomic Energy. East West press, 3rd Edition, 2014.

Web References:

1. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/gaseous-state
2. http://photobiology.info/Photochem.html
3. https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/photchem.htm
4. https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/photchem.htm
5. https://www.sas.upenn.edu/~mcnemar/apchem/nuclear.pdf
6. https://opentextbc.ca/introductorychemistry/chapter/dilutions-and-concentrations-2/

Quantitative Analysis (Volumetric method)

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Core Practical I	U21CH2P1	Inorganic Quantitative Analysis (Volumetric method)	-	-	60	2

Contact hours per Semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
First	**First & Second**	**40**	**60**	**100**

Preamble:

The Course is designed to provide students quantitative skills in Volumetric analysis viz. making up of solutions, preparing standard solutions, filling the burette, pipetting out etc. and train them to calculate strengths of solutions. The students will be able to understand the theories of acid-base (neutralization), redox and complexometric titrations.

Course Outcomes (COs)

On successful completion of the Course, the learners should be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	recall the principles of volumetric titrations	K1
CO2	demonstrate the experimental skills in volumetric titration	K2
CO3	apply the volumetric formula to calculate strengths of solutions	K3
CO4	analyse the theory of indicators and employ it in volumetric titrations	K4
CO5	evaluate and interpret the results of Volumetric Analysis	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	3	3	3	2	2	2
CO2	2	3	3	3	3	2	2

CO3	2	2	2	1	3	2	2
CO4	2	2	2	2	3	2	2
CO5	2	2	2	2	3	2	2
Total Contribution of COs to POs	**10**	**12**	**10**	**11**	**14**	**10**	**10**
Weighted Percentage of COs Contribution to POs	**66.6**	**80**	**80**	**73.3**	**93.3**	**66.6**	**66,6**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT
INORGANIC QUANTITATIVE ANALYSIS (VOLUMETRIC METHOD)

I. Calibration of Volumetric Apparatus: Burette, Pipette and Standard flasks

II. Making up of solutions

III. Acidimetry and alkalimetry

1. Estimation of oxalic acid – Std. oxalic acid
2. Estimation of Na_2CO_3 – Std. Na_2CO_3
3. Estimation of hydrochloric acid – Std. oxalic acid

IV. Permanganometry

4. Estimation of sodium oxalate – Std. oxalic acid
5. Estimation of ferrous ammonium sulphate – Std. ferrous ammonium sulphate
6. Estimation of ferrous sulphate – Std. oxalic acid

V. Iodometry

7. Estimation of copper – Std. copper sulphate
8. Estimation of $K_2Cr_2O_7$ – Std. $K_2Cr_2O_7$

VI. Dichrometry

9. Estimation of ferrous iron – Std. ferrous ammonium sulphate
10. Estimation of $K_2Cr_2O_7$ – Std. $K_2Cr_2O_7$

VII. Complexometry

11. Estimation of Zn – Std. $ZnSO_4$
12. Estimation of Pb – Std. $ZnSO_4$
13. Estimation of Mg – Std. $ZnSO_4$
14. Estimation of Ca - Std. $ZnSO_4$
15. Estimation of Mn- Std. $ZnSO_4$
16. Estimation of Cu - Std.$CuSO_4$
17. Estimation of Ni- Std. Nickel ammonium sulphate

VIII. Water Analysis:

18. Estimation of Total Hardness (Permanent, Temporary hardness)

(Any Eight Estimations from the above mentioned Volumetric Estimations have to be recorded)

Text Books:

1. G.H.Jeffery, J.Bassett, J.Mendham and R.C.Denny 'Vogel's Text book of Quantitative Chemical Analaysis', ELBS, London, 5th Edition, 1989.
2. D.N Bajpai, O.P. Pandey, S. Gini, Practical Chemistry, for I, II & III BSc Students. S.Chand & Company Ltd, 30th Edition, 2013.

Reference books:

1. I.M.Kolthoff and E.A.Sanderson, Quantitative Chemical Analysis, Macmillan, Madras, 1980.
2. V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulate College Practical Chemistry, Universities Press (India) Pvt Ltd, 2008 (reprint).

Web Reference

1. https://gtu.ge/AgroLib/Vogel_TEXTBOOK_OF_QUANTITATIVE_CHEMICAL_ANALYSIS_5th_ed__-_G_H_Jeffery.MsuCity.pdf

for Physical Sciences- I

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part –III	Additional Core -1	U21PS1PE	Professional English for Physical Science - I	-	-	-	4

Contact hours per semester: -60
Contact hours per week: -4

Year	Semester	Internal Marks	External Marks	Total Marks
First	First	25	75	100

Preamble:

The learning objective of the to develop the language skills of students by offering adequate practice in professional contexts, to enhance the lexical, grammatical and socio-linguistic and communicative competence of first year physical sciences students, to focus on developing students' knowledge of domain specific registers and the required language skills, to develop strategic competence that will help in efficient communication and to sharpen students' critical thinking skills and make students culturally aware of the target situation.

Course Outcomes (COs):

On successful completion of the course, the learners should be able to

CO No.	Course Outcome	Knowledge Level
CO1	Recognize their own ability to improve their own competence in using the language.	K1
CO2	Use language for speaking with confidence in an intelligible and acceptable manner.	K2
CO3	Understand the importance of reading for life and Read independently unfamiliar texts with comprehension.	K3
CO4	Understand the importance of writing in academic life.	K4
CO5	Write simple sentences without committing error of spelling or grammar.	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

COURSE CONTENT

PROFESSIONAL ENGLISH FOR PHYSICAL SCIENCE - I

Unit I:

Communication Listening: Listening to audio text and answering questions - Listening to Instructions.
Speaking: Pair work and small group work.
Reading: Comprehension passages –Differentiate between facts and opinion.
Writing: Developing a story with pictures**.**
Vocabulary: Register specific - Incorporated into the LSRW tasks.

Unit II:

Description Listening: Listening to process description.-Drawing a flow chart. **Speaking:** Role play (formal context).
Reading: Skimming/Scanning- Reading passages on products, equipment and gadgets.
Writing: Process Description –Compare and Contrast Paragraph-Sentence Definition and Extended definition- Free Writing.
Vocabulary: Register specific -Incorporated into the LSRW tasks.

Unit III:

Negotiation Strategies Listening: Listening to interviews of specialists / Inventors in fields (Subject specific)
Speaking: Brainstorming.(Mind mapping). Small group discussions (Subject- Specific) **Reading:** Longer Reading text.
Writing: Essay Writing (250 words)
Vocabulary: Register specific - Incorporated into the LSRW tasks.

Unit IV:

Presentation Skills Listening: Listening to lectures.
Speaking: Short talks.
Reading: Reading Comprehension passages.
Writing: Writing Recommendations Interpreting Visuals inputs.
Vocabulary: Register specific - Incorporated into the LSRW tasks

Unit V:

Critical Thinking Skills Listening: Listening comprehension- Listening for information.
Speaking: Making presentations (with PPT- practice).
Reading: Comprehension passages –Note making. Comprehension: Motivational article on Professional Competence, Professional Ethics and Life Skills).
Writing: Problem and Solution essay– Creative writing –Summary writing.
Vocabulary: Register specific - Incorporated into the LSRW tasks.

Books:

1. Isaac Assimov – *I, Robot* (film also available)
2. Isaac Assimov – *The Last Question*
3. Antoine De Saint Exupery – *The Little Prince*
4. Philip K. Dick – *Do Androids Dream of Electric Sheep?*
5. Stephen Hawking – *A Brief History of Time*

Channels/Videos:

1. Discovery Channel
2. National Geographic Channel
3. Kurzgesagt (videos on YouTube)
4. Joe Scott (videos on YouTube)

Elective Generic I: Allied Chemistry- I

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Elective Generic - I	U21CH1A1	Allied Chemistry I	55	5	-	3

Contact hours per Semester: 60
Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
First Botany/ Second Physics	**First/ Third**	**25**	**75**	**100**

Preamble

The Course is designed to equip the students with the knowledge of basic concepts in atomic structure and bonding, reactions of organic compounds, reaction intermediates, different kinds of photochemical processes and polymers. It also gives an insight into some of the chemicals used in day to life

Course Outcomes (COs)

On successful completion of the Course, the learners should be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	Recall the basic concepts of atomic structure and chemical bonding, reaction intermediates, types of reactions, basics of photo chemistry, polymer chemistry and applied chemistry	K1
CO2	understand the structure and bonding in molecules, types of reactions, photophysical processes and photo chemical reactions	K2
CO3	identify and differentiate photochemical processes	K3
CO4	classify different types of polymers and polymerization reactions	K4
CO5	justify the chemicals used in day-to-day life	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	2	1	1	1	2
CO2	2	1	2	1	1	1	1
CO3	2	1	2	1	1	1	1

CO4	2	1	2	1	1	1	1
CO5	2	1	2	1	1	1	1
Total Contribution of COs to POs	**10**	**5**	**10**	**5**	**5**	**5**	**6**
Weighted Percentage of COs Contribution to POs	**66.6**	**33.3**	**40**	**33.3**	**33.3**	**33.3**	**40**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT

ALLIED CHEMISTRY - I

Unit I – Inorganic Chemistry - Atomic Structure and Chemical Bondimg (L -11 hrs, T- 1 hr)

Atomic structure: electronic configuration - Aufbau principle - Pauli's exclusion principle- Hund's rule. **Bonding-** electrovalent, covalent, hydrogen bonds. **orbital overlap** - s-s, s-p. **Hybridisation and VSEPR theory** - CH_4, C_2H_4, C_2H_2- $BeCl_2$, BF_3, NH_3, H_2O, PCl_5, IF_5, IF_7.

Unit II - Organic Chemistry – Principles of reactions (L -11 hrs, T- 1 hr)

Heterolytic and homolytic cleavage - nucleophiles and electrophiles, **reaction intermediates** – preparation and properties of carbonium ions, carbanions and free radicals - **types of reactions** - substitution, addition, elimination and polymerisation reactions.

Unit III - Physical Chemistry – Photochemistry (L -11 hrs, T- 1 hr)

Definition - Laws of photochemistry-Beer Lambert's law-Grothus Draper law-Einstein's law-low and high quantum yield-determination of quantum yield- **fluorescence, phosphorescence, thermoluminescence, chemiluminescence and bioluminescence**-definition with examples - photosensitisation. **comparision between thermal and photochemical reactions**

Unit IV - Polymer Chemistry (L -11 hrs, T- 1 hr)

Definition- Monomers, Oligomers and Polymers - **Classification of polymers**- natural, synthetic- linear, branched and cross linked polymers- plastics, elastomers, fibres- homopolymers and co-polymers. **Thermoplastics**: polyethylene, polypropylene, polystyrene, polyacrylonitrile, polyvinyl chloride, nylon and polyester - **Thermosetting Plastics** : phenol formaldehyde and epoxide resin. **Elastomers:** natural and synthetic rubber - Buna - N, Buna-S and neoprene rubber

Unit V - Applied Chemistry (L -11 hrs, T- 1hr)

Lubricants - classification, criteria of good lubricating oils, **synthetic lubricating oils**- poly glycols and poly alkene oxides**. greases or semi solid lubricants**: examples, **solid lubricants**-graphite, Preparation and uses of shampoo, nail polish, sun screens, tooth powder, tooth paste, boot polish, moth ball and chalk piece.

Tutorial topics

Unit I (1 hour)

Hybridisation and VESPR theory - CH_4, C_2H_4, C_2H_2, $BeCl_2$, BF_3, NH_3, H_2O, PCl_5, IF_5, IF_7.

Unit II (1 hour)

substitution, addition, elimination and polymerisation reactions.

Unit III (1 hour)

fluorescence, phosphorescence, thermoluminescence, chemiluminescence and bioluminescence

Unit IV (1 hour)

Classification of polymers

Unit V (1 hour)

Preparation and uses of shampoo, nail polish, sun screens, tooth powder, tooth paste, boot polish, moth ball and chalk piece.

Text Books:

1. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand and Co., Delhi, 33rd Edition, 2017.
2. P.L. Soni, Mohan Katyal, Text book of Inorganic Chemistry, Sultan Chand & Sons, 20th Edition, 2015.
3. V.R. Gowariker, Polymer Science, New Age International Publishers, 3rd Edition, 2019.
4. B.R. Puri and L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, S. Chand & Co. 47th Edition, 2017.

Reference Books:

1. K. S. Tewari and N. K. Vishnoi, A Text Book of Organic Chemistry, Vikas Publishing House, 4th Edition, 2017
2. Arun Bahl and B.S. Bahl, Advanced Organic Chemistry, S. Chand and Sons, 1st Edition, 2012.
3. M.K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co, 1st edition, 2009.
4. K.K.Rohatgi Mukherjee, Fundamentals of Photochemistry, Wiley Eastern Ltd, 1978.
5. Malcom P. Stevens, Polymer Chemistry – An Introduction, OUP, USA, 3rd Edition, 1999.
6. SawyerW, Experimental Cosmetics, Dover publishers, New York, 2000.

Web References:

1. https://byjus.com/jee/atomic-structure/
2. https://tophat.com/marketplace/science-&-math/chemistry/textbooks/organic-chemistry-principles-reactions-and-mechanisms-guy-plourde/3275/
3. http://photochemistry.epfl.ch/PC/photochemistry%20-book.pdf2.
4. http://cryssmat.fq.edu.uy/ricardo/libro.pdf
5. https://www.industrialchemicals.gov.au/cosmetics-and-soap/cosmetics-and-therapeutics

Semester /Elective Generic Practical I: Inorganic Quantitative Analysis (Volumetric Method) and Organic Analysis

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Elective Generic Practical-I	U21CH2AP	Inorganic Quantitative Analysis (Volumetric Method) and Organic Analysis	-	-	60	2

Contact hours per Semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
First Botany Second Physics	**First & Second Third & Fourth**	**40**	**60**	**100**

Preamble:

The Course is designed to provide students quantitative skills in volumetric analysis viz.making up of solutions, preparing standard solutions, filling the burette, pipetting out etc. and train them to calculate strengths of solutions. The students will be able to understand the theories of acid- base (neutralization), redox and complexometric titrations They will be able to identify the organic functional group, aliphatic/aromatic and saturated/unsaturated nature of compounds.

Course Outcomes (COs)

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	understand the concept of volumetric titrations and carry out volumetric titrations	K1
CO2	demonstrate the experimental skills in volumetric titration and organic analysis	K2
CO3	apply the volumetric formula to calculate the strengths of solutons, observe, infer and thereby identify the functional group present in the organic compound	K3
CO4	analyse and apply the theory of indicators in volumetric titration	K4
CO5	Evaluate and interpret the results in volumetric and organic analyses	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	3	3	3	3	2	2
CO2	2	3	2	3	2	2	2
CO3	2	3	2	2	2	2	2
CO4	2	3	2	2	2	2	2
CO5	2	3	2	2	2	2	2
Total Contribution of COs to POs	**10**	**15**	**10**	**12**	**11**	**10**	**10**
Weighted Percentage of COs Contribution **to POs**	**66.6**	**100**	**53.33**	**80**	**73.3**	**66.6**	**66.6**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT

INORGANIC QUANTITATIVE ANALYSIS (VOLUMETRIC METHOD) AND ORGANIC ANALYSIS

A. Volumetric Analysis:

1. Calibration of volumetric Apparatus: Burette, Pipette and Standard flasks

2. Acidimetry and alkalimetry

1. Estimation of oxalic acid – Std. oxalic acid
2. Estimation of Na_2CO_3 – Std. Na_2CO_3
3. Estimation of hydrochloric acid – Std. oxalic acid

3. Redox Titations:

4. Estimation of ferrous ammonium sulphate Std. FAS (Permanganometry)
5. Estimation of oxalic acid – Std. oxalic acid (Permanganometry)
6. Estimation of ferrous sulphate – Std. oxalic acid (Permanganometry)
7. Estimation of copper – Std. copper sulphate (Iodometry)
8. Estimation of $K_2Cr_2O_7$ – Std. $K_2Cr_2O_7$ (Iodometry)
9. Estimation of ferrous iron –Std. FAS (Dichrometry)
10. Estimation of $K_2Cr_2O_7$ – Std. $K_2Cr_2O_7$ (Dichrometry)

4. Complexometrc Titrations

11. Estimation of Zn – Std. $ZnSO_4$
12. Estimation of Mg – Std. $ZnSO_4$

B. Organic Analysis

1. Test for aromatic and aliphatic nature of substances
2. Test for saturation and unsaturation
3. Detection of Nitrogen
4. Identification of functional groups
   a) Carboxylic acid(mono & di)
   b) Phenols
   c) Aldehydes
   d) Ketones
   e) Carbohydrates
   f) Primary amines
   g) Amides

   (Any six Volumetric Estimations and any six Organic Analysis from the above list have to be recorded)

Text Books:

1. G.H.Jeffery, J.Bassett, J.Mendham and R.C.Denny 'Vogel's Text book of Quantitative Chemical Analaysis', ELBS, London, 5th Edition, 1989.
2. D.N Bajpai, O.P. Pandey, S. Gini, Practical Chemistry, for I, II & III BSc Students. S.Chand & Company Ltd, 30th Edition, 2013.

Reference books:

1. I.M.Kolthoff and E.A.Sanderson, Quantitative Chemical Analysis, Macmillan, Madras, 1980.
2. V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulate College Practical Chemistry, Universities Press (India) Pvt. Ltd, 2008 (reprint).

Web Reference

1.https://gtu.ge/AgroLib/Vogels_TEXTBOOK_OF_QUANTITATIVE_CHEMICAL_ANALYSIS_5th_ed__-_G_H_Jeffery.MsuCity.pdf

Studies

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – IV	AECC1	U21AE101	Environmental Studies	30	-	-	2

Contact hours per Semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
First	**First**	**--**	**50**	**50**

Preamble

The Course is designed to provide Students knowledge about the basic concepts, components and importance of environment.

Course Outcomes

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level
1.	define the structure and functions of ecosystem	K1
2.	explain the benefits of biodiversity conservation	K2
3.	summarise the sources, effects and control measures of various types of Pollution	K1
4.	Perceive the environment legislations in India for sustainable development.	K3

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Cre

COURSE CONTENT

ENVIRONMENTAL STUDIES

Unit I: (L-6 Hours)

Definition and Scope of Environmental Studies – Ecology and Ecosystem – Structure of an Ecosystem – Types & Function of Ecosystem - Food chains, food webs, energy flow and ecological pyramids.

Unit II: (L-6 Hours) Environmental problems and Management: Causes, effects and Control measures of Air Pollution – Water Pollution – Noise Pollution – Nuclear Hazards. Solid waste management and Waste Disposal methods.

Unit III: (L-6 Hours)

Biodiversity and its conservation: Introduction-definition, Types of diversity: genetic, species and ecosystem biodiversity. Value of biodiversity: Consumptive use, productive use, social, ethical and aesthetic values. Biodiversity at global, national and local levels.

Unit IV: **(L-6Hours)**

Environment protection Act, Wildlife protection Act, Forest conservation Act, Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Environment Impact Assessment (EIA).

Unit V: **(L-6 Hours)**

Climate change and Global Warming causes and Measures. Disaster management: floods, earthquake, cyclone and landslides. Social issues and the Environment: Rain water harvesting, watershed management.

Text Books

1. P.D.Sharma.2003. Ecology and Environment. Rastogi Publication.
2. N. Arumugam and V. Kumaresan. Environmental Studies. Saras Publication.

Reference Books

1. Agarwal. K.C. 2001. Environmental Biology, Nidi Publications Limited, Bikaner.
2. A.K.De. 1999. Environmental Chemistry, Wiley Eastern Limited, India.
3. Jadhav,H. and Bhosale, V.M.1995. Environmental Protection and Laws,Himalaya Publishing House, Delhi. pp284.
4. Odum, E.P.1971. Fundamentals of Ecology, W.B.Saunders Co., USA. pp.574.

E-References

1. Biodiversity: https://www.pmfias.com/biodiversity-hotspots-india/
   https://byjus.com/free-ias-prep/biodiversity/
2. Pollution; https://www.livescience.com/22728-pollution-facts.html
   https://sciencing.com/types-pollutants-5270696.html
3. Wildlife Protection Act:
   https://www.indiacode.nic.in/handle/123456789/1726?view_type=browse&sam_handle=123456789/1362
4. https://byjus.com/free-ias-prep/wildlife-protection-act-1972/

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Core – 3	U21CH203	Inorganic Chemistry II	55	5	-	4

Contact hours per Semester: 60
Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
First	**Second**	**25**	**75**	**100**

Preamble

The Course is designed to provide students an in-depth knowledge about noble gases and their compounds.It also gives an insight into the Chemistry of d & f block elements, an understanding about the basic concepts of metallurgy and a grasp on the principles of inorganic volumetric titration and the theories behind inorganic qualitative analysis.

Course Outcomes (COs)

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	remember the chemistry of noble gases, d and f block elements, principles of metallurgy and theory of practicals	K1
CO2	explain the properties of noble gases, d and f block elements, principles of metallurgy and theory of practicals	K2
CO3	apply the knowledge of solubility product and common ion effect in inorganic qualitative analysis and inorganic quantitative estimations	K3
CO4	analyse the theory of inorganic practicals, principles of metallurgy, general properties of d and f block elements	K4
CO5	justify the position of noble gases, d and f block elements in the periodic table	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	2	2	1	2	2
CO2	2	1	2	2	1	2	2
CO3	2	1	2	2	1	2	2
CO4	3	1	2	3	1	2	2
CO5	2	1	2	2	1	2	2
Total Contribution of	**11**	**5**	**10**	**11**	**5**	**10**	**10**

COs to POs							
Weighted Percentage of COs Contribution to POs	**73.3**	**33.3**	**66.6**	**73.3**	**33.3**	**66.6**	**66.6**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT

INORGANIC CHEMISTRY II

UNIT-I NOBLE GASES (L -11 hrs, T- 1 hrs)

Occurrence. isolation of noble gases from the atmosphere, separation of the gases from one another. **general physical properties** - special properties of helium, isotopes of helium, uses of noble gases, importance of inert gases in theoretical chemistry, **chemical properties**. **xenon chemistry**: preparation and properties of fluorides, **oxides and oxofluorides of xenon**- xenates and perxenates - xenon fluoride complexes - structure and bonding in xenon compounds. Fluorides of Krypton and Radon - **hydrates and clathrates of noble gases** - uses of clathrate compunds.

UNIT II- CHEMISTRY OF d - BLOCK ELEMENTS (L -11hrs, T-1 hr)

Occurence, General characteristics of d- Block elements – Group study of Titanium, Vanadium, Iron, Coinage and Zinc group metals. **Important compounds of transition metals:** Ziegler – Natta catalyst. Prussian blue, Sodium nitroprusside, Turnbull's blue, Ni-DMG complex, Wilkinsn's Catalyst, $KMnO_4$ and $K_2Cr_2O_7$.

UNIT III- CHEMISTRY OF f- BLOCK ELEMENTS (L -11 hrs, 1 hr)

Occurrence, General characteristics of f-block elements- Synthetic elements, **comparative account of lanthanides and actinides** – oxidation states, magnetic properties, **colour and spectra** – separation by ion exchange and solvent extraction methods – lanthanide contraction — preparation, properties and uses of ceric ammonium sulphate, thorium dioxide, thorium nitrate, uranium hexafluoride, uranylacetate.

UNIT IV- METALLURGY (L -11 hrs, T- 1 hr)

Occurrence of metals- Ores and minerals in lithosphere -Mineral wealth of India **principles of metallurgy**: **concentration of ores** – froth floatation, magnetic separation, calcination, roasting and smelting. **Purification of metals** – electrolysis, zone refining, van Arkel de Boer methods. **Extraction of the following metals in pure form** - Li, Be, Ti, V, Th and U

UNIT V: THEORY OF INORGANIC PRACTICALS (L -11 hrs, T- 1 hr)

Inorganic Qualitative Analysis: Interfering acid radicals and their elimination (oxalate, fluoride, borate, phosphate, chromate, arsenite and arsenate)–**Titrimetry:** Primary standard-Molarity, Molality Formality, Normality, wt%, ppm, milli equivalence and millimoles - problems **Types of titrimetric reactions** – Acid-Base, Redox, Iodometric, Iodimetric, Precipitation and Complexometric titrations – Indicators. **Gravimetric analysis**: **Precipitation from homogeneous soloution**- precipitants, conditions for precipitation, co-precipitation and post precipitation, washing of precipitates. Minimisation of errors

Tutorial Topics

UNIT-I (1 hour)

Isolation of noble gases from the atmosphere - separation of the gases from one another - general physical properties - uses of noble gases.

UNIT-II (1 hour)

Important compounds of transition metals: Ziegler – Natta catalyst. Prussian blue, Sodium nitroprusside, Turnbull's blue, Ni-DMG complex, Wilkinsn's Catalyst, $KMnO_4$ and $K_2Cr_2O_7$.

UNIT-III (1 hour)

Occurrence, General characteristics of f-block elements- Synthetic elements, comparative account of lanthanides and actinides – oxidation states, magnetic properties, colour and spectra

UNIT IV (1 hour)

Principles of metallurgy-concentration of ores.

UNIT V (1 hour)

Titrimetry: Primary standard- Molarity, molality formality, normality, wt% , ppm, milli equivalence and millimoles –problems, types of titrimetric reactions.

Text Books:

1. Puri B.R., Sharma L.R., Kalia K.K., Principls of Inorganic Chemistry, Vallabh Publication, New Delhi, 28th Edition, 2004
2. G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denny, Vogel's Text book of Quantitative Chemical Analysis, ELBS, 5th Edition, 1989.
3. R. Gopalan, V. Ramalingam, Concise Coordination Chemistry, Vikas Publishing House PVT LTD, New Delhi, 1st Edition, 2008.

Reference Books

1. R.D. Madan, Advanced Inorganic Chemistry, S. Chand & Company, New Delhi, 2nd Edition, 2005.
2. J.D.Lee, Concise Inorganic Chemistry, Oxford University Press, New Delhi, 5th Edition, 2008.

3. D.A.Skoog and D.M.West, Fundamentals of Analytical Chemistry, Holler Saunders College Publishing, USA. 6th Edition, 1998.

Web References:

1. https://courses.lumenlearning.com/introchem/chapter/the-noble-gases-group-18/

2.https://books.google.co.in/books?id=Mtth5g59dEIC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

3.https://gtu.ge/AgroLib/Vogels_TEXTBOOK_OF_QUANTITATIVE_CHEMICAL_ANALYSIS_5th_ed-G_H_Jeffery.MsuCity.pdf

4. http://fmcet.in/MECH/ME2253(ME)_uw.pdf

Part-III (B.Sc. Chemistry) / Semester – II / Core 4 – Organic Chemistry I

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Core – 4	U21CH204	Organic Chemistry I	55	5	-	4

Contact hours per Semester: 60
Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
First	**Second**	**25**	**75**	**100**

Preamble

The Course is designed to equip students with the basic knowledge on nomenclature of organic compounds, their structure and classification. It also gives an insight into the theories of hybridization and fundamental concepts associated with electronic effects in organic compounds. It also provides basic knowledge of the Chemistry of olefins, mechanisms of SN1, SN2, E1 and E2 reactions and an insight into the properties of alcohols and ethers.

Course Outcomes (COs)

On successful completion of the Course, the learners should be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	recall the classification and nomenclature of organic compounds, types of structural isomerism, electronic theories, dissociation of bonds, stability of free radicals, carbonium ions, carbanions, types of reactions, preparation and uses of halogen derivatives, addition reactions of olefines, differences between 1º, 2° and 3º alcohols and between ethers and alcohols, estimation of hydroxyl groups and methoxy groups. preparation and properties of allyl alcohol. preparation and uses of oxirane and dioxane	K1
CO2	understand the classification and nomenclature of organic compounds, explain structural isomerism, the electronic theories of organic compound, dissociation of bonds, stability of free radicals, carbonium ions, carbanions, olefins, types of reactions, preparation and uses of halogen derivatives, addition reactions of olefines, differences between 1º, 2° and 3º alcohols and between ethers and alcohols, estimation of hydroxyl groups and methoxy groups, preparation and properties of allyl alcohol, preparation and uses of oxirane and dioxin	K2
CO3	apply the knowledge of IUPAC nomenclature to naming of organic	K3

	compounds, knowledge of hybridisation to predict the geometry of molecules, knowledge of electronic theories to predict the strength of aliphatic mono carboxylic acids and basic strength of amines, reactivity of alkyl halides in SN1 and SN2 reactions, to study their influence on the reactivity of organic compounds, stability of free radicals, carbonium ions and carbanions, markownikoff rule and peroxide effect to the addition reactions of unsymmetrical olefins, Saytzeff rule and Hoffmann rule to predict the major product in the elimination reactions of alkyl halides and quarternary ammonium hydroxide respectively, show the distinction between 1º, 2º and 3º alcohols and between alcohols and ethers, explain the mechanism of dehydration of alcohols, illustrate the estimation of hydroxyl group and Zeisel method for the estimation of methoxy group, calculate the no. of methoxy groups present in an organic compound using the given data, describe the preparation and properties of allyl alcohol, preparation and uses of oxirane, dioxan and dynamite	
CO4	categorise organic compounds on the basis of their carbon skeleton and functional groups, identify structural isomers, analyse the stability of resonance structures , the influence of electronic effects, relative strengths of acids and bases, the geometry of molecules in correlation with the hybridisation of molecules, electrophilic and nucleophilic, substitution , addition reactions and elimination reactions, differentiate between SN1 and SN2, E1 and E2 reactions, classify alkadienes, differentiate between terminal and non-terminal alkynes, analyse the mechanism of 1,2 and 1, 4 addition, distinguish between 1º, 2º and 3º alcohols and between alcohols and ethers, discuss the mechanism of dehydration of alcohols, preparation and properties of allyl alcohol , preparation and uses of oxirane and dioxan	K4
CO5	explain types of structural isomerism, rules of IUPAC system of nomenclature, various electronic effects and their applications, bond fission, stability of carbonium and carbanions and free radicals addition to unsymmetrical olefins, ozonolysis and its importance, hydroboration, dihydroxylation with $KMnO_4$, acidity of alkynes, formation of methyl acetylides, stability of conjugated dienes, mechanism of 1,2 and 1,4 addition, Diel's – Alder reaction and its mechanism, the types of reactions in organic chemistry, mechanism of SN1, SN2, E1 and E2 reactions with evidences for them, preparation, properties and uses of chloroform, CCl4, vinyl chloride, allyl chloride, westron, westrosol, chloroprene. Saytzeff and Hoffmann orientation in elimination of alkyl halides and quarternary ammonium hydroxides compare and distinguish primary, secondary and tertiary alcohols and differentiate between alcohols and ethers, explain the mechanism of dehydration of alcohols, estimate -OH and $-OCH_3$ groups, explain the preparation and properties of allyl alcohol, preparation and uses of	K5

	oxirane, dioxan and dynamite	

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	3	2	1	2	2
CO2	2	1	3	2	1	2	2
CO3	2	1	2	2	1	2	2
CO4	2	1	2	2	1	2	2
CO5	2	1	2	5	1	2	2
Total Contribution of COs to POs	**10**	**5**	**12**	**11**	**5**	**10**	**10**
Weighted Percentage of COs Contribution to POs	**66.6**	**33.3**	**80**	**73.3**	**33.33**	**66.6**	**66.6**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT
ORGANIC CHEMISTRY – I

UNIT-I IUPAC SYSTEM OF NOMENCLATURE (L -11 hrs, T- 1 hr)

IUPAC system of nomenclature of common organic compounds (upto C-10) – alkanes, alkenes, alkynes, cycloalkanes, bicycloalkanes with and without bridges and aromatic compounds. **Naming of organic compounds with one functional group** - halogen compounds, alcohols, phenol, aldehydes, ketones, carboxylic acids and its derivatives, cyano compounds, amines and nitro compounds (Both aliphatic and aromatic) -**Naming of compounds with two functional groups- naming of compounds with more than one carbon chain. Naming of heterocyclic compounds containing one and two hetero atoms present in five and six membered rings**. **Structural isomerism** – types with examples

UNIT-II FUNDAMENTAL CONCEPTS (L -11 hrs, T- 1 hr)

Electronic effects: inductive effect, resonance effect, resonance structures– conditions for resonance –stability of resonance structures, hyper conjugation, electromeric effect. Steric effect – steric overcrowding – steric inhibition– steric relief (with examples). **Dissociation of bonds** – homolysis and heterolysis- free radicals – carbocations – carbanions – stability of radicals, carbocations and carbanions. Electrophiles and nucleophiles Influence of electronic effects - dipole moment – relative strengths of acids and bases – stability of olefins

UNIT III HALOGEN DERIVATIVES (L -11 hrs, T- 1 hr)

Type of reactions - substitution, addition, elimination and polymerisation reactions. S_N1, S_N2, E_1 and E_2 mechanisms, Hoffmann's and Saytzeffs rule. preparation, properties and uses of

chloroform, carbon tetrachloride, vinyl chloride and allyl chloride- preparation and uses of westron, westrosol, freon and chloroprene.

UNIT-IV UNSATUTATED HYDROCARBONS (L -11 hrs, T- 1 hr)

Addition to unsymmetrical olefins: Markownikoff's rule and peroxide effect., hydroboration, ozonolysis, dihydroxylation with $KMnO_4$, allylic bromination by NBS (mechanisms not required). Classification of alkadienes, **stability of conjugated dienes**- Mechanism of 1, 2 and 1, 4- addition, Diels-Alder reaction. Acidity of alkynes and formation of metal acetylides.

UNIT-V ALCOHOLS & ETHERS (L -11 hrs, T-1 hr)

Distinction between primary, secondary and tertiary alcohols, nitroglycerol, dynamite. **estimation of hydroxyl groups**- mechanism of dehydration of alcohols. preparation and properties of allyl alcohol. Preparation and uses of oxirane and dioxin, **Estimation of number of methoxy groups**- Zeisel's method. Distinction between ethers and alcohol

Tutorial Topics

UNIT I (1 hour)

IUPAC system of nomenclature of Organic compounds- Structural isomerism

UNIT-II (1 hour)

Electronic effects: inductive effect, resonance effect, hyper conjugation, electromeric effect, Steric effect

UNIT-III (1 hour)

Type of reactions - substitution, addition, elimination and polymerisation reactions.
S_N1, S_N2, E_1 and E_2 mechanisms, Hoffmann's and Saytzeffs rule

UNIT -IV (1hour)

Markownikoff's rule and peroxide effect., hydroboration, ozonolysis, dihydroxylation with $KMnO_4$, allylic bromination by NBS

UNIT -V (1hour)

Distinction between primary, secondary and tertiary alcohols- Distinction between ethers and alcohol

Text Books:

1. K. S. Tewari and N. K. Vishnoi, A Text Book of Organic Chemistry, Vikas Publishing House, 4th Edition, 2017.
2. Arun Bahl and B.S. Bahl, Advanced Organic Chemistry, S. Chand and Sons, 1st Edition, 2012.
3. M.K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co, 1st Edition, 2009.

Reference Books:

1. N. Tiwari, Advanced Organic Reaction Mechanism, Books & Allied (P) Ltd, 3rd Edition, 2011.
2. I. L. Finar, Organic Chemistry Volume I, ELBS, Longmans, 6th Edition, 2002.
3. Bhupinder Mehta & Manju Mehta, Organic Chemistry - PHI Learning Pvt Ltd, 2nd Edition, 2015.

Web References:

1. https://www.clearIitmedical.com/2019/04/chemistry-notes-classification-and-nomenclature-
2. http://www.careerpoint.ac.in/download/smp_sample/Chemistry_Classifi.pdf
3. https://ncert.nic.in/ncerts/l/kech205.pdf
4. https://www.toppr.com/guides/chemistry/organic-chemistry/fundamental-concepts-of-organic-reaction-mechanism/
5. http://chemistry.univer.kharkov.ua/files/seminar_4.pdf
6. http://www.organicmystery.com/HaloGroup/ClassificationOfHalogenContainingCompounds.php
7. https://tophat.com/marketplace/science-&-math/chemistry/textbooks/organic-chemistry-principles-reactions-and-mechanisms-guy-plourde/3275

Part - III B.Sc. Chemistry / Semester – I / Additional Core : Professional English for Physical Sciences- II

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part –III	Additional Core – 2	U21PS2PE	Professional English for Physical Science - II	-	-	-	4

Contact hours per semester: -

Contact hours per week: -

Year	Semester	Internal Marks	External Marks	Total Marks
First	Second	25	75	100

Preamble:

The learning objective of the Course is to develop the language skills of students by offering adequate practice in professional contexts, to enhance the lexical, grammatical and socio-linguistic and communicative competence of first year physical sciences students, to focus on developing students' knowledge of domain specific registers and the required language skills, to develop strategic competence that will help in efficient communication and to sharpen students' critical thinking skills and make students culturally aware of the target situation.

COURSE CONTENT
PROFESSIONAL ENGLISH FOR PHYSICAL SCIENCE - II

Unit I: Communicative Competence

Calculus can save life - Coding as a creative art - Relativity of time and space - The spirit of chemical sciences.

Unit II: Persuasive Communication

Counting the sequence - Robots come in peace - Electronic fitness trackers - Lavoisier – The Father of Modern Chemistry.

Unit III: Digital Competence

The Fibonacci around us - Software localization and social justice - Digital competence for academic and professional life - Electronic warfare and defense - Phosgene - The Deadly villain of the Bhopal Gas Tragedy.

Unit IV: Creativity And Imagination

Walking on water like a water strider: A Glimpse on surface tension - The invention story of Barcodes - Acid-Base chemistry with at - Home Volcanoes - Ada and her breakthrough in analytical engine.

Unit V: Workplace Communication & Basics of Academic Writing

Workplace Communication - Academic PowerPoint presentation - Artificial Intelligence - Siri, Cortana, and Alexa Carry the marks of their human makers – Drafting a Circular – Writing minutes of a meeting – Writing Introduction, Paraphrase and Summary – Punctuation - Capitalization.

Part-III B.Sc. Botany Semester – II & B.Sc. Physics Semester – IV / Elective Generic II: Allied Chemistry II

Category	Course Type	Course Code	Course Title		Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Elective Generic – II	U21CH2A2	Allied Chemistry II		55	5	-	3

Contact hours per Semester: 60
Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
First Botany Second Physics	**Second Fourth**	**25**	**75**	**100**

Preamble

The Course is designed to equip students with the knowledge of the Chemistry of aromatic compounds, nuclear reactions and study of the applications of radio isotopes. It gives an understanding about the Chemistry of some important biomolecules, fuels, fertilizers, soaps, cement and glass. It also provides an insight into some of the common diseases and the drugs used for common ailments in our daily life.

Course Outcomes (COs)

On successful completion of the Course, the learners should be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	recall the preparation, properties and structure of aromatic compounds. and the classification of carbohydrates, amino acids and proteins	K1
CO2	summarise the applications of radio isotopes.	K2
CO3	apply the knowledge about common diseases and drugs in common ailments encountered in daily life	K3
CO4	analyse the composition of fuels, fertilizers, soaps, cement and glass	K4
CO5	explain the Chemistry of carbohydrates, amino acids, proteins and nucleic ac	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Creative

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	2	2	1	2	2
CO2	2	1	2	1	1	2	2

CO3	2	1	2	1	1	2	2
CO4	2	2	2	1	1	2	2
CO5	2	2	2	1	1	2	2
Total Contribution of COs to POs	**10**	**7**	**10**	**6**	**5**	**10**	**10**
Weighted Percentage of COs Contribution to POs	**66.6**	**46.6**	**66.6**	**40**	**33.3**	**66.6**	**66.6**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT
ALLIED CHEMISTRY - II

UNIT I: ORGANIC CHEMISTRY - Aromatic compounds (L – 11 hrs, T- 1 hr)

General characteristics of aromatic compounds – aromaticity, Huckel's rule with examples, non – benzenoid aromatic compounds ss(definition and examples only) Preparation, properties and structure of benzene, naphthalene and anthracene.

UNIT II: PHYSICAL CHEMISTRY - Nuclear chemistry (L -11 hrs, T- 1 hr)

Nuclear stability – n/p ratio, packing fraction, mass defect, binding energy. isotopes, isobars, isotones with examples. Separation of isotopes by diffusion method. Group displacement law, radioactive series. Nuclear fission, fusion - Application of radio isotopes (radio diagnosis and therapy, C-14 dating).

UNIT III: BIO- CHEMISTRY (L -11 hrs, T- 1 hr)

Carbohydrates –definition and classification – artificial synthetic sweeteners. Amino acids - classification – amphoteric nature – isoelectric point. **Proteins** - classification according to composition, solubility and shape - colour reactions - biological action. **Nucleic acids** – purines, pyrimidines, nucleosides, nucleotides, **DNA** – structure of DNA . **RNA** - different types of RNA.

UNIT IV: INDUSTRIAL CHEMISTRY (L -11 hrs, T- 1 hr)

Fuel gases – Water gas, Producer gas, L.P.G, Gobar gas and Natural gas. **Fertilizers** – N.P.K and mixed fertilizers. **Soaps and detergents** – an elementary idea of soaps and detergents- Cleansing action of soaps and detergents. **Cement and glass**: Portland cement: manufacture only. Manufacture of glass, types and uses of borosilicates -photochromic and safety glass.

UNIT V: PHARMACEUTICAL CHEMISTRY (L -11 hrs, T- 1 hr)

Common disease: infective diseases – insect borne, air borne, water borne. hereditary diseases. Definition and examples of analgesics, antipyretics, sulpha drugs, antimalarials and, antibiotics. **Diabetes** – causes – hyper and hypoglycemic drugs. **Indian medicinal plants** – tulsi, neem, keezhanelli- their importance.

Tutorial Topics

UNIT I (1 hour)

Aromatic compounds - Huckel's rule with examples- non – benzenoid aromatic compounds.

UNIT II (1 hour)

Nuclear Chemistry - Application of radio isotopes (radio diagnosis and therapy, C-14 dating).

UNIT III (1 hour) **Carbohydrates** – definition and classification – Amino acids - classification – **Proteins** - classification according to composition, solubility and shape - colour reactions - **Nucleic acids** – purines, pyrimidines, nucleosides, nucleotides

UNIT IV (1 hour)

Water gas, Producer gas, L.P.G, Gobar gas and Natural gas- N.P.K and mixed fertilizers.- Soaps and detergents -. Cement and glass

UNIT V (1 hour)

Indian medicinal plants – tulsi, neem, keezhanelli- their importance.

Text Books:

1. Puri B.R., Sharma L.R., Kalia K.K., Principles of Inorganic Chemistry, Vallabh Publication, New Delhi, 28th Edition, 2004.
2. P.L. Soni, Mohan Katyal, Text book of Inorganic Chemistry, Sultan Chand & Sons, 20th Edition, 2015.
3. Bahl and Arun Bahl, Text book of Organic Chemistry, S. Chand and Sons, New Delhi, 22nd Edition, 2019
4. P. L. Soni, Text book of Organic Chemistry, S. Chand and Company Ltd., New Delhi, 29th Edition, 2014.

Reference Books

1. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand and Co., Delhi, 33rd Edition, 2017.
2. Morrison & Boyd, Organic Chemistry, Prentice Hall of India Pvt. Ltd., New Delhi, 6th Edition, 1998.
3. J. L. Jain, Sunjay Jain and Nitin Jain, Fundamentals of Biochemistry, S. Chand and Company Ltd., New Delhi, 7th Edition, 2016.
4. Jayasri Ghose. A Text book of Pharmaceutical Chemistry, S. Chand and Sons, New Delhi, 3rd Edition 2010.

Web References:

1.https://tophat.com/marketplace/science-&-math/chemistry/textbooks/organic-chemistry-principles-reactions-and-mechanisms-guy-plourde/3275

2.https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Book%3A_The_Basics_of_GOB_Chemistry_(Ball_et_al.)/11%3A_Nuclear_Chemistry

3. http://library.um.edu.mo/ebooks/b28050745.pdf

4. https://labalbaha.files.wordpress.com/2014/04/fundamentals-of-biochemistry.pdf

5. http://www.survivorlibrary.com/library/a_handbook_of_industrial_organic_chemistry_1900.pdf

Part - IV (B.Sc. Chemistry) Semester – II / Foundation Course: Yoga and Value Education

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – IV	Foundation Course	U21FC201	Yoga and Value Education	-	20	10	2

Contact hours per Semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
First	Second	50	-	50

Preamble:

Human beings are facing enormous problems in this 21st century and thus leading a meaningful Life is really challenging. It is both the internal and external factors that prevent one not to have a peaceful living. It is the need of the hour to impart the ways and means of holistic living to the student learners.

Course outcomes

Upon completion of the Course, the learner will be able to

S.No.	Course Outcomes	Knowledge level
CO1	understand the scientific basis of yoga, importance of practice of yoga and holistic living.	K1, K3
CO2	get motivated to develop moral values and empathic feeling	K3, K4
CO3	identify the tools for a positive self development	K4, K5
CO4	gain a realistic understanding about various social evils and measures to overcome it.	K2, K4

COURSE CONTENT
YOGA AND VALUE EDUCATION

Unit: 1- SCIENCE OF YOGA (T:03 P: 10 Hours)

Science of Yoga: Meaning - Pancha kosha - **Types of yoga**: Karma yoga – Bakthi Yoga - Jnana yoga - Raja yoga - **Paths of Yoga**: Yama - Niyama - Asana - Pranayama - Prathyahara - Dharana - Dhyana - Samadhi.

(Practice: Suksma Vyama – Surya Namaskar – Basic set of Asanas, Pranayama & yogic kriyas)

Unit: 2 - VALUES FOR LIFE (T: 04 Hours)

Human Values: Definition - Nature – Types - Process and Significance - **Social Consciousness and responsibility - Holistic living**

Unit: 3 - MORAL DEVELOPMENT (T: 04 Hours)

Morality: Moral Development - Inherent difficulties in Acquiring moral Values - Truth – Commitment - Honesty and Integrity - Forgiveness and Love - **Empathy and ability to sacrifice**

Unit: 4 -SELF DEVELOPMENT **(T: 04 Hours)**

Self Development: Meaning - Growth mindset - Self-soothing mechanism - Developing resilience – **Body Language** - Good Manners and Etiquette

Unit: 5 - SOCIAL EVILS **(T: 05 Hours)**

Social Evils: Meaning - Domestic violence - Corruption - Terrorism - **Measures to eradicate social evils.**

REFERENCES

1. Study Material: The work book compiled by the TEAM of GVN College
2. Yoga: (Asanas, Pranayama, Mudra, Kriya) Vivekananda Kendra (1977), Vivekananda Prakasan Trust, Chennai.
3. Value Based Education, N. Arumugam, S.Mohana and Lr. Palkani, Saras Publication

Web References

1.https://www.mea.gov.in/in-focus-article.htm?25096/Yoga+Its+Origin+History+and+Development
2.https://www.incredibleindia.org/content/incredibleindia/en/blogs/india-the-land-of-yoga.html
3.https://www.artofliving.org/in-en/yoga/yoga-for-beginners/science-behind-yoga
4.https://www.livescience.com/35129-yoga-increases-brain-function-bone-density.html
5.https://kripalu.org/presenters-programs/science-yoga

Part-III (B.Sc. Chemistry) / Semester – III/ Core 5 –Organic Chemistry II

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Core – 5	U21CH305	Organic Chemistry II	85	5	-	6

Contact hours per Semester: 90
Contact hours per week: 6

Year	Semester	Internal Marks	External Marks	Total Marks
Second	**Third**	**25**	**75**	**100**

Preamble:

The Course aims at the detailed interceptions of bonding concepts of organometallic compounds and alicyclic compounds. To provide the comprehensive information about the Aldehydes, Ketones and carboxylic acids. To know the basic concepts in some naming reactions involving carbonyl compounds, chemistry of dicarboxylic acids. It also gives brief idea about the Tautomerism.

Course Outcomes (COs)

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level RBT)
CO1	remember the structure and Name reactions of aldehydes, ketones, carboxylic acids, ,organometallic, organosulphur and alicyclic compounds and uses of Acrolein, dicarboxylic acids etc	K1
CO2	understand the preparation, properties of aldehydes, ketones, carboxylic acids, ,organometallic, and alicyclic compounds	K2
CO3	apply knowledge to the structure and chemical reactions of aldehydes, ketones, carboxylic acids, and theories of alicyclic compounds and synthetic applications of active methylene compounds	K3
CO4	analyse the structure and chemical reactions of crotonaldehyde, sulphonol, urea, organosulphur compounds and relative stabilities of alicyclic compounds, various types of name reactions and types of tautomerism	K4
CO5	Evaluate of mechanism of esterification, ester hydrolysis and relative stability theories of cyclo alkanes	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7

CO1	3	2	2	1	1	1	1
CO2	3	3	2	1	2	1	1
CO3	2	2	2	2	2	2	2
CO4	2	2	1	2	2	2	2
CO5	2	2	2	1	1	2	1
Total Contribution of COs to POs	**12**	**11**	**9**	**7**	**8**	**8**	**7**
Weighted Percentage of COs Contribution to POs	**80**	**73.33**	**60**	**46.66**	**53.33**	**53.33**	**46.66**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT
ORGANIC CHEMISTRY - II

UNIT - I ALDEHYDES AND KETONES (L -17 hrs & T - 1 hr)

Structure and reactivity of carbonyl group – relative reactivities of aldehydes and ketones – mechanism of nucleophilic addition reaction (HCN, $NaHSO_3$, Grignard reagent)–mechanism of aldol condensation, crossed aldol condensation, Knoevenagal reaction. Study of the following reactions – Wolff-Kishner reduction, Wittig reaction, Meerwein Ponndorf Verley reduction. Preparation, properties and uses of chloral, acrolein, crotonaldehyde and succinaldehyde.

UNIT-II : CARBOXYLIC ACIDS & ACID DERIVATIVE (L -17 hrs & T - 1 hr)

Structure of carboxylic acid and carboxylate anion – relative strengths of monocarboxylic acids – effect of substituents on acidity – Hell – Volhard – Zelinsky reaction- action of heat on hydroxy acids- preparation, properties and uses of lactic acid and citric acid – dicarboxylic acids: action of heat on dicarboxylic acids - preparation, properties and uses of oxalic acid and succinic acid. Acid anhydrides – Amides – Preparation, properties and structure of urea – Esters- mechanism of esterification and ester hydrolysis.

UNIT-III : ORGANOMETALLIC COMPOUNDS AND ORGANO SULPHUR COMPOUNDS (L -17 hrs & T - 1 hr)

Preparation, structure and synthetic uses of Grignard reagent-preparation and reactions of methyl lithium, diethyl zinc and tetraethyl lead - Reformatsky reaction
Preparation and properties of thioalcohols and thioethers – sulphonal - mustard gas and sulphones

UNIT –IV: ACTIVE METHYLENE COMPOUNDS & TAUTOMERISM (L -17 hrs & T - 1 hr)

Reactivity of compounds with active methylene groups – preparation and synthetic uses of diethyl malonate and ethyl acetoacetate. Tautomerism – definition – various types, keto – enol, amido – imido, nitro – acinitro and oxime – nitroso tautomerism.

UNIT-V : ALICYCLIC COMPOUNDS (L -17 hrs & T - 1 hr)

Nomenclature -general methods of preparation – spectroscopic properties – chemical properties – relative stabilities of cyclo alkanes – Baeyer strain theory –Sache-Mohr theory –

Coulson and Moffit's concept – conformations of cyclohexane and mono substituted cyclo hexanes – large ring compounds – synthesis and structure of civetone and muscone (Elucidation of structure not necessary).

Tutorial Topics:

Unit 1- Relative reactivities of aldehydes and ketones.
Unit II - Structure of urea – Esters- mechanism of esterification and ester hydrolysis.
Unit III – Sulphonal - mustard gas and sulphones.
Unit IV – Synthetic uses of diethyl malonate and ethyl acetoacetate.
Unit V - Baeyer strain theory –Sache-Mohr theory – Coulson and Moffit's concept

Text books

1. M. K. Jain & S.C. Sharma "Modern Organic chemistry", 4th Edition, Vishalpublishing Co. 2012. (Unit I, II, III, IV, V). Reprinted S. Chand & Company Ltd. 2008. (Unit I, II, III, IV, V).
2. B. S. Bahl & ArunBahl, "Advanced Organic Chemistry" 1st edition
3. K. S. Tewari and N. K. Vishnoi,A Text Book of Organic Chemistry.
4. Organic Chemistry – I.L. Finar – Vol I&II – AddisionWelsey

Reference books

1. V. S. Parmar& H. M. Chawla, "Principles of Reaction Mechanism in Organic Chemistry", Sultan Chand & Sons. 2008.
2. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th Edition, Printice Hall Of India Limited, New Delhi, 1992.
3. B. Y. Paula, Organic Chemistry, 3rd Edition, Pearson Education, Inc.(Singapore), New Delhi, reprint, 2002.

Web sources:

https://www.cliffsnotes.com/study-guides/chemistry/organic-chemistry-ii/aldehydes-and-ketones/reactions-of-aldehydes-and-ketones
https://www.khanacademy.org/science/chemistry/thermodynamics-chemistry
https://www.khanacademy.org/science/chemistry/gases-and-kinetic-molecular-theory/non-ideal-gas-behavior/a/non-ideal-behavior-of-gaseshttps://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry (Petrucci_et_al.)/22%3A_Chemistry_of_The_Maingroup_Elements_II/22.4%3A_Group_16%3A_The_Oxygen_Family

Part - III B.Sc. Chemistry / Semester – III & IV / Core Practical II : Inorganic Qualitative Analysis

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Core Practical II	U21CH4P2	Inorganic Qualitative Analysis	-	-	60	2

Contact hours per Semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
Second	**Third & Fourth**	**40**	**60**	**100**

Preamble:

The Course is designed to provide students qualitative skills in Salt analysis viz. identification of anions-both interfering and non-interfering, elimination of interfering anions, Identification of group of cations and identification of cations The students will be able to understand the principles of common ion effect and solubility product.

Course Outcomes (COs)

On successful completion of the Course, the learners should be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	recall the procedure for analysis of anions and cations	K1
CO2	demonstrate the experimental skills in Inorganic Qualitative Analysis	K2
CO3	apply the principles of common ion effect and solubility product to the selective precipitation of cations	K3
CO4	analyse and employ the principles of common ion effect and solubility product in Inorganic Qualitative Analysis	K4
CO5	evaluate the observations and interpret the results	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	3	3	3	2	2	2
CO2	2	3	3	3	3	2	2
CO3	2	2	2	1	3	2	2
CO4	2	2	2	2	3	2	2
CO5		2	2	2	3	2	2

	2						
Total Contribution of COs to POs	**10**	**12**	**10**	**11**	**14**	**10**	**10**
Weighted Percentage of COs Contribution to POs	**66.6**	**80**	**80**	**73.3**	**93.3**	**66.6**	**66,6**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT
INORGANIC QUALITATIVE ANALYSIS

Qualitative analysis of inorganic salt mixtures containing two acidic radicals (one should be an interfering radical) and two basic radicals

1. Acidic radicals

Non-interfering acidic radicals:

Carbonate, Nitrate, Sulphate and Chloride

Interfering acidic radicals:

Borate, Fluoride, Oxalate and Phosphate.

Basic radicals

Group I : Lead
Group II : Copper, Cadmium, Bismuth.
Group III : Aluminium, Ferrous, Ferric
Group IV : Cobalt, Nickel, Manganese, Zinc
Group V : Barium, Strontium, Calcium
Group VI : Magnesium, Ammonium.

Experiments done in the class alone should be recorded. A minimum of **Eight** mixtures have to be recorded

Reference books:

1. V.V. Ramanujam, Inorganic Semi Micro Qualitative Analysis, 3rd edition, The National Publishing Company, Chennai, 1974.
2. Vogel‘s Text Book of Inorganic Qualitative Analysis, 4th edition, ELBS, London, 1974.

Part-III (B.Sc. & B.Com.) / Semester III / EEC 1 - APPLIED CHEMISTRY

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	EEC 1	U21CH3EEA	Applied Chemistry	26		4	2

Contact hours per Semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
Second	**Third**	**50**	**-**	**50**

Preamble

The Course is aimed to equip the students with the fundamentals of soap and detergents, fertilizers and some common medicines. Further to gain knowledge about polymers. It also gives an insight into the chemicals in our day-to-day life.

Course Outcomes (COs)

On successful completion of the course, the learners should be able to

S#	Course Outcome	Knowledge Level (RBT)
CO1	Recall and relate the knowledge about soap, detergents, fertilizers,fibres,resins, plastics, Antiseptics,Mouth washes, Antacids,Analgesics, Antibiotics,Haematinics, Laxatives, Sedatives Tooth powder, tooth paste, writing inks, gum paste, boot polish, talcum powder, chalk crayons, agar battis, phenyl and moth balls in a broader context	K1,
CO2	understand the manufacture and cleaning action of soap, detergents, characteristics and types of fertilizers, classification and uses of polymers, therapeutic uses of some common pharmaceuticals and preparation and uses of chemicals used in daily life	K2
CO3	Apply the knowledge in the preparation in small scale of some of the chemicals used in daily life	K3
CO4	analyse the application of soaps, detergents, plastics, fibres, resins	K4
CO5	explain the manufacture of soaps, detergents, types of plastics, fibres, resins ant uses of some common pharmaceuticals and chemicals used in daily life	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	2	2	2
CO2	3	3	2	3	2	2	1
CO3	3	3	2	2	2	2	2
CO4	2	2	2	2	2	2	2
CO5	3	2	2	3	2	2	2
Total Contribution of COs to POs	**14**	**13**	**11**	**12**	**10**	**10**	**9**
Weighted Percentage of COs Contribution to POs	**93.33**	**86.66**	**73.33**	**80**	**66.66**	**66.66**	**60**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT

APPLIED CHEMISTRY

UNIT- I : SOAPS AND DETERGENTS (T-6 Hrs.)

Soaps: Definition-classification-raw materials used in the manufacture of soap –manufacture of toilet soap. Detergents: Definition –various types with examples- advantages of detergents over soaps –cleansing action of soap.

UNIT- II: FERTILIZERS (T- 5 Hrs.)

Definition-characteristics of a good fertilizer- role of nitrogen, potassium and phosphorous in plant growth – natural fertilizers- chemical fertilizers: urea, muriate of potash and triple superphosphate - mixed fertilizers - bio fertilizers – advantages of bio fertilizers.

UNIT III-POLYMERS (T- 7 Hrs.)

Fibers: Classification –uses of Terylene, nylon and orlon.
Resins: Natural resins- synthetic resins-type-uses of fevicol, quick fix, araldite, glyptal and Bakelite.
Plastics: classification- differences between thermoplasts and thermosets. Advantages of plastics-uses of polythene, PVC, polystyrene, Teflon and thermocole.
Rubber: Types-defects in natural rubber-vulcanization-synthetic rubbers- uses of neoprene, thiocol, butyl rubber, silicone rubber and foam rubber.

UNIT IV - CHEMICALS IN PHARMACY (T- 6 Hrs+1)
Definition and therapeutic uses of the following (an elementary study only)

Antiseptics: alum, boric acid

Mouth washes: Hydrogen peroxide
Antacids: Aluminium hydroxide
Analgesics: Aspirin, paracetamol
Antibiotics: Penicillins, tetracyclines
Haematinics: Ferrous fumerate, ferrous gluconate
Laxatives: Epsom salt, milk of magnesia
Sedatives: Diazepam

UNIT- V: CHEMICALS IN DAY-TO-DAY LIFE (5 Hrs. +2 Hrs. Practical)

An outline of the preparation and uses of the following articles-
Tooth powder, tooth paste, writing gum paste, boot polish, talcum powder, chalk crayons, agar battis, phenyl and moth balls.(Preparation of any three chemicals compulsory)

Text books:

1. B. K. Sharma, Industrial Chemistry, Goel Publishing House,Meerut.
2. Jeyashree Gosh, A text book of Pharmaceutical Chemistry, S. Chand and Company, NewDelhi.

Reference books:

1.B. N. Chakrabarty, Industrial Chemistry, Oxford and IBH Publishing Co. Pvt.Ltd., Calcutta.

Part-III (B.Sc. & B.Com.) / Semester – III / EEC 1 Agro Chemistry

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	EEC 1	U21CH3EEB	Agro Chemistry	30	-	-	2

Contact hours per Semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
Second	**Third**	**50**	**-**	**50**

Preamble

The Course is aimed to furnish the students with the understanding about fertilizers and pesticides and study the origin, characterisation and testing of soils.

Course Outcomes (COs)

On successful completion of the course, the learners should be able to

S#	Course Outcome	Knowledge Level (RBT)
CO1	Remember the of soil, fertilizer and pesticides	K1
CO2		K2
CO3	To examine the texture of soil	K3
CO4	analyse the soil characteristics and draw conclusions about the nature of the soil	K4
CO5	evaluate the nature of the soil by soil parameters	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	3	2	2
CO2	3	3	2	3	2	2	2
CO3	3	3	2	2	2	2	2
CO4	2	2	2	2	2	2	1
CO5	3	2	2	2	2	2	2
Total Contribution of COs to POs	**14**	**13**	**11**	**12**	**11**	**10**	**9**

Weighted Percentage of COs ContribPOs	**93.33**	**86.66**	**73.33**	**80**	**73.33**	**66.66**	**60**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT

AGRO CHEMISTRY

UNIT –I Fertilizer (T- 14 Hrs)

Classification, macronutrients -role of nitrogen, potassium and phosphorus on plant growth – manufacture of urea, muriate of potash and triple super phosphate. Complex fertilizers, mixed fertilizers & bio fertilizers – their composition. Micro nutrients – their role in plants.

Manures : Bulky organic manures – Farm yard manure - oil cakes - blood meal – fish manures - Composting process – handling and storage

UNIT –II Pesticides (T-14 Hrs)

Definition - Classification of Pesticides based on the use and chemical composition – examples - general methods of application – Benefits of pesticides - Potential hazards. Safety measures –first aid.

Insecticides: Plant products – Nicotine, pyrethrin – Inorganic pesticides – borates. Organic pesticides – D.D.T. and BHC.

Fungicide: Sulphur compounds, Copper compounds, Bordeaux mixture.

Herbicides : Acaricides – Rodenticides. Attractants – Repellants.

UNIT–III Origin of Soil (T-10 Hrs)

Origin of soil - definition of soil - rock system - weathering of rocks and minerals- main components of soil - organic, inorganic constituents - soil formation - factors favouring soil formation.

UNIT –IV Characteristics of Soil (T-10 Hrs)

Physical aspects - soil texture - pore space - bulk density, particle density - soil colour- surface area - soil colloids - plasticity, shrinkage - flocculation and deflocculation,soil air, soil temperature and their importance in plant growth. Acid, alkaline and saline soils – diagnosis – Methods of reclamation and after care.

UNIT –V Soil testing (T-12 Hrs)

Concept and objectives – soil sampling , tools, collection, processing, dispatch of soil sample. Estimation of total organic compound, available nitrogen and phosphorus in the soil sample. Determination of pH, EC, moisture content, bulk density and particle density of the soil sample.

Text books:

1. A text book of Soil Science – Daji.A, Asia Publishing House, Madras1970.
2. Textbook of soil Chemical Analysis – Hesse,P.R.A John MurrayNewyork,1971

Reference books:

1. Textbook of Soil Science - Biswas,T.D and Mukherjee,S.K.Second edition, Tata McGraw-HillEducation
2. Chemistry for Agriculture and Ecology-Y.MidoM.Satake, Discovery Publishing House.
3. Soil Fertility &Fertilisers – Samuel L.Tisdale,WernerL.Nelson, James
4 D.Beaton, John L. Havlin. Fifth edition,Macmillan
5. Nature and properties of soils-Harry, O Buckman N Yle C. Brandy,Macmillan
6. Insecticides, Pesticides and Agro based Industries– R.C.Paliwal, K.Goel, R.K.Gupta,Small BusinessPublications.

Part IV - AECC-2 Media and Information Literacy Communication

Category	Course Type	ourse Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part - IV	AEC- 2	U21AE302	**Media and Information Literacy Communication**	30	-	-	2

Contact hours per semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
Second	**Third**	**--**	**50**	**50**

Preamble:

Media literacy creates awareness regarding mediated environment or consumption of mass communication. It enhances the ability to responsibly comprehend, access, and use mass communication in personal and professional lives.

Course Learning Outcomes (CO)

By the end of the Course the students will be able to

No.	Course Outcomes	Knowledge Level (RBT)
CO1	give the knowledge concept and scope of media information.	K1
CO2	help students recognize misleading out of date or false information and to share any problem with précis and accuracy.	K2
CO3	apply or create conceptual visual representation and use the communication knowledge to devise new ways of representing insights.	K3
CO4	focus on digital skills and standard alone computers to evaluate an individual's grammar composition, tying skills and the ability to produce text, images audio and designs using technology.	K4
CO5	enrich creative works and create new vistas of knowledge.	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

COURSE CONTENT
MEDIA AND INFORMATION LITERACY COMMUNICATION

Unit 1- Understanding Media and Information Literacy

Introduction: New media - Meaning and characteristics; New Media-Definition, concept and scope; Interactivity and New Media; Core values of the Constitution - Freedom of Expression - Article 19 (1) (a), Article 19(2) ; ICT and media – definition and role; Effect of computer mediated communication; Impact of ICT on mass media; Digitization.

Unit II- Media Literacy

Media Literacy Skills - Nature, Scope and Importance, Interpreting media messages: Semiotics, Ideology , Media as Text , Commercial messages, Sub fields: Digital Literacy and Visual literacy, Fundamentals of Media Literacy, Mediated and Non Mediated Communication.

Unit III- Information Literacy and Library Skills

Information Literacy Skills – Definition, Special aspects of Information Literacy; Information Literacy and Library Skills - Similarities and dissimilarities.

Unit IV - Visual Literacy

Visual Communication – Definition, Importance of Visual Literacy, Nature and Scope of Visual Communication ,The role of Visual communication in today's content marketing and The Power and Influence of Visuals.

Unit V - Digital Literacy

Digital Literacy – Definition, Types of Digital Literacy, Fundamentals of Digital Literacy, The difference between Computer Literacy and Digital Literacy, Benefits of Digital Literacy; 24/7 news broadcast: Features, Audience effectiveness, advertisements and Dumbing down of News, Convergence and Multimedia.

References:

Baran, Stanley J. "Mass Communication, Culture and Media Literacy." *Introduction to Mass Communication: Media Literacy and Culture*, McGraw-Hill Education, 2015, pp. 4–26.

Pavlik, John V., and Shawn McIntosh. "Media Literacy in the Digital Age." *Converging Media: A New Introduction to Mass Communication*, Oxford University Press, 2018, pp. 44-68.

Rosenwald, Michael. "Making Media Literacy Great Again." *Columbia Journalism Review*, vol. 56, no. 2, 2017, pp. 94–99.

Potter, W.J. Theory of Media Literacy: A cognitive approach (Sage, 2004)

Part-III (B.Sc. Chemistry) / Semester – IV/ Core 6 –Inorganic Chemistry III

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Core – 6	U21CH406	Inorganic Chemistry III	60	-	-	5

Contact hours per semester: 60
Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
Second	**Fourth**	**25**	**75**	**100**

Preamble:

The Course introduces the theory of bonding, reactions and spectra of coordination compounds and provides them with a brief idea of the structure of coordination compounds. It gives an insight into the fundamentals of photochemistry and various photochemical reaction involved. The students will be able to plan synthetic routes to compare organic molecules through cycloaddition reaction.

Course Outcomes (COs)

On successful completion of the Course, the learners will be able to

S.No.	Course Outcome	Knowledge Level RBT)
CO1	recall the basic terminology in coordination chemistry, EAN rule application and limitation of CFT, types of ligands, classification of complexes. spin – only magnetic moment of simple coordination compounds	K1
CO2	understand the IUPAC nomenclature of coordination compounds, Naming of ligands, isomerism	K2
CO3	apply the knowledge of CFT and VBT concepts to square planar and octahedral complexes	K3
CO4	analyse the structure and nature of M-L bond in metal carbonyls. Photochemical pathways, stability of complexes and various ligand substitution reactions in octahedral and square planar geometry	K4
CO5	Evaluate Photochemical conversion and storage of solar energy: photolytic cleavage of water into H_2 and O_2 - photo electrochemical devices: photo galvanic cells and semiconductor based photo voltaic cells.	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO - PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7

CO1	2	2	2	1	1	2	2
CO2	2	2	2	2	2	1	2
CO3	3	2	2	1	2	2	1
CO4	3	2	1	2	1	1	1
CO5	2	2	1	2	1	2	2
Total Contribution of COs to POs	**12**	**10**	**8**	**8**	**7**	**7**	**8**
Weighted Percentage of COs Contribution to POs	**80**	**66.66**	**53.33**	**53.33**	**46.66**	**46.66**	**53.33**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT
INORGANIC CHEMISTRY- III

UNIT - I COORDINATION CHEMISTRY-I (T-11 Hrs)

Introduction: IUPAC nomenclature, Classification of ligands- monodentate, bidentate, and polydentate ligands; ambi-dentate ligands. coordination sphere; coordination number; nomenclature of mononuclear and dinuclear complexes. Structural and stereoisomerism in tetrahedral, square planar and octahedral complexes. Valence Bond theory – applications of valence bond theory to tetrahedral, square planar and octahedral complexes - Merits and limitations of VB theory.

UNIT – II COORDINATION CHEMISTRY II (11 Hrs)

Crystal field theory - splitting of d-orbitals in octahedral and tetrahedral complexes -factors affecting the magnitude of crystal field splitting - effects of crystal field splitting - spectrochemical series - applications of CFT - magnetic properties and spectra of transition metal complexes - crystal field stabilization energy and their uses - limitations of CFT - effective atomic number rule - stability of complexes - step-wise and overall stability constants - factors affecting the stability of complexes - determination of stability constants.

UNIT – III: CO-ORDINATION CHEMISTRY - III (11 Hrs)

Labile and inert complexes - ligand substitution reactions in octahedral complexes: aquation, base hydrolysis and anation reactions - substitution reactions in square planner complexes - Trans effect - theories of Trans effect - mechanism of substitution reactions - redox reactions: inner-sphere and outer-sphere electron transfer reactions.

UNIT – IV: ORGANO METALLIC CHEMISTRY (11 Hrs)

Introduction–History, Nomenclature of organometallic compounds, EAN rule and 18 electron rule. Structure and nature of M-L bond in metal carbonyls - metal nitrosyls. preparation of organo metallic compounds of Mg, Zn, Li, Cu, P, B, Ti, Fe and Co. Applications- Wilkinson‘s catalyst and alkene hydrogenation, hydroformylation, Mansanto acetic acid process, Ziegler – Natta catalyst and polymerization of olefins.

UNIT – V: INORGANIC PHOTO CHEMISTRY (11 Hrs)

Introduction- Electronic transitions in metal complexes: selection rules - metal-centered and charge- transfer transitions - properties of excited states - bimolecular quenching and energy transfer - photochemical pathways: substitutional, reduction-oxidation and isomerization processes – photo substitution reactions of Cr (III) complexes - Adamson's rules – photo redox reactions of Co (III) complexes – photo isomerization in Pt(II) complexes. Photochemical conversion and storage of solar energy: photolytic cleavage of water into H_2 and O_2 - photo electrochemical devices: photo galvanic cells and semiconductor based photo voltaic cells.

Tutorial

Unit-I: IUPAC nomenclature. Valence Bond theory. Merits and limitations of VB theory.

Unit-II: Crystal field theory - splitting of d-orbitals in octahedral and tetrahedral complexes determination of stability constants.

Unit-III: Labile and inert complexes- Trans effect - theories of Trans effect- inner-sphere and outer-sphere electron transfer reactions

Unit-IV: Nomenclature of organometallic compounds- Natta catalyst and polymerization of olefins.

Unit-V: Adamson's rules – photo redox reactions of Co (III) complexes. Photochemical conversion and storage of solar energy:

Text books:

1. R.D.Madan, 'Modern Inorganic Chemistry" 2nd edition, S. Chand and Co. Pvt. Ltd., 2004.
2. Shriver and Atkins, Inorganic chemistry, 4th edition, Oxford University Press, 2006.(Unit-3.1)
3. P.L. Soni, and Mohan Katyal, "Text book of Inorganic Chemistry", 20th edition, Sultan Chand Co. Pvt. Ltd., 2006.(Unit 5.3)
4. Gurdeep Chatwal and M.S.Yadav, "Coordination Chemistry", 1st edition, Himalaya Publishing House, 1992. (Unit-5.2).

Reference books:

1. Sathyaprakash and R.D. Madan, Advanced Inorganic Chemistry Volume I, S. Chand and Company, New Delhi 2005
2.. R. Gopalan and V. Ramalingam Concise Co-ordination Chemistry – 2001; Vikas Publishing House, New Delhi.
3. Wahid U. Malik, G.D.Tuli, R.D.Madan Selected topics in Inorganic chemistry
4. B.R Puri, LR.Sharma and K.C.KaliaVallabh; Principles of Inorganic Chemistry, Publications, Delhi.

Web references:

1.https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_(Inorganic_Chemistry)/Descriptive_Chemistry/Elements_Organized_by_Block/4_f-Block_Elements

2.https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_-_3.The_Central_Science_(Brown_et_al.)/21%3A_Nuclear_Chemistry/21.S%3A_Nuclear_Chemistry_(Summary)

Part-III (B.Sc. Chemistry) / Semester – IV / Core 7 – PHYSICAL CHEMISTRY – II

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Core - 7	U21CH407	PHYSICAL CHEMISTRY –II	55	5	-	4

Contact hours per semester: 60
Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
Second	**Four**	**25**	**75**	**100**

Preamble:

The course is designed to give an insight into the basic concepts and various laws of thermodynamics chemical equilibrium, electrochemistry and solutions

Course outcomes (COs)

On successful completion of the course, the learners should be able to

S.No.	Course outcome	Knowledge level
CO1	outline the basic concepts, definitions and statements of thermodynamics, different types of systems, processes, variables, kinds of solutions, strong and weak electrolytes	K1
CO2	understand the concept of entropy, Ideal behaviour of solutions, molar conductivity, and deviation from Ideal behaviour of solutions	K2
CO3	apply the Law of mass action, Le Chatelier's principle to different systems, sketch Hittorf's device, CST-types with examples	K3
CO4	Compare reversible and irreversible reactions, calculate the equivalent conductance of weak electrolytes, Relationship between Cp, Cv & Kp, Kc	K4
CO5	Determine transport number by moving boundary method, Debye-Huckle-Onsager Equation	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO Mapping (Course Articulation Matrix)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	0	1	2
CO2	3	3	3	2	0	1	2
CO3	3	3	3	3	0	1	3
CO4	3	3	3	2	0	1	3
CO5	3	3	3	2	0	1	3

Total contribution of COs To POs	15	15	15	11	0	5	13
Weighted percentage of COs Contribution to POs	100	100	100	70.3	0	33.4	80.6

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT
PHYSICAL CHEMISTRY –II

UNIT –I THERMODYNAMICS-I (10 Hrs)

Basic concepts - system, surroundings - types of systems - extensive and intensive properties - state functions and path functions - types of processes - . Exact and inexact differentials - Zeroth law of thermodynamics. Statements of first law - definition of internal energy and enthalpy - heat capacities at constant volume (Cv) and at constant pressure (Cp), relationship between Cp and Cv - calculation of work, heat, internal energy change and enthalpy change for the expansion of an ideal gas under reversible isothermal and adiabatic conditions. Joule- Thomson effect – Joule-Thomson coefficient and its significance - derivation of the expression for Joule-Thomson coefficient - inversion temperature. Kirchoff‘s equation and its applications - numerical problems.

UNIT II: THERMODYNAMICS-II (12 Hrs)

Introduction to second law of thermodynamics - spontaneous processes - statement of second law of thermodynamics. Entropy: Definition –entropy a state function - Trouton‘s rule. -entropy change in reversible and irreversible processes- Clausius inequality- entropy as function of T and V - entropy as a function of T and P - entropy change in isothermal transformation - entropy change accompanying change of phase-– entropy of mixing of ideal gases -physical significance of entropy.

Free energy: Work and free energy functions – definition-general conditions of equilibrium and spontaneity – -physical significance of dA and dG. Temperature and pressure dependence of G - variation of G during isothermal change -Gibbs Helmholtz equation

UNIT III: CHEMICAL EQUILIBRIUM (10 Hrs)

Reversible and irreversible reactions-nature of chemical equilibrium-Law of mass action- equilibrium constants- Kp, and Kc Thermodynamic derivations- -Relations between Kp& Kc Temperature dependence of equilibrium constant-properties of equilibrium constant –- Pressure dependence of equilibrium constant-Application of law of mass action to homogenous and Heterogeneous equilibrium-Le-Chatelier principle-application of Le- Chatelier principle to homogenous equilibrium and heterogeneous equilibrium –effect of inert gas on equilibrium

UNIT IV : SOLUTIONS (11 Hrs)

Introduction- Types of solutions –- methods for expressing concentration – Molarity, molality, mole fraction, normality, mass fraction, parts per million -solutions of gases in liquid -Solubility of gases in liquids – Henry's law – statement and limitations. Solutions of liquid in liquid– Binary liquid mixture - Ideal and non-ideal solutions – Raoult's law. - deviation from ideal behaviour – pressure – composition and temperature – Composition diagrams for completely miscible binary solutions-Fractional distillation – Azeotropic distillation—nature of azeotropic mixtures-partially miscible liquids—consolute temperature-

critical solution temperature-system with upper CST, lower CST and upper and lower CST – Liquid crystals, Nematic, smectic and cholesteric types and their applications

UNIT-V ELECTROCHEMISTRY-I (12 Hrs)

Introduction-Metallic and electrolytic conductance – Definitions of specific, equivalent and molar conductances – Relations between them – measurement of conductance and cell constant. Variation of conductance with dilution – Qualitative explanation– Strong and weak electrolytes. Migration of ions – transport number – determination by Hittorf and moving boundary methods – Kohlrausch s law – applications – calculation of equivalent conductance for weak electrolytes and determination of transport number. Ionic mobilities and Ionic conductances. Diffusion and ionic mobility- molar ionic conductance and viscosity- Walden rule-Applications of conductance measurements – Degree of dissociation of weak electrolytes – Determination of Ionic product of water – Determination of solubility of sparingly soluble salts – conductometric titrations- Theory of strong electrolytes – Debye – Huckel – Onsager theory-verification of Onsager equation – Wein and Debye –Falkenhagen effect.

Tutorial Topics:

Unit I- relationship between Cp and Cv- derivation of the expression for Joule-Thomson coefficient
Unit II- entropy as function of T and V - entropy as a function of T and P. Gibbs Helmholtz equation
Unit-III: Relations between Kp & Kc. application of Le- Chatelier principle to homogenous equilibrium and heterogeneous equilibrium –effect of inert gas on equilibrium
Unit-IV: Henry's law – statement and limitations. Raoult's law. Fractional distillation –Azeotropic distillation.
Unit-V: Kohlrausch s law – applications – calculation. Debye – Huckel – Onsager theory-verification of Onsager equation.

Text books:

1. Principles of physical chemistry - Puri, Sharma and Pathania, Millennium Edition, Vishal Publishing Co
2. Text Book of physical chemistry - P.L. Soni - Sultan Chand.

Reference books:

1. Atkins' Physical chemistry, 9th Edition, Oxford University Press.
2. Advanced Physical Chemistry - Gurdeep Raj, Goel Publishing House. 3. Physical Chemistry, G.M.Barrow, Tata McGraw Hill.
4. Thermodynamics for chemist S.Glasstone
5. Physical chemistry P.K.Sharma and L.K.Sharma.

Part-IV (B.Sc. Chemistry) / Semester – V / Employability Enhancement 2 - CHEMISTRY OF FOOD, NUTRITION AND PRESERVATION

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – IV	Employability Enhancement –2	U20CH5EEA	Chemistry of Food, Nutrition and Preservation	25	5	-	2

Contact hours per semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
Third	Fifth	50	00	50

Preamble:

The course is aimed to furnish the students with the understanding about the knowledge of different food groups and their functions and biological importance of nutrition, food additives, preservative techniques, detection and analysis of adulterants in foods and food standards.

Course Outcomes (COs)

On successful completion of the course, the learners should be able to

S#	Course Outcome	Knowledge Level (RBT)
CO1	gain knowledge about the different food groups and their functions and nutritional value, food additives, preservative methods, detection and analysis of adulterants in foods, specification and standards	K1
CO2	understand energy requirements of individuals, bleaching and maturing agents – leavening agents, methods of food preservation and processing, detection and analysis of adulterants in foods, specification and standards.	K2
CO3	examine the classification of nutrition, food additives and chemical composition, preservative techniques, detection and analysis of adulterants in foods and food standards, adulteration and food poison and health problem associated with it	K3
CO4	create an awareness about nutritional value, food additives, preservative methods, detection and analysis of adulterants in foods and various food standards	K4
CO5	learn about the balanced diet, food additives, preservatives in foods, analysis of adulterants in foods and various food standards, Essential Commodities Act, specific quality attributes and the basic concepts of food system, drug license WHO standard and ISI specifications	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	2	1	1
CO2	2	2	2	2	1	1	1
CO3	2	2	2	2	1	1	1
CO4	2	1	2	1	1	1	1
CO5	2	1	1	2	1	1	1
Total Contribution of COs to POs	11	7	8	9	6	5	5
Weighted Percentage of COs Contribution to POs	73.33	46.66	53.33	60	40	33.33	33.33

1- low, 2-moderate 3-high 0-no correlation

Course Content
CHEMISTRY OF FOOD, NUTRITION AND PRESERVATION

UNIT – I - INTRODUCTION (L-5 Hrs, T– 1 Hr)

Food : sources and classification – food as a source of energy - functions and biological importance of carbohydrates, protein, fat, vitamins and minerals - calorific value of food – energy requirements of individuals - balanced diet.

UNIT – II - FOOD ADDITIVES (L-5 Hrs, T– 1 Hr)

Definition, food colourants: natural and artificial - antioxidants, stabilizers, flavours, bleaching and maturing agents – leavening agents.

UNIT - III - FOOD PRESERVATIVES (L-5 Hrs, T– 1 Hr)

Definition - classification - methods of food preservation and processing by heat, cold, radiation, drying and deep freezing.

UNIT – IV - FOOD ADULTERATION (L-5 Hrs, T– 1 Hr)

Definition – types – detection and analysis of adulterants in foods: milk, chilli powder, coffee powder, turmeric powder, ghee, oil and pulses.

UNIT -V - QUALITY STANDARDS (L-5 Hrs, T– 1 Hr)

Quality control - specification and standards - FA, WHO standards – packing and labeling of foods, Essential Commodities Act - Consumer Protection Act - AGMARK.

Tutorial Hours:

Unit I	: Energy requirements of individuals - balanced diet.
Unit II	: Natural and artificial food additives
Unit III	: Classification food adulteration
Unit IV	: Analysis of adulterants in foods
Unit V	: Specification and standards

Text books:

1. Sivasankar B, Food Processing and Preservation, Prentice Hall of India Pvt. Ltd, New Delhi, 2002
2. Swaminathan M. Textbook on Food Chemistry, Printing and Publishing Co, Ltd, Bangalore 1993.

Reference books:

` 1. Food Science – III Edition – Sri Lakshmi B, New Age International Publisher, 2005.
2. Fundamentals of Foods and Nutrition – Mudambi. R. Sumathi, and Rajagopal, M.V. - Willey Eastern Ltd, Madras.
3. The Food Safety and Standards Act, 2006 along with Rules & Regulations, Commercial Law Publishers (India) Pvt. Ltd. 2011.
4. Introduction to food toxicology, T. Shibamoto, L. Bjeldanes, Elsevier, UK. 2 nd Ed., 2009.
5. M. Swaminathan, Essentials of food and Nutrition, Ganesh and company, Volume I and II, 2nd Ed.
6. An operational Text Book, Guide to Food Laws and Regulations, P. A. Curtis, Wiley Blackwell publishers, 2nd Ed., 2013.
7. Food & Beverage Laws - Food Safety and Hygiene. J. Negi. ABD Publishers: Distribution, 2016.
8. Alex Ramani, V., Food Chemistry, MJP Publishers, Triplicane, Chennai, 2009.

Web Resources:

1. https://agrimoon.com/wp-content/uploads/Food-Chemistry.pdf
2. http://www.uprtou.ac.in/other_pdf/dvapfv_block_3.pdf
3. https://dmcdharan.com/download/1614574103Essentials%20of%20food%20chemistry%20(R%20-%20Rai.pdf
4. http://154.68.126.6/library/Food%20Science%20books/batch1/Principles%20of%20Food%20Chemistry%203rd%20Edition.pdf
5. http://pustaka.unp.ac.id/file/abstrak_kki/EBOOKS/Essential%20Guide%20to%20Food%20Additives.pdf
6. https://agri.najah.edu/sites/default/files/Lecture%201_0.pdf
7. http://www.uop.edu.pk/ocontents/Lecture%20no%208%20part%202.pdf
8. http://www.cold.org.gr/library/downloads/Docs/Handbook%20of%20Food%20Preservation.PDF

Part-IV (B.Sc. Chemistry) / Semester – IV / Employability Enhancement Course 2 - WATER MANAGEMENT

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – IV	EEC - 2	U21CH4EEB	Water Management	25	5	0	2

Contact hours per semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
Third	Fourth	50	00	50

Preamble:

The course is designed to equip the students with the basic knowledge of causes of water pollution, water standards and quality parameters and to know about the different kinds of water purification techniques. It also gives an insight into the waste water treatment, restoration and water management. Further to realize the significances of quality water in day-to-day life.

Course Outcomes (COs):

On successful completion of the course, the learners should be able to

CO#	Course Outcome	Knowledge Level (RBT)
CO1	know the nature of causes of water pollution, Physical, chemical and biological water quality parameters, Purification of water for drinking purposes, Elementary ideas of waste water treatment, A restoration case study	K1,
CO2	identify the water polluted effluents, quality parameters, purification techniques, preliminary waste water treatment methods and water recycling methods	K2
CO3	examine the effluents, chemical parameters, purification techniques, waste water treatment methods and water restoration	K3
CO4	build an awareness about water pollution, Physical, chemical and biological water quality parameters, Purification of techniques, waste water treatment, water management	K4
CO5	evaluate the types of water pollutants, Determination of water quality parameters, Purification of water for industrial purposes, secondary treatment, tertiary treatment and water harvesting –water recycling	K5

K1 – Remember; K–Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	2	1	1
CO2	2	2	2	2	1	1	1
CO3	2	2	2	2	1	1	1
CO4	2	1	2	1	1	1	1
CO5	2	1	1	2	1	1	1
Total Contribution of COs to POs	11	8	9	9	6	5	5
Weighted Percentage of COs Contribution to POs	73.33	53.33	60	60	40	33.33	33.33

1- low, 2-moderate 3-high 0-no correlation

COURSE CONTENT

WATER MANAGEMENT

Unit I - WATER POLLUTION (L-5 Hrs, T– 1 Hr)

Definition-sources of water pollution-types of water pollutants: sewage and domestic wastes, industrial effluents, agricultural discharges, detergents, disease causing agents and radioactive materials. Eutrophication and its effects.

Unit II - WATER QUALITY PARAMETERS (L-5 Hrs, T– 1 Hr)

Physical, chemical and biological water quality parameters-water quality standards for drinking water –BIS and WHO. Determination of pH, Total hardness, DO, BOD and COD.

Unit III - WATER PURIFICATION (L-5 Hrs, T– 1 Hr)

Purification of water for drinking purposes: Sedimentation, filtration and disinfection- Desalination: reverse osmosis-Purification of water for industrial purposes: water softening- permutit process and ion-exchange process.

Unit IV - WASTE WATER TREATMENT (L-5 Hrs, T– 1 Hr)

Elementary ideas of waste water treatment: pre-treatment-primary treatment-secondary treatment: aerobic and anaerobic processes –tertiary treatment: evaporation adsorption – chemical precipitation.

Unit V - RESTORATION AND MANAGEMENT (L-5 Hrs, T– 1 Hr)

Importance of lakes and rivers-stresses on the Indian rivers and their effects –A restoration case study: Ganga Action Plan: objectives implementation and drawbacks. Rain water harvesting –water recycling- The water Prevention and control of Pollution Act 1974.

Tutorial Topics:

Unit I : Sources of water pollution-types of water pollutants.
Unit II : BIS and WHO.
Unit III : Purification of water for industrial purposes.
Unit IV : Aerobic and anaerobic processes.
Unit V : Rain water harvesting.

Text books:

1. A. K. De, Environmental Chemistry, Wiley Eastern Ltd., New Delhi.
2. B. K. Sharma, Environmental Chemistry, Goel Publishing House, Meerut.

Reference books:

1. R. K. Trivedy and P. K. Goel, Chemical and biological methods for water pollution studies, Environmental Publications, Karad, India.
2. BIS 1991, Specification for drinking water, Bureau of Indian Standards, New Delhi.
3. WHO 1992, International standards for drinking water, World Health Organisation, Geneva.

Web References:

1. **https://www.britannica.com/science/water-pollution**
2. **https://www.researchgate.net/publication/321289637_WATER_POLLUTION-SOURCESEFFECTS_AND_CONTROL**
3. **https://sswm.info/sites/default/files/reference_attachments/MCCAFFREY%20ny%20Water%20Quality%20Parameters%20&%20Indicators.pdf**
4. **https://www.who.int/water_sanitation_health/dwq/fulltext.pdf**
5. **https://www.epa.gov/sites/default/files/2014-10/documents/handbook-chapter3.pdf**
6. **https://www.who.int/water_sanitation_health/hygiene/om/linkingchap6.pdf**
7. **https://www.publichealthnotes.com/importance-of-water-purification-and-different-methods/**
8. **https://www.researchgate.net/publication/221911472_Wastewater_Management**
9. **https://web.iitd.ac.in/~arunku/files/CVL100_Y16/LecSep1220.pdf**
10. **https://phedharyana.gov.in/WriteReadData/Notice/2%20STP%20(1)%20%5BCompatibility%20Mode%5D.pdf**
11. **https://www.iwapublishing.com/sites/default/files/ebooks/9781780402086.pdf**
12. **https://www.gdrc.org/uem/water/rainwater/rainwaterguide.pdf**
13. **http://cpcbenvis.nic.in/scanned%20reports/Concepts%20and%20Practices%20for%20Rainwater%20Harvesting.pdf**

Part- III (B.Sc. Chemistry) / Semester – IV / Core- Institutional Training/ Minor Project

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Core	U21CH5IT	*Institutional Training / Minor Project	-	-	-	3

- To be carried out in the vacation between IV and V Semesters. Report to be submitted in the beginning of V Semester.

Year	Semester	Internal Marks	External Marks	Total Marks
II	**FOURTH***	**40**	**60**	**100**

- Exam to be conducted in the end of V Semester

Part-III - B.Sc. Chemistry/ Semester – VI / Core - 8: Inorganic Chemistry IV

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – III	Core - 8	U21CH508	Inorganic Chemistry -IV	70	5	-	4

Contact hours per Semester: 75
Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
III	V	25	75	100

Preamble:

The Course enables the students to understand the basics of Inorganic & Bioinorganic Chemistry. It provides on insight into the Chemistry of Acids and Bases, Non-aqueous solvents, role of metal ions in biological system, application of metals as anti-Cancer drugs and the Chemistry of Redox reactions.

Course Outcomes (COs):

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	remember the basic terms, ideas, theories and concepts used in Acids and Bases, Non-aqueous solvents, Bio-inorganic Chemistry, Redox reactions and Metals and Health	K1
CO2	understand the basic ideas, theories and concepts used in Acids and Bases, Non-aqueous solvents, Bio-inorganic Chemistry, Redox reactions and Metals and Health	K2
CO3	discuss various theories of acids and bases, classification of solvents, characteristics of a solvent, dielectric constant, dipole moment and solvation, advantages and disadvantages of liq. Ammonia, liq. HF and liq.SO_2 as solvents, chemical reactions in liq. ammonia, liq. HF and liq. SO_2, role of metals in enzymes and proteins, functions of Na^+/K^+ pump, redox reactions and half reactions, Oxidizing agent (Oxidant) and reducing agent (Reductant), calculate equivalent weight of a given oxidizing and reducing agent, applications of therapeutic chelating agents,	K3
CO4	analyze and explain Bronsted acids and Bronsted bases, Lewis acids and Lewis bases, Hard and Soft Acids and Bases, auto ionization, solutions of alkali metals in liquid ammonia, oxygen dissociation curves, role of carboxy peptidase and carbonic anhydrase, function of ceruloplasmin, mechanism of Na^+/K^+ pump, role of Ca, role of Cu in ascorbic acid oxidase, role of Mg in hexokinase, ion electrode method, Oxidation number method, Direct and Indirect redox reaction, toxicity of metals Cd, Hg and Cr	K4

CO5	evaluate Arrhhenius theory, Bronsted – Lowry theory, Lewis concept, HSAB principle, liq.ammonia, liq. HF and liq.SO_2 as non-aqueous solvents, structural changes during reversible binding of oxygen, Bohr effect, Perutz mechanism-oxygen dissociation curves, role of metalloenzymes, metal ions as charge carrier, MRI contrast agents, anti-cancer drugs, toxicity of metals, oxidizing agent (Oxidant) and reducing agent (Reductant) oxidation number and valency or covalency of an element, Redox reactions and half reactions	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate

CO-PO Mapping (Course Articulation Matrix):

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	2	1	2	1	2
CO2	1	1	2	2	2	1	2
CO3	1	1	2	2	3	2	3
CO4	2	2	2	1	1	1	2
CO5	2	3	2	2	2	2	1
Total Contribution of COs to POs	8	8	10	8	10	7	10
Weighted Percentage of COs Contribution to POs	53.33	53.33	66.66	53.33	66.66	66.66	66.66

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT
INORGANIC CHEMISTRY - IV

UNIT I - ACIDS AND BASES (L-14 Hrs, T- 1 Hr)

Arrhenius concept: Water system concept; Acids and bases in protic solvents, Bronsted-Lowry theory: Protonic concept- conjugate acid-base pairs; Amphiprotonic substances; Solvent system concept; Lewis concept: electron pair acceptor-donor concept, Lewis acids and Lewis bases- Lux-Flood definition, Usanovich definition,

UNIT II - NON-AQUEOUS SOLVENTS (L-14 Hrs, T- 1 Hr)

Classification of solvents- characteristics of a solvent-dielectric constant, dipole moment and solvation. Liq. Ammonia as a non-aqueous solvent- Auto-ionization - ammono acids and bases-chemical reactions in liq. Ammonia - precipitation, neutralization, solvolysis, complex formation and redox reactions - Solutions of alkali metals in liquid ammonia-advantages and disadvantages of liq. Ammonia as solvent-Liq. Hydrogen fluoride as non-aqueous solvent - chemical reactions in liq.HF - Liq.SO_2 as non-aqueous solvent- chemical reactions in liq. SO_2

UNIT III - REDOX REACTIONS (L-14 Hrs, T- 1 Hr)

Oxidation number and oxidation state- General rules for calculating oxidation number of elements - Distinction between oxidation number and valency or covalency of an element – oxidation and reduction

(definition only)– Redox reactions and half reactions – Oxidizing agent (Oxidant) –ferric salts ad acidified solution of potassium dichromate and reducing agent (Reductant) – oxalic acid and acidified solution of ferrous sulphate. Calculation of the equivalent weight of a given oxidizing or reducing agent – Comproportionation reaction – Ion-electron method and oxidation number method for balancing a given unbalanced redox reaction - Direct and indirect redox reactions- Importance of redox reactions.

UNIT IV – BIO INORGANIC CHEMISTRY (L-14 Hrs, T- 1 Hr)

Basic chemical processes in bio system Metalloproteins-role of metals in proteins. Metalloenzymes-role of metals in enzymes- iron proteins - hemoglobin and myoglobin- structural changes during reversible binding of oxygen, Bohr effect, Perutz mechanism-oxygen dissociation curves -Vitamin B12 - Role of Cobalt - Zinc containing enzymes - Carboxy peptidase, Carbonic anhydrase. Function of Na+ /K+ Mechanism of ion pump - Role of Calcium. Transamination reactions- Role of Magnesium in Hexokinase. Copper proteins : ceruloplasmin and its role, Role of Copper in ascorbic acid oxidase-function of copper-zinc superoxide dismutase-metal ions as charge carrier- ionophores-transport through channels

UNIT V - METALS AND HEALTH (L-14 Hrs, T- 1 Hr)

Application of therapeutic chelating agents- anti-cancer drugs- cisplatin, carboplatin, platinum anti-cancer drugs, gadolinium MRI contrast agents, Gold and arthritic agents – auranofin, solganol, myochristin, Toxicity of metals–Cd, Hg and Cr-bio methylation of mercury.

Tutorial Topics:

UNIT I	: Hard and Soft Acids and Bases- HSAB principle
UNIT II	: chemical reactions in liq. Ammonia - precipitation, neutralization, solvolysis, complex formation and redox reactions
UNIT III	: Comproportionation reaction.
UNIT IV	: Mechanism of binding of oxygen to hemoglobin
UNIT V	:Toxicity of metals–Cd, Hg and Cr, bio methylation of mercury.

Text Books:

1. Satyaprakash, G.D.Tuli, S.K.Basu, Madan (2006) Advanced Inorganic Chemistry, (19th ed. Reprint with correction), S.Chand & Co. Ltd., New Delhi
2. Puri B.R., Sharma L.R., Kalia K.C., (2010). Principles of Inorganic Chemistry, (31st ed.), Milestone Publishers and Distributors, New Delhi
3. Bioinorganic Chemistry, Asim K. Das, 2007 Books and allied (P) Ltd.

Reference Books:

1. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt.
2. H.J.Emeleus & A.G.Sharpe, Modern aspects of Inorganic Chemistry, 4 th Ed., ISBN, 1974.
3. R. Gopalan & amp; V.Ramalingam, Concise Coordination Chemistry, 1st Ed., Vikas Pub. House Pvt. Ltd., 2001.
4. Inorganic Chemistry, Principles of Structure and Reactivity Huheey, J. E.; Keiter, E.A. & Keiter,
5. R.L. 2014 (4) Dorling Kindersley (India) Pvt. Ltd, New Delhi.
6. Concise Inorganic Chemistry Lee, J.D. 2008 (5) John Wiley and Sons, New Delhi.
7. Lippard, S. J., & Berg, M.J., Principles of Bio-inorganic chemistry, University Science Books, 1994.
8. Basic Inorganic Chemistry Cotton, F.A., Wilkinson, G., & Gaus, P.L. 2011 (3) Wiley India, (P) Ltd., New Delhi.

Web References:

1. https://www.toppr.com/ask/content/posts/acids-bases-and-salts/best-reference-on-internet-22046/https://chemistrytalk.org/acid-base-properties/
2. https://pubs.acs.org/doi/10.1021/ed055p459
3. https://link.springer.com/chapter/10.1007/978-94-017-2744-0_13
4. https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Map%3A_Inorganic_Chemistry_(Housecroft)/09%3A_Non-aqueous_media
5. https://en.wikipedia.org/wiki/Redox
6. https://www.britannica.com/science/oxidation-reduction-reaction
7. https://www.khanacademy.org/science/ap-chemistry-beta/x2eef969c74e0d802:chemical-reactions/x2eef969c74e0d802:oxidation-reduction-redox-reactions/a/oxidation-number
8. https://libguides.lib.rochester.edu/CHEM414/Texts
9. https://authors.library.caltech.edu/25052/1/BioinCh.pdf
10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3189586/
11. https://www.intechopen.com/chapters/74650

Part-III (B.Sc. Chemistry) / Semester – V / Core 9 – Organic Chemistry- III

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – III	Core – 09	U21CH509	Organic Chemistry III	70	5	-	4

Contact hours per Semester: 75
Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
Third	Fifth	25	75	100

Preamble

The Course is designed to equip students with the basic knowledge of optical, geometrical and conformational isomerism. It also provides an insight into the properties of heterocyclic compounds, aromaticity, aromatic electrophilic and nucleophilic substitution reactions and dyes.

Course Outcomes (COs)

On successful completion of the Course, the learners should be able to

S.No.	Course Outcome	Knowledge Level (RBT)
CO1	recall and state the definitions, terms, concepts, principles, theories in optical, geometrical and conformational isomerism, aromaticity and aromatic substitution, heterocyclic compounds, dyes and polynuclear hydrocarbons, list out the preparation and uses of dyes, synthesis and electrophilic substitution reactions of heterocyclic compounds	K1
CO2	discuss the requirements, classification, preparation and uses of dyes, understand symmetry elements, asymmetry and dissymmetry and pseudo symmetry, stability of geometrical isomers, methods to assign configuration, Huckel‘s rule, consequence of aromaticity, carbon-carbon bond lengths of benzene, resonance energy, aromatic character of pyrrole, furan, thiophene, pyridine, theories of colour and constitution, classification of dyes according to application and structure.	K2
CO3	apply the knowledge to draw saw horse, Fischer, flying-wedge and Newman formulae and their inter translations eclipsed, staggered, gauche and anti-forms, chair, boat and twist boat conformation of compounds, energy profile diagram, conformations of cyclohexane, erythro and threo representation, activating and deactivating substituents, orientation in mono	K3

	substituted benzenes, ortho/para ratio, Korner's absolute method, dipole moment method, direct influence of substituents, rules of orientation, preparation and reactions of indole, quinoline and isoquinoline.	
CO4	compare the basic character of pyrrole, pyridine and thiophene, aromatic character of furan, pyrrole and thiophene, discuss the optical activity in compounds without asymmetric carbon, partial asymmetric synthesis, stereo selectivity, stereo specificity, methods to assign configuration, non-benzenoid compounds, Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis, aromatic nucleophilic substitutions-unimolecular, bimolecular and benzyne mechanisms, mechanism of electrophilic and nucleophilic substitution reaction in pyridine.	K4
CO5	explain racemisation and resolution of acids, bases and alcohols via diastereomeric salt formation, Cahn-Ingold-Prelog rules, R and S notations for optical isomers with one and two asymmetric carbon atoms - erythro and threo representations - D and L representations, the mechanism of aromatic electrophilic and nucleophilic substitution, directive influence of the substituents, electrophilic substitution reactions of the 5 and 6 membered heterocyclic compounds, justify the basic and aromatic character of heterocyclic compounds, synthesis and structure of poly nuclear hydrocarbons, conformational analysis of simple compounds.	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO Mapping (Course Articulation Matrix)

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	3	2	1	2	2
CO2	2	1	3	2	1	2	2
CO3	2	1	2	2	1	2	2
CO4	2	1	2	2	1	2	2
CO5	2	1	2	5	1	2	2
Total Contribution of COs to POs	**10**	**5**	**12**	**11**	**5**	**10**	**10**
Weighted Percentage of COs Contribution to POs	**66.6**	**33.3**	**80**	**73.3**	**33.33**	**66.6**	**66.6**

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT

ORGANIC CHEMISTRY – III

UNIT I - OPTICAL ISOMERISM (L-16 Hrs, T- 1 Hr)

Representation of molecules in sawhorse, Fischer, flying-wedge and Newman formulae and their inter translations. Symmetry elements - chirality – asymmetric molecules and molecular dissymmetry-pseudo asymmetry.

Optical rotation – specific rotation –optical purity – racemisation (through cationic and anionic and radical intermediates), resolution of acids, bases and alcohols via diastereomeric salt formation.

Optical isomers - enantiomers – diastereomers – epimers - notation of optical isomers - Cahn-Ingold-Prelog rules, R and S notations for optical isomers with one and two asymmetric carbon atoms - erythro and threo representations - D and L representations - Optical activity in compounds without asymmetric carbon atoms namely biphenyls, allenes and spiranes. Stereo selectivity – stereo specificity – partial asymmetric synthesis.

UNIT II - GEOMETRICAL & CONFORMATIONAL ISOMERISM (L-15 Hrs, T- 1 Hr)

Geometrical isomerism – nomenclature of geometrical isomers – cis–trans, E-Z notation and syn-anti for C=C, C=N compounds. Methods to assign configurations. Stability of geometrical isomers and heats of hydrogenation Conformation: Conformational nomenclature - eclipsed, staggered, gauche and anti; dihedral angle, torsion angle, energy barrier of rotation – potential energy diagram. Relative stability of conformers on the basis of steric effect, dipole-dipole interaction, H- bonding; Conformational analysis of ethane, propane, n-butane, haloethane, 1,2-dihaloethane, 1,2-glycol and 1,2-halohydrin, cyclopentane, cyclohexane and mono substituted cyclohexanes.

UNIT III - AROMATICITY & AROMATIC SUBSTITUTION (L - 14 Hrs, T- 1 Hr)

Aromaticity – definition – Huckel‘s rule – consequence of aromaticity – stability, carbon-carbon bond lengths of benzene, resonance energy and participation of substitution. Non-benzenoid aromatic compounds - Aromatic electrophilic substitution – general pattern of the mechanism, role of σ and π complexes, Mechanism of nitration, halogenation, sulphonation and Friedel-Crafts reaction. Activating and deactivating substituents, orientation in mono substituted benzenes, ortho/para ratio- Orientation- Korner‘s absolute method, dipole moment method – direct influence of substituents – rules of orientation - Aromatic Nucleophilic substitutions-unimolecular, bimolecular and benzyne mechanisms.

UNIT IV - HETEROCYCLIC COMPOUNDS (L - 14 Hrs, T- 1 Hr)

Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution and mechanism of nucleophilic substitution reaction in pyridine. Comparison of basicity of pyridine, piperidine and pyrrole. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Nepieralski synthesis, mechanism of electrophilc substitution reactions of indole, quinoline and isoquinoline.

UNIT – V DYES & POLYNUCLEAR HYDROCARBONS (L - 11 Hrs, T- 1 Hr)

Dyes - theory of color and constitution - chromophore, auxochrome, classification according to application and structure - preparation and uses of azo dyes - methyl orange, triphenyl methane dyes -malachite green, indigo dyes - Indigotin, anthraquinone dyes -alizarin, phthalein dyes Phenolphthalein-Synthesis reactions & Structure of Naphthalene & Anthracene

Tutorial Topics:

UNIT I : R and S notations for optical isomers with one and two asymmetric carbon atoms.
UNIT II : E-Z notation and syn-anti for C=C, C=N compounds.
UNIT III : Non-benzenoid aromatic compounds.
UNIT IV : Molecular orbital picture of pyrrole, furan, thiophene and pyridine
UNIT V : Structure of Naphthalene & Anthracene.

Text Books:

1. Textbook of Organic Chemistry - P.L.Soni - Sultan Chand
2. Advanced organic Chemistry - B.S.Bahl - S. Chand

Reference Books:

1. Principles of Organic Chemistry - A.K.Bansal - New Age.
2. A Textbook of Organic Chemistry - A.K.Bansal - New Age.
3. Organic Chemistry - I.L.Finar - Volume I & II - Addision Welsey.
4. Organic Chemistry - R.T.Morrison and Boyd - Prentice Hall.
5. Stereochemistry of Organic Compounds - D.Nasipuri - New Age.
6. Stereochemistry, Conformation and Mechanisms - Kalsi New Age.
7. Advanced General Organic Chemistry - Sachin K.Ghosh - Books and Allied (P) Ltd.
8. Textbook of Organic Chemistry - P.S.Kalsi – Macmillan.
9. Organic Chemistry – Bhupinder Mehta and Manju Mehta - PHI Learning (P) Ltd.

Web resources:

1. https://byjus.com/jee/optical-isomerism/
2. https://www.chemguide.co.uk/basicorg/isomerism/optical.html
3. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Fundamentals/Isomerism_in_Organic_Compounds/Geometric_Isomerism_in_Organic_Molecules
4. http://www.adichemistry.com/organic/basics/isomerism/geometrical/geometrical-isomerism.html
5. https://www.toppr.com/ask/content/concept/geometrical-isomerism-203878/
6. https://byjus.com/chemistry/aromaticity/#:~:text=Aromaticity%20is%20defined%20as%20a,with%20other%20types%20of%20substances.
7. https://www.masterorganicchemistry.com/2017/02/23/rules-for-aromaticity/
8. https://application.wiley-vch.de/books/sample/3527332014_c01.pdf
9. https://www.pharmaguideline.com/2007/01/polynuclear-hydrocarbons-synthesis-and-reactions.html

Part-III (B.Sc. Chemistry) / Semester – V/ Core 10 – Physical Chemistry III

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – III	Core – 10	U21CH510	Physical Chemistry-III	70	5	-	4

Contact hours per Semester: 75
Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
III	V	25	75	100

Preamble:

The Course gives a detailed account of the Third law of thermodynamics, Chemical kinetics and surface chemistry and provides comprehensive information about Ostwald's dilution law and experimental verification, basic concepts in Collision theory and Absolute reaction rate theory. It also gives a brief idea about buffer solutions, hydrolysis of salts, electrochemical cells, Nernst heat theorem, potentiometric titrations and concentration cells.

Course Outcomes (COs):

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	state Nernst heat theorem, Third law of thermodynamics, Residual entropy, Chemical potential, Arrhenius equation, standard states, common ion effect, Solubility product, Adsorption, Chemisorption, physisorption, Galvanic cells.	K1
CO2	understand and discuss about Partial molar free energy, concept of fugacity and Activity, Nernst heat theorem, order of a reaction, molecularity, Adsorption principle, Lewis concept, Calomel Electrode, LJP expression, polarization, over voltage and decomposition voltage.	K2
CO3	discuss the applications of Clapeyron-Clausius equation, III law, Gibbs - Duhem equation, Effect of temperature on rate constant, activation energy, determination of Arrhenius frequency factor and energy of activation, Adsorption, Buffer solution, solubility product principle, common ion effect and EMF measurements.	K3
CO4	give Experimental verification of third law, compare collision theory with the Absolute reaction rate theory. physisorption and chemisorption, phase transfer catalysis, acid base catalysis, enzyme catalysis, buffer solution and its types, calculation of pH value of buffer solution, standard reduction potentials, electrochemical series, electrode concentration cells and electrolyte concentration cells.	K4
CO5	evaluate absolute entropy from heat capacity measurements,	K5

	Gibbs-Duhem equation, derive expressions for rate constant of I, II and III order reaction, Collision, Lindemann, Arrhenius theory, derivation of Langmuir adsorption isotherm, salts of weak acids & strong base, salts of weak base and strong acids, salts of weak acid and weak base, determination of degree of hydrolysis. Michaelis-Menten equation, Ostwald's dilution law, determination of pH using hydrogen, quinhydrone and glass electrodes, potentiometric titrations, derivation of Nernst equation both for emf of cells and single electrode potentials.	

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	1	1	1	1
CO2	3	3	2	1	2	1	1
CO3	2	2	2	2	2	2	2
CO4	2	2	1	2	2	2	2
CO5	2	2	2	1	1	2	1
Total Contribution of COs to POs	**12**	**11**	**9**	**7**	**8**	**8**	**7**
Weighted Percentage of COs Contribution to POs	80	73.33	60	46.66	53.33	53.33	46.66

1- low, 2-moderate 3-high 0-no correlation

COURSE CONTENT

PHYSICAL CHEMISTRY - III

UNIT I: THERMODYNAMICS-III (L-14 Hrs, T- 1 Hr)

Van't Hoff isotherm and isochore - Clapeyron equation-Clapeyron - Clausius equation-Applications of Clapeyron-Clausius equation. Third law of thermodynamics: Nernst heat theorem-statement of III law and its applications. Exception to third law- experimental verification of the law-residual entropy - Evaluation of absolute entropy from heat capacity measurements. Partial molar properties: Partial molar free energy. The concept of chemical potential – variation of chemical potential with T and P- Gibbs Duhem equation- concept of fugacity and activity- activity coefficient-standard states.

UNIT II: CHEMICAL KINETICS (L-14 Hrs, T- 1 Hr)

Rate of reaction-Measuring rates of reaction-expressing reaction rates- factors influencing rate-rate constant-Rate laws, Stoichiometry, order and molecularity of reactions- First order, second order, third order and zero order reactions and example. Characteristics of I, II, III and Zero order reactions. Determination of order of reactions-expression for rate constant of first and second order reaction-derivation. Effect of temperature on rate constant. The activation energy - determination of Arrhenius frequency factor and energy of activation-The collision theory of reaction rates and its limitation. Lindemann theory of unimolecular reactions-The theory of Absolute reaction rates. Comparison of the collision theory with the Absolute reaction rate theory.

UNIT III: SURFACE CHEMISTRY (L-14 Hrs, T- 1 Hr)

Adsorption - physisorption and chemisorption- adsorption of gases by solids - adsorption isotherms - Freundlich adsorption isotherm - derivation of Langmuir adsorption isotherm, statement and explanation of BET isotherm - applications of adsorption - determination of surface area – adsorption indicators. General characteristics of catalytic reactions – phase transfer catalysis - acid base catalysis - enzyme catalysis - mechanism and kinetics of enzyme catalyzed reactions - Michaelis-Menten equation.

UNIT IV: IONIC EQUILIBRIA (L-14 Hrs, T- 1 Hr)

The Ostwald‘s dilution law-experimental verification-limitations-acids and bases-Lewis concept-dissociation of weak acids and weak bases-dissociation of water-pH scale-common ion effect- its applications-buffer solution-different types-calculation of pH value of buffer solution. Hydrolysis of salts - salts of weak acids & strong base, salts of weak base and strong acids, salts of weak acid and weak base - determination of degree of hydrolysis. Acid- base indicators- acid-base titration and use of indicators. Solubility product - Application of solubility product principle.

UNIT V: ELECTROCHEMISTRY –II (L-14 Hrs, T- 1 Hr)

Galvanic cells – Reversible and Irreversible cells – EMF and its measurement – Weston Standard cell – types of reversible single electrodes – standard Hydrogen electrode – Calomel electrode –Derivation of Nernst equation both for emf of cells and single electrode potentials – Nernst theory for single electrode potential –standard reduction potentials – electrochemical series – significance. Application of emf measurements – Application of Gibbs –Helmholtz equation to galvanic cells – calculation of thermodyamic quantities – pH using hydrogen, quinhydrone and glass electrodes – potentiometric titrations. Concentration cells – electrode concentration cells- electrolyte concentration cells- concentration cells with and without transference – LJP expression –polarization – over voltage- decomposition voltage.

Tutorial Topics:

UNIT I : Evaluation of absolute entropy from heat capacity measurements.
UNIT II : Determination of order of reactions.
UNIT III : Mechanism and kinetics of enzyme catalyzed reactions.
UNIT IV : calculation of pH value of buffer solution.
UNIT V : calculation of thermodyamic quantities.

Text books:

1. B.R. Puri, L.R. Sharma & M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Co., Jalandhar.
2. P.L. Soni, O.P. Dharmarha & U.N. Dash, Text book of Physical Chemistry, 22nd Edn., Sultan Chand & Sons, New Delhi.

Reference books:

1.Essentials of Physical Chemistry – B.S.Bahl, Arun Bahl, G.D.Tuli, Reprint 2006, S.Chand & Company Ltd., New Delhi-110055.

2. Physical Chemistry volumes I & II- S.Pahari, 2004, New Central Book Agency, Kolkotha.

3. Physical Chemistry-G.M.Barrow, 2005, Tata McGraw Hill Publishing Company, New Delhi.

4. Physical Chemistry-G.K.Vemulapalli, 2004, Prentice Hall of India.

Web resources:

1. https://www.vedantu.com/chemistry/third-law-of-thermodynamics
2. https://byjus.com/chemistry/third-law-of-thermodynamics/
3. https://byjus.com/jee/chemical-kinetics/
4. https://chemed.chem.purdue.edu/genchem/topicreview/bp/ch22/rate.php
5. https://testbook.com/learn/surface-chemistry/
6. https://nios.ac.in/media/documents/SrSec313NEW/313_Chemistry_Eng/313_Chemistry_Eng_Lesson12.pdf
7. https://www.teachmint.com/tfile/studymaterial/b-sc/physicalchemistry/electrochemistry-iipaperi/3b8c45d5-3db2-4838-8b9d-c78d006eb3ef
8. https://chem.libretexts.org/Courses/University_of_California_Davis/UCD_Chem_002C/UCD_Chem_2C_(Larsen)/Text/02%3A_Electrochemistry
9. https://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-Physical-Chemistry-Volume-1/ATOPCV1-8-0-Electrochemistry-II-Ion-Transport-in-Solutions.pdf

Part-III (B.Sc. Chemistry) / Semester-V & VI/ Core Practical 3 - INORGANIC QUANTITATIVE ANALYSIS (GRAVIMETRIC METHOD & INORGANIC PREPARATIONS)

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – III	Core practical-3	U21CH6P3	Inorganic Quantitative Analysis (Gravimetric Method & Inorganic Preparations)	-	-	90	3

No. of hours per semester-45
No. of Hours per week-3

Year	Semester	Internal Marks	External Marks	Total Marks
Third	Fifth and Sixth	40	60	100

Preamble:

The Course enables the students to understand the principles and used techniques in Gravimetric Estimation and gives an insight into Inorganic complex preparations.

Course Outcomes (COs):

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	understand the safe and green laboratory practices, handling laboratory glasswares, equipments and chemical reagents, do's and don'ts and first aid techniques.	K1
CO2	identify the starting materials and suitable methods for the preparation of Inorganic compounds.	K2
CO3	apply suitable synthetic routes for the preparation of Inorganic compounds.	K3,
CO4	inspect the conditions, methods and techniques for the estimation of metals using reagents and also for inorganic complex preparation.	K4
CO5	estimate metals as complex compounds using reliable methods.	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	1	1	1	1
CO2	3	3	2	1	2	1	1
CO3	2	2	2	2	2	2	2
CO4	2	2	1	2	2	2	2
CO5	2	2	2	1	1	2	1
Total Contribution of COs to POs	**12**	**11**	**10**	**7**	**8**	**8**	**7**
Weighted Percentage of COs Contribution to POs	80	**73.3**	**66.6**	**46.6**	**53.3**	**53.3**	**46.6**

1- low, 2-moderate 3-high 0-no correlation

COURSE CONTENT

INORGANIC QUANTITATIVE ANALYSIS (GRAVIMETRIC METHOD & INORGANIC PREPARATIONS)

i) Gravimetric Estimation

1. Estimation of lead as lead chromate
2. Estimation of barium as barium chromate
3. Estimation of nickel as nickel dimethyl glyoximate
4. Estimation of zinc as zinc oxinate
5. Estimation of copper as copper thiocyanate
6. Ore Analysis: Estimation of Calcium as Calcium Oxalate in Limestone
7. Spectroscopic determination of formation of complex compounds (Estimation of iron)

ii) Inorganic preparations

1. Preparation of potash alum
2. Preparation of chrome alum
3. Preparation of prussian blue
4. Preparation of tetramminecopper(II) sulphate

5. Preparation of tristhioureacopper(I) chloride dihydrate

6. Preparation of potassium trisoxalatoferrate (III)

7. Preparation of hexathiourealead(II) nitrate

8. Preparation of copper sulphate from waste copper turnings

(Record at least 3 experiments in gravimetric estimation, five preparations)

Practical Marks Distribution

TOTAL MARKS = 100 (Internal 40 + External 60)

External mark distribution

1) Record	= 10
Procedure	= 10 (Estimation 05, preparation 05)
Experiment	= 40 (Estimation 30, preparation 10)

Reference books:

1. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part III), S. Viswanathan Co. Pvt., 1996.

2. Vogel's Text Book of Quantitative Chemical Analysis. 5th Edi., ELBS/Longman England, 1989.

3. O.P. Pandey, D.N Bajpai, S. Gini, Practical Chemistry, for I, II & III BSc. Students. S.Chand & Company Ltd reprint 2009.

4. V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulate College Practical Chemistry, Universities Press (India) Pvt Ltd 2008 (reprint)

Web resources:

1. https://www.youtube.com/watch?v=BnprU6voN1U
2. https://www.youtube.com/watch?v=WZ4f1YQ04sI
3. https://www.youtube.com/watch?v=peMyqdJ57dA
4. https://www.youtube.com/watch?v=ORecjcIjhAo
5. https://www.youtube.com/watch?v=F-abEnACGpE
6. https://www.youtube.com/watch?v=ST5wITpK9IE
7. https://www.youtube.com/watch?v=bhoMvPJKc24
8. https://www.youtube.com/watch?v=oPvG6alQbgk
9. https://www.youtube.com/watch?v=tQYmWVvsMYA
10. https://www.youtube.com/watch?v=TWYu4d6-xj8
11. https://www.youtube.com/watch?v=OGFWZclzXkk
12. https://www.youtube.com/watch?v=SilzJBCEins
13. https://www.youtube.com/watch?v=EKwsLuFXMow
14. https://editn.in/app/webroot/img/EDII%20Project%20Reports/Chemical%20Project/Copper%20Sulphate.pdf

Part-III (B.Sc. Chemistry) / Semester – V &VI / Core Practical – 4- Organic Analysis, Organic Preparations & Determination of Physical Constants

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part-III	Core Practical – 4	U21CH6P4	Organic Analysis, Organic Preparations & Determination of Physical Constants	-	-	90	3

Contact hours per Semester: 45
Contact hours per week: 3

Year	Semester	Internal Marks	External Marks	Total Marks
Third	Fifth & Sixth	40	60	100

Preamble:

The Course is aimed to furnish the students with the understanding about the knowledge of identification of organic components based on their color, appearance,solubility, functionality, recrystallization and derivatisation.

Course Outcomes (COs)

On successful completion of the Course, the learners should be able to

S#	Course Outcome	Knowledge Level (RBT)
CO1	follow safe and good laboratory practices, handle laboratory glasswares, equipments and chemical reagents.	K1,
CO2	identify the starting materials and suitable methods for the preparation of organic compounds and determine the physical constants of solid and liquid organic compounds.	K2
CO3	apply suitable synthetic routes for the preparation of organic compound.	K3
CO4	analyse the given organic compound from its colour, physical state, solubility, action of heat, chemical reactions and prepare solid derivative.	K4
CO5	determine the conditions, methods and techniques for the preparation of organic compounds and methods of recrystallization.	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	3	2	3	2	1	1
CO2	3	2	3	3	1	1	1
CO3	2	2	2	2	1	1	1
CO4	2	2	2	2	1	1	1
CO5	2	1	2	2	1	1	1
Total Contribution of COs to POs	**11**	**10**	**11**	**12**	**6**	**5**	**5**
Weighted Percentage of COs Contribution to POs	73.33	66.66	73.33	80	40	33.33	33.33

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT

ORGANIC ANALYSIS, ORGANIC PREPARATIONS & DETERMINATION OF PHYSICAL CONSTANTS

1. Organic Analysis:

Analysis of simple Organic compounds:

a) Test for aliphatic and aromatic nature of substances
b) Test for saturation and unsaturation
c) Identification of functional groups (Carboxylic acids, phenols, aldehydes, ketones, esters, carbohydrates, amines, amides, anilides, and nitro compounds.
d) Preparation of solid derivatives / characteristic colour reactions, to confirm the presence of functional group
(Note: Mono-functional compounds are given for analysis. In case of bi-functional compounds, students are required to report any one of the functional groups).

2. Organic Preparations:

i) Preparation of Organic Compounds involving the following Chemical conversions:
1. Oxidation 2. Reduction 3. Hydrolysis 4. Nitration
5. Bromination, 6. Diazotization 7. Osazone formation
8. Microwave assisted organic preparation (Preparation of aspirin from salicylic acid).

ii) Isolation methods:
1. Isolation of caffeine from Tea and Coffee.
2. Isolation of casein from milk.

3. Determination of Physical Constants:

Determination of boiling /melting points by semi micro method.
(Record at least 6 experiments in organic analysis, five preparations and two physical constant Determination).

Practical Marks Distribution

TOTAL MARKS = 100 (Internal 40 + External 60)
External mark distribution

1) Record	= 10
Analysis = 30 (Element present or absent	= 05
Aromatic/Aliphatic	= 05
Saturated/Unsaturated	= 05
Functional group	= 10
Solid Derivative	= 05)
Organic Preparation = 10	
(Crude Sample	= 05
Recrystalised sample	= 05)
Physical Constant determination	= 10

Reference Books:

1. A.I. Vogel, Textbook of Practical Organic Chemistry, (4th Edition).
2. N.K. Vishnoi, Advanced Practical Organic Chemistry, Vikas Publishing, 2009, 3rd Ed.
3. A. I. Vogel, Elementary Practical Organic Chemistry: Part 1- Small Scale Preparations, Pearson, 2010, 2nd Ed.
4. A. I. Vogel, Elementary Practical Organic Chemistry: Part 2 –Qualitative Organic Analysis, Pearson, 2010, 2nd Ed.
5. A. I. Vogel, Elementary practical organic chemistry: Part 3- Quantitative organic analysis, Pearson, 2010, 2nd Ed.
6. F G Mann & B C Saunders, Practical Organic Chemistry, Pearson, 2009, 4th Ed.
7. A.R. Tatchell, B.S. Furnis, A.J. Hannaford & P.W.G. Smith, Vogel's Textbook of Practical Organic Chemistry, Longman, 1989, 5th Ed.

Web resources:

1. http://www.iscnagpur.ac.in/study_material/dept_chemistry/3.1_MIS_and_NJS_Manual_for_Organic_Qualitative_Analysis.pdf.
2. https://www.csub.edu/chemistry/organic/manual/Lab14_QualitativeAnalysis.pdf.
3. https://people.chem.umass.edu/mcdaniel/CHEM-268/Experiments/Qualitative-Organic-Analysis.pdf.
4. https://soe.unipune.ac.in/studymaterial/ashwiniWadegaonkarOnline/mixturechartfinalwatermark.pdf.
5. http://klepharm.edu/media/uploads/qualitative_analysis_of_organic_compounds_(chart)_-_pjb.pdf

Part-III (B.Sc. Chemistry) / Semester – V &VI / Core Practical – 5 - Physical Chemistry Experiments

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part-III	Core Practical – 5	U21CH6P5	Physical Chemistry Experiments	-	-	60	3

Contact hours per Semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
Third	Fifth & Sixth	40	60	100

Preamble:

The Course is aimed to enable the students with the knowledge of the physical chemistry experiments.

Course Outcomes (COs)

On successful completion of the Course, the learners should be able to

S#	Course Outcome	Knowledge Level (RBT)
CO1	follow safe and good laboratory practices, handle laboratory glasswares, equipments and chemical reagents.	K1,
CO2	understand the principles of Physical Chemistry experiments	K2
CO3	apply suitable procedure for Physical Chemistry experiments.	K3
CO4	tabulate the readings and calculate the desired quantity by applying suitable formula	K4
CO5	determine and report the desired quantity	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	3	2	3	2	1	1
CO2	3	2	3	3	1	1	1
CO3	2	2	2	2	1	1	1

CO4	2	2	2	2	1	1	1
CO5	2	1	2	2	1	1	1
Total Contribution of COs to POs	**11**	**10**	**11**	**12**	**6**	**5**	**5**
Weighted Percentage of COs Contribution to POs	73.33	66.66	73.33	80	40	33.33	33.33

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT
PHYSICAL CHEMISTRY EXPERIMENTS

List of experiments

1. Determination of molar mass of the given substance by Rast macro method.
2. Determination of molecular weight of the given substance by Transition temperature method.
3. Determination of solubility of a substance at different temperatures and calculation of heat of solution.
4. Study of adsorption of oxalic acid on charcoal and verification of Freundlich isotherm.
5. Study of phase equilibrium – Simple eutectic.
6. Estimation of HCl by conductometric method using standard oxalic acid (to be prepared)and link NaOH.
7. Estimation of $MgSO_4$ by conductometric method using standard $MgSO_4$ (to be prepared)and link $BaCl_2$.
8. Estimation of Fe(II) by potentiometric method using standard ferrous ammoniumsulphate (to be prepared) and link $KMnO_4$
9. Estimation of $KMnO_4$ by potentiometric method using standard $K_2Cr_2O_7$ (to be prepared) and link ferrous ammonium sulphate
10. Determination of equivalent conductance of weak electrolyte and calculation ofdissociation constant
11. Comparison of the strengths of acids by studying the kinetics of ester hydrolysis.
12. Determination of CST of phenol-water system. Study of the effect of impurity on CST and determination of the strength of unknown

(Record at least 8 experiments).

Practical Marks Distribution

TOTAL MARKS = 100 (Internal 40 + External 60)

External mark distribution

Record = 10 marks

Procedure = 10 marks

Experiment = 40 marks

Reference books:

1. J.N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987.
2. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt.,1996.
3. David P. Shoemaker, Carl W. Garland, Joseph W. Nibler, Experiments in PhysicalChemistry, 5th Edi., McGraw- Hill Book company, 1989.
4. Alexander Findlay and J.A. Kitcher. Practical Physical Chemistry, Longmans
5. Y.B. Yadav, Practical Physical Chemistry, Goel publishing house
6. Vogel's Text Book of Quantitative Chemical Analysis. 5th Edi., ELBS/Longman England,1989.
7. V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulate College PracticalChemistry, Universities Press (India) Pvt Ltd 2008 (reprint).

Web resources:

1. https://srcollege.edu.in/temp/lms/Manuals/UGPhysicalChem.pdf
2. https://www.eddusaver.com/adsorption-isotherm-of-oxalic-acid-by-charcoal/
3. https://solutionpharmacy.in/conductometric-titration-of-strong-acid-and-weak-acid-against-strong-base/
4. http://mail.nsec.ac.in/images/bes_Conductometric%20titration.pdf
5. https://labmonk.com/determination-of-critical-solution-temperature-cst-of-phenol-water-system

Part-III (B.Sc. Chemistry) / Semester – V/ Core Elective -1 – ADVANCED ANALYTICAL CHEMISTRY

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – III	Core elective -1	U21CH5E1A	Advanced Analytical Chemistry	70	5	-	4

Contact hours per Semester: 75
Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
III	V	25	75	100

Preamble:

Aimed to impart theoretical and practical skills that underpin the various techniques used in Chemistry. Provides the ability to think analytically and solve problems. To facilitate the students of B. Sc. Chemistry to join PG courses which in turn offer job opportunities and research pursuits and also to apply the skills and knowledge gained through the subject to real life situations.

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Course Outcomes (COs):

On successful completion of the Course, the learners should be able to

S#	Course Outcome	Knowledge Level (RBT)
CO1	recall the basic concepts of analytical chemistry and to explain the confidence level, confidence limit, random errors and effects of random errors on analytical results. Interpret the analytical data of water and fuels and able to correlate theoretical and experimental results using various analytical techniques. To know about the various electro analytical and spectrometric/ spectrophotometric techniques used for the estimation of metal ions.	K1
CO2	understand the experimental errors, sampling of water. Analytical methods for the analysis of water and fuels. To understand about the various techniques used for the estimation of metal ions.	K2
CO3	apply and evaluate the principle of photometric, thermometric techniques in the estimation of metal ions, methods to analyze	K3

	water, fuels and to rectify the experimental errors	
CO4	explicate the theoretical principles of selected instrumental methods within electro analytical and spectrometric/ spectrophotometric methods, and main components in such analytical instruments. To analyze the physical, chemical and biological parameters of water, proximate and ultimate analysis of fuels. To analyze the various terms like mean, median, standard deviation for the experimental datas.	K4
CO5	evaluate the materials using various analytical techniques. Summarize the principle, instrumentation and application of thermogravimetric analysis. To evaluate the errors and to calculate the standard deviation for the experimental datas.	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate;

CO-PO Mapping (Course Articulation Matrix)

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	2	2	2	2	2
CO2	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2
CO4	2	2	2	2	2	2	2
CO5	2	2	2	2	2	2	2
Total Contribution of COs to POs	10	10	10	10	10	10	10
Weighted Percentage of COs Contribution to POs	66.6	66.6	66.6	66.6	66.6	66.6	66.6

1- low, 2-MODERATE 3-high 0-no correlation

COURSE CONTENT

ADVANCED ANALYTICAL CHEMISTRY

UNIT I - ERRORS AND DATA ANALYSIS (L-14 Hrs, T-1 Hr)

Definition and explanation with examples of the terms – mean, median, mode, range, deviation, mean deviation, relative mean deviation, standard deviation, coefficient of variation

and variance – accuracy and precision – types of errors – random and systematic errors – methods of detection and elimination of systematic errors – student‘s t-test – confidence levels – Q-test for rejection of result – curve fitting – method of least squares – significant figures and computational rules.

UNIT II - WATER ANALYSIS (L-14 Hrs, T-1 Hr)

Sampling and preservation of water samples – physical examination of water : color, odor, turbidity, taste and electrical conductivity – chemical characterization : pH, acidity, alkalinity, TDS, total, temporary, permanent, calcium and magnesium hardness, chloride, fluoride, BOD, COD, detergents and pesticides – residual chlorine and chlorine demand – Bacteriological examination : total and faecal coliforms.

UNIT III - FUEL ANALYSIS (L-14 Hrs, T-1 Hr)

Solid fuels : coal – classification – proximate analysis : moisture content, ash content, volatile matter and fixed carbon – ultimate analysis : carbon, hydrogen, nitrogen, sulphur and oxygen – heating values – grading of coal – comparison of coal and coke – liquid fuels : flash point, aniline point, octane number and carbon residues – gaseous fuels : producer gas and water gas – calorific values.

UNIT IV - ELECTROANALYTICAL TECHNIQUES (L-14 Hrs, T-1 Hr)

Electrogravimetry: principle, instrumentation and applications. Coulometry : constant current coulometry – coulometric titrations – applications – potentiostatic coulometry – Polarography : principle – experimental assembly – working – advantages and disadvantages of DME – applications to qualitative and quantitative analysis. Amperometric titrations: theory – apparatus – general procedures – applications – advantages.

UNIT V - SPECTROANALYTICAL AND THERMOANALYTICAL METHODS (L-14 Hrs, T-1 Hr)

Spectroanalytical methods: principle, instrumentation and applications of colorimetry, spectrophotometry and fluorimetry – light scattering techniques: nephelometry and turbidimetry. Thermo analytical methods : principle, instrumentation and applications of TGA and DTA – characteristic features of TGA and DTA curves – factors affecting TGA and DTA curves – simultaneous DTA - TGA curves – thermometric titrations.

Tutorial Topics:

UNIT I : Accuracy and precision.
UNIT II : BOD, COD.
UNIT III : Liquid fuels: flash point, aniline point, octane number and carbon residues.
UNIT IV : DME – applications to qualitative and quantitative analysis.
UNIT V : Thermometric titrations.

Text books:

1. D.A.Skoog, D.M.West and Holler, *Analytical Chemistry: An introduction*, 6th Ed.,

Saunders College Publising.
2. Gary D. Christian, *Analytical Chemistry*, 6th Ed., John Wiley & Sons.

Reference books:

1. S.M.Khopkar, Environmental Pollution Analysis, 1st Ed., Wiley Eastern Ltd.,
2. APHA, *Standard Methods for Estimation of Water and Waste water*, 19th Ed., American Public Health Association.
3. O.P.Vermani and A.K. Narula, *Applied Chemistry*, 2nd Ed., New Age International Publishers.
4. A.K.Shaha, *Combustion Engineering and Fuel Technology*, Oxford & IBH Publising Company.
5. D.A.Skoog, Holler and Nieman, *Principles of Instrumental Analysis*, 5th Ed., Saunders College publishing.
6. Hobart H.Willard, Lynne L.Merritt, John A.Dean and Frank A. Settle, *Instrumental Methods of Analysis*, 7th Ed., CBS Publishers & Distributors Pvt. Ltd.,

Web resources:

1. https://lcn.people.uic.edu/classes/che205s17/docs/che205s17_reading_12a.pdf
2. https://stannescet.ac.in/cms/staff/qbank/CSE/Notes/CY8151-Engineering%20Chemistry-1908708516-unit_4.pdf
3. https://www.mpcb.gov.in/sites/default/files/water-quality/reports/LSD-NEERI-%20Water%20Quality%20Analysis.pdf
4. http://www2.sci.u-szeged.hu/inorg/Physical%20analysis%202010%20-%20Electroanalytical%20methods.pdf
5. https://www.bartleby.com/subject/science/chemistry/concepts/spectroanalytical-methods

Part-III (B.Sc. Chemistry) / Semester – V / Core Elective 1 – GREEN CHEMISTRY

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – III	Core elective -1	U21CH5E1B	Green Chemistry	70	5	-	4

Contact hours per Semester: 75
Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
III	V	25	75	100

Preamble:

Introduces the basics of Green Chemistry, principles for designing green synthesis of selected compounds, make the learners familiar with the usage of green solvents and green catalysts in chemical reactions. To learn the principles of the microwave and ultrasound assisted reactions.

Course Outcomes (COs)

On successful completion of the Course, the learners should be able to

S#	Course Outcome	Knowledge Level (RBT)
CO1	recall the process and advantages of alternative materials, choice of starting materials. To get familiarize about the green house technology, green catalysts, green reagents, green solvents	K1
CO2	understand the different types of reactions, Concept of selectivity, synthesis of ionic liquids, Development of mesoporous supports by liquid crystal templating, Green synthesis of compounds using microwave assisted reactions.	K2
CO3	apply their knowledge to synthesis of compounds in a greener way. Get skills on developing novel materials through new synthetic routes	K3
CO4	analyze the Concept of selectivity – enantioselectivity, chemoselectivity, regioselectivity and diasterioselectivity. Classify the different types of reactions. To study about the biocatalytic reactions.	K4
CO5	Justify the chemicals used in day-to-day life Calculation of atom economy, mass intensity, mass productivity and carbon efficiency. Applications of green chemicals in organic synthesis.	K5

K1–Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	2	2	2	2
CO2	2	2	1	1	1	2	2
CO3	2	2	2	2	1	1	2
CO4	2	2	2	1	2	2	2
CO5	2	2	2	2	2	1	2
Total Contribution of COs to POs	**10**	**9**	**8**	**8**	**8**	**8**	**10**
Weighted Percentage of COs Contribution to POs	67	60	53	53	53	53	67

1- low, 2-moderate 3-high 0-no correlation

COURSE CONTENT
GREEN CHEMISTRY

UNIT I - INTRODUCTION TO GREEN CHEMISTRY (L-14 Hrs, T-1 Hr)

Definition – need for green chemistry – scope of green chemistry. Concept of atom economy – yield – mass intensity and atom economy. Calculation of atom economy, mass intensity, mass productivity and carbon efficiency. Different types of reactions and atom economy – addition, substitution, elimination and rearrangements. Concept of selectivity – enantioselectivity, chemoselectivity, regioselectivity and diasterioselectivity.

UNIT II - GREEN SOLVENT (L-14 Hrs, T-1 Hr)

Super critical fluids – Introduction – extraction of super critical fluids – solvents of super critical fluid– advantages and applications. Carbondioxide as a super critical fluid – features of technique for using super critical carbondioxide - advantages and applications. Chemical reactions in supercritical water and Near – Critical Water (NCW) - Region. Extracting natural products, dry cleaning, supercritical polymerization, hydrogenation and hydroformylation, ionic liquid as green solvent: Introduction – synthesis of ionic liquids - acidic ionic liquid and neutral ionic liquids – applications in organic synthesis. Green reagents: Dimethyl carbonate and Polymer supported reagents.

UNIT III - GREEN CATALYST (L-14 Hrs, T-1 Hr)

Catalysis over view: acid catalyst - basic catalyst – oxidation catalyst – polymer supported catalyst- photosensitized super acid catalyst and Tetra Amido Macrocylic Ligand (TAML) catalyst. Biocatalyst: microbial oxidation, microbial reduction, enzyme catalyzed

hydrolytic process, per fluorinated catalyst and modified biocatalyst. Development of mesoporous supports by liquid crystal templating – neutral templating methods- heterogeneous catalyst – solid supported catalyst.

UNIT- IV - GREEN SYNTHESIS (L-14 Hrs, T-1 Hr)

Green synthesis of the following compounds -Adipic acid, Catechol, Benzoyl bromide, Acetaldehyde, Citral, Ibruprofen and Paracetamol. Microwave assisted reactions in water – Hoffmann Elimination, Hydrolysis of benzyl chloride and methyl benzoate – oxidation of toluene and alcohols. Microwave assisted reactions in organic solvents – Esterification, Fries rearrangement, Claisen Rearrangement, Diels-Alder Reaction and Decarboxylation. Ultra sound assisted reactions – Esterification, Saponification, alkylation, oxidation, reduction, coupling reactions and Cannizaro reactions.

UNIT -V - GREEN REACTIONS INVOLVING BASIC PRINCIPLE OF GREEN CHEMISTRY (L-14 Hrs, T-1 Hr)

Twelve principle of green chemistry – choice of starting materials – biomimitic, multifunctional reagents – materials reagents. Combinatorial green chemistry – green chemistry in sustainable developments. Importance of Green chemistry in day to day life, versatile bleaching agents and analgesic drugs.

Tutorial Topics:

UNIT I : Calculation of atom economy, mass intensity, mass productivity and carbon efficiency.
UNIT II : Extracting natural products.
UNIT III : Enzyme catalyzed hydrolytic process.
UNIT IV : Ultra sound assisted reactions.
UNIT V : Importance of Green chemistry in day to day life.

Text Books:

1. V.K.Ahluwallia &M.R Kidwai ―New Trends in Green Chemistry‖, Anamalaya Publishers (2005).
2. P.T.Anaster &J.K.Warnerr ― Oxford Green Chemistry, Theory and Practical, University Press (1998).

Reference Books:

1. A.S. Matlack,‘‘ Introduction to Green Chemistry‖-Marcel Deckkar (2001).
2. V.K.Ahhluwallia,―Green Chemistry Environmentally Benign Reaction. Anamalaya Publishers, New Delhi (2009)
3. Rashmi Sannghi &MM Srivastava, ‒Green Chemistry Environment Friendly Alternatives. Narosa Publishing House Pvt Ltd, New Delhi (2009)

Web resources:

1. https://www.intechopen.com/chapters/57200
2. https://www.asdlib.org/onlineArticles/ecourseware/Manahan/GreenChem-2.pdf

3. https://www.kngac.ac.in/elearning-portal/ec/admin/contents/2_18KP1CHELCH1_2020120403270660.pdf
4. https://www.acs.org/content/dam/acsorg/greenchemistry/education/summerschool/Tamer%20Andrea_Greener%20Solvents.pdf
5. https://www.researchgate.net/publication/277944432_Green_Synthesis_of_Nanoparticles_Current_Prospectus
6. https://www.mdpi.com/books/pdfview/book/1800

Part-III (B.Sc. Chemistry)/Semester– V / Core Elective 1 – NANO CHEMISTRY

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – III	Core elective -1	U21CH5E1C	Nano Chemistry	70	5	-	4

Contact hours per Semester: 75
Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
III	V	25	75	100

Preamble:

Gives an insight into the basics of nano chemistry, bulk and nanomaterials, the synthesis, application and fabrication of nanostructure, importance of nano catalyst, nano composites and fibers. Makes the students familiar with the characterization and applications of nanomaterials.

Course Outcomes (COs)

On successful completion of the Course, the learners should be able to

CO#	Course Outcomes	KL
CO1	recall the basic concepts of nanochemistry and difference between bulk materials and nanomaterials, types of nanomaterials and structures, physical and chemical properties of nanomaterials. To know about bulk and surface characterization techniques, Current applications.	K1
CO2	understand the types of nanomaterials, their properties and choose the suitable synthetic methods to prepare particular nanomaterials. To study the applications of nanomaterials in different fields.	K2
CO3	interpret the different types of nanomaterials, structure of nanomaterials using various characterization techniques. Apply physical, chemical, spectroscopic methods for the synthesis of nano particles, nanosized semiconductors, ceramics, carbon fibers, nanotubes and nanocatalysts.	K3
CO4	classify different types of of nanomaterials, catagorize	K4

	and identify the different types carbon nano structures, carbon nanomaterials, types of characterization of nanocatalyst.	
CO5	evaluate the types of nanocomposite materials, Summarize the applications of nanomaterials in different fields. To evaluate types of composite materials, Carbon fibers and nanotubes, synthetic methods, characterization methods.	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	2	2	2	2	2
CO2	2	2	2	1	1	1	1
CO3	2	3	2	2	2	1	2
CO4	2	2	2	1	2	3	2
CO5	2	2	2	2	2	1	1
Total Contribution of COs to POs	**10**	**11**	**10**	**8**	**9**	**9**	**8**
Weighted Percentage of COs Contribution to POs	66.6	73.3	66.6	53.3	60	60	53.3

1- low, 2-moderate 3-high 0-no correlation

COURSE CONTENT
NANO CHEMISTRY

UNIT I - INTRODUCTION TO NANO CHEMISTRY (L-5 Hrs, T– 1 Hr)

Definition: nanoscience – nanotechnology – nanochemistry – significance of nanoscale - factors responsible for special properties of nanomaterials. Nanomaterials: Different types of nanomaterials and structures- quantum wells – quantum wires – quantum dots – nanoclusters – nanocrystals – nanowires and nanotubes. Feynman‘s Prophecy– manufacturing of nanomaterials - top-down and bottom-up approaches.

UNIT II - SYNTHESIS OF NANO PARTICLES (L-14 Hrs, T-1 Hr)

Introduction – orientation of nanoparticles – synthesis of nanoparticles. Physical methods: laser ablation, physical vapour deposition (PVD) and solvated metal atom dispersion (SMAD). Chemical methods: thermolysis, sonochemical method, reduction methods, phase-

transfer processes and biosynthesis of nanoparticles. Synthesis of nanosized semiconductors: precipitation methods and thermal decomposition of complex precursors. Synthesis of ceramics: physical methods, gas condensation method, laser method, chemical methods and sol-gel synthesis.

UNIT III - NANOCATALYST AND CARBON BASED NANOMATERIALS (L-14 Hrs, T-1 Hr)

Introduction – fundamentals of catalysis – adsorption of a molecule on a catalyst surface, adsorption theory- Langmuir adsorption isotherm. Surface reactions – synthesis – synthesis requirements, example of a conventional synthetic technique, non-traditional methods for preparing nanocatalyst. Characterization of nanocatalyst: overview - bulk characterization technique and surface characterization technique. Carbon nanomaterials: structure and properties of graphite, diamond and fullerenes.

UNIT IV - NANOCOMPOSITES AND F I B E R S (L-14 Hrs, T-1 Hr)

Introduction - Background - types of composite materials - The nano perspective. Physical and chemical properties of materials – mechanical properties, thermal properties, electronic properties and chemical properties. Natural nanocomposities - Skin of the sea cucumber and hard natural nanocomposites. Carbon fibers and nanotubes – Types of fibers, Whiskers and nanotubes – synthesis of fibers and nanotubes - chemical modification and applications of carbon nanotube. Metal and Ceramic nanocomposites - Metal nanocomposites, inorganic nanofibers and concrete. Clay nanocomposite materials -polypropylene clay nanocomposite, montmorillonite clay nanocomposite and halloysite nanotube clay composites.

UNIT V - CHARACTERIZATION AND APPLICATIONS OF NANOMATERIALS (L-14 Hrs, T-1 Hr)

Types of characterization methods – Electron probe method- Scanning electron microscopy – Transmission electron microscopy, Spectroscopic Methods, - UV – Visible adsorption and emission spectroscopy, Infra-Red and Raman spectroscopy and X-ray diffraction methods. Current applications: sunscreens and cosmetics – nano medicine, drug delivery and cancer drugs – food and drinks, textiles, chemical industry and electronic devices. Short term applications - paints – fuel cells – displays – batteries – fuel additives and catalysts. Long term applications- composites – lubricants – magnetic materials – medical implants – machinable ceramics – water purification and military battle suits.

Tutorial Topics:

UNIT I : Different types of nanomaterials and structures.
UNIT II : Biosynthesis of nanoparticles.
UNIT III : Non-traditional methods for preparing nanocatalyst.
UNIT IV : Natural nanocomposities.
UNIT V : Drug delivery and cancer drugs.

Text Books:

1. Geoffrey A. Ozin and Andre C. Arsenault, ‒Nanochemistry: A chemical approach to nanomaterials‖, RSC publishing, (2005), U.K.

2. Hari Singh Nalwa, –Nanostructured Materials and Nanotechnology, Academic Press, New York, (2002).

Reference Books

1. C.N.R. Rao, A. Muller and A.K. Cheetham, –The Chemistry of Nanomaterials, Volume I & II, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, (2004).
2. Kenneth J. Klabunde, Nanoscale Materials in Chemistry, Wiley-Interscience, New York, (2001).
3. Gabor L.Hornyak, Harry F. Tibbals, Joydeep Dutta and John J Moore. –Introduction to Nanoscience and Nanotechnology, CRC Press, Taylor and Francis group London Newyork.

Web resources:

1. https://bbec.ac.in/wp-content/uploads/2015/08/Nanochemistry.pdf
2. https://ggu.ac.in/gguold/download/Class-Note13/Intriduction%20to%20Nanosc.24.10.13.pdf
3. https://nanohub.org/resources/22262/download/NACK_U3_Maeder_Nanoparticle_Synthesis.pdf
4. https://nanobiotec.iqm.unicamp.br/download/preparation%20nanoparticles-chapter%205.pdf
5. https://folk.ntnu.no/fredrol/Nanomaterials%20and%20Nanochemistry.pdf

Part - IV (B.Sc. Chemistry) / Semester – V / SEC 1 - Women Studies

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – IV	Skill Enhancement1	U21SE5S1	Women Studies	30	-	-	2

Contact hours per Semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
II	**FIFTH**	**-**	**50**	**50**

Preamble

This is an introductory course that emphasizes the roles of women, their experiences and contributions to society and enables students to analyze contemporary issues from feminist perspective

Course Outcomes

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level
1.	find methods to promote inclusion of women in development of all sectors	K1
2.	demonstrate how gender has been socially constructed and maintained through a variety of institutions	K2
3.	apply concepts and theories of Women's Studies to life experiences and processes	K3
4.	analyse socio-political systems and contemporary issues from feminist perspective	K4
5.	evaluate the extent to which women can contribute to preservation of environment and natural resources	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

COURSE CONTENT

WOMEN STUDIES

Unit I: Introduction to women's studies (T-6 Hrs)

Definition, need, scope, importance and challenges of Women's Studies- Emergence of Women's studies as an academic discipline in India – - Need for gender sensitisation - Women

as individuals in families and societies- Matriarchy and matrilineal societies. Women's movements - global and local.

Unit II: Role of women in family (T-6 Hrs)

Study of the evolution of women's role – Women as individuals in families-Gender roles in domestic/personal sphere- Women's roles, aspirations and familial expectations on women - Foeticide, Female infanticide, Sex selective abortion, Domestic violence, Gender issues, Gender violence, Maternal mortality rate, Property rights, Reproductive rights – Women's health and nutrition

Unit III: Role of women in society (T-6 Hrs)

Gender roles in social spheres- Choice of profession - Self , Family and Societal pressures, Decision making/ Leadership roles- myths and misconceptions- roles expected from women – stereotyping – Representation in media / politics / arts and literature / sports

Unit IV: Against all odds- Women achievers (T-6 Hrs)

Socio-cultural, socio-political and economic factors that deter women's talent- Life narratives of women achievers- Savitri Bhai Phule, Dr.Muthu Lakshmi Reddy, Kiran Mazumdhar Shah, Kalpana Chawla, Saina Nehwal, Sania Mirza, Deepika Palikkal, Mary Kom, P T Usha, Smriti Mandanna, Arundhati Roy, Vandana Siva, Kamala Das, Indira Goswami, Amrita Pretham, Anita Desai, Jhumpa Lahiri, Kiran Desai, Shashi Deshpande.

Unit V: Role of women in National Development: (T-6 Hrs)

Role of women in rural and community development- community bio-diversity conservation – gender and Agro biodiversity-role of women in seed preservation- sustainable development- Joint forest management,- Chipko movement, Narmada Bachao Andolan—India's - Neem patent victory-Living Democracy Movement for reclaiming life's diversity and freedom

Text books

1. Maithreyi Krishna Raj. (1986). "Women Studies in India: Some Perspectives". Popular Prakasham, Bombay.

2. Sharmila Rege, (Ed.). (2003). "Sociology of Gender: The Challenge of Feminist Sociological Knowledge". Sage Publications, New Delhi

3. Veena Majumdar. (1974). "Report on the committee on the Status of Women: Towards Equality". Journal of Women Studies.

4. Kadambari,V. 2009. Gender Studies: A Primer. Chennai: RJYND

5. Devaki Jain and Pam Rajput (Ed). (2003). "Narratives from the Women"s Studies Family: Recreating Knowledge, Sage, and New Delhi.

6. M.S.Swaminathan. (1998)."Gender Dimensions in Biodiversity Management". Konark publishers pvt ltd, New Delhi.

References

1. **Amy S. Wharton.** (2005). "The Sociology of Gender: An Introduction to Theory and Research". (KeyThemes in Sociology) Blackwell Publishing, UK, Indian Reprint,Kilaso Books, New Delhi

2. **Jasbir Jain (Ed).** (2005). "Women in Patriarchy: Cross Cultural". Rawat Publications, Jaipur.
3. **Lerner, Gerda**. (1986). "The Creation of Patriarchy". Oxford University Press, New Delhi.
4. **Mala Khullar, (Ed). (**2005). "Writing the Women‟s Movement: A Reader". Zubaan, Kali for Women, New Delhi.
5. **Mies, Maria.** (1980). "Indian Women and Patriarchy". Concept Publishing Company, New Delhi.
6. **Promilla Kapur** (Ed), Empowering Indian Women, Publication Division, Government of India, New Delhi, 20
7. **Mitchell, J**. 1975. Women in a Man Made World. Chicago: Rand McNally & Co
8. **Putnam Tong, Rosemarie**. 2013. Feminist Thought: A More Comprehensive Introduction. USA: Westview.
9. **Russell, Bertrand**. 1936. Marriage and Morals. London: Bantam.
10. **Smith, Bonnie.** 2013. Women's Studies: The Basics. London: Routledge
11. **Drinkwater, Barabara, Ed.** 2000. Women in Sport. Oxford: Blackwell Science
12. **Spence, Jean and Sarah Jane et al.** 2010. Women Education and Agency 1600-2000. New York: Routledge Publishing House.
13. **Nancy**. 2011. Feminism and Science. Indianapolis: Indiana University Press.
14. **Tharu, Susie and K. Lalitha (ed).** 1991 &1993. Women Writing in India, 2 Vols. New Delhi: Oxford University Press.
15. **P.K.Rao.** (2000) "Sustainable Development – Economics and Policy". Blackwell, New Delhi.
16. **Radha Kumar,** (1993). "The History of Doing". Kali for Women, New Delhi.
17. **Ronnie Vernooy,** (Ed). (2006). "Social and gender Analysis Natural Resource Management: Learnning studies and lessons from Aisa". Sage, New Delhi.
18. **Swarup, Hemlata and Rajput, Pam.** (2000). Gender Dimensions of Environmental and Development Debate: The Indian Experience". In Sturat S.Nagel, (ed). "India‟s Development and Public Policy". Ashgate, Burlington.
19. **Venkateshwara, Sandhay**. (1995). "Environment, Development and the Gender Gap" Sage Publications,NewDelhi.

Web references

1.https://r.search.yahoo.com/_ylt=AwrxhWjc7_9geRUAlADnHgx.;_ylu=Y29sbwMEcG9zAzUEdnRpZAMEc2VjA3Ny/RV=2/RE=1627414620/RO=10/RU=https%3a%2f%2fin.sagepub.com%2fen-in%2fsas%2findian-journal-of-gender-studies%2fjournal200917/RK=2/RS=wGNZp8L5sqXOSojTzCefS4hzShA-
2.https://r.search.yahoo.com/_ylt=Awrx5kom8f9gJDAAXC_nHgx.;_ylu=Y29sbwMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1627414951/RO=10/RU=https%3a%2f%2fwgs.fas.harvard.edu%2fpast-thesis-topics/RK=2/RS=cjxRQNT0UmGS1Fia5z9Er8a8P.I-

Part-V B.Sc. Chemistry/ Semester I - VI / Proficiency Enhancement Course (Self Study Course) : GENERAL STUDIES

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
PART-V	Proficiency Enhancement Courses - Self Study Course		General Studies	-	-	-	1

Year	Semester	Completion only-
I to III year	I to VI Semester	

COURSE CONTENT

GENERAL STUDIES

UNIT-I: General Science

i) General Scientific Laws – Mechanics - Properties of Matter, Force, Motion and Energy –Electricity and Magnetism, Light, Sound, Heat, Nuclear Physics, Electronics and Communications, solar energy

ii) Atomic structure, Elements and Compounds, Acids, Bases, Salts, Petroleum Products, Fertilisers, Pesticides, Energy resources

iii) Classification of Living Organisms, Evolution, Genetics, Physiology, Nutrition, Health and Hygiene, Diseases

iv) Environment and Ecology- Biosphere, Conservation of biodiversity- Biosphere Reserves of India, Sanctuaries and National parks, Environmental pollution, causes and control measures, alternate sources of energy

UNIT-II: General knowledge, Current Events, Quantitative Aptitude and Mental Ability

i) Latest Diary of Events - National symbols - Profile of States and Union territories Eminent persons and places in news – Sports - Books and Authors-

Prominent Personalities in various spheres – Arts, Science, Literature and awards.

ii) Political parties and Political system in India – Public awareness and General administration - Welfare oriented Government Schemes and their utility, Problems in Public Delivery Systems. Public Corruption and Lokpal & Lokayuktha act

iii) Geographical landmarks - Current socio - economic issues - Latest inventions in Science and Technology. Industrial growth in India and Tamilnadu

iv) Quantitative Aptitude and Mental Ability- Simplification – Percentage - Ratio and Proportion- Time and Work - Simple interest - Compound interest - Area - Volume – Logical Reasoning -Visual Reasoning – Alpha numeric Reasoning – Number Series

UNIT-III: Geography of India & Tamil Nadu

i) Location – Physical features - Monsoon, Rainfall, Weather andClimate - Water Resources-Rivers in India - Soil, Minerals and Natural Resources - Forest and Wildlife – Agricultura pattern

ii) Transport – Communication

iii) Social Geography –Population, Census, poverty eradication and unemployment

iv) Natural calamity – Disaster Management – Environmental pollution
Climate change, pandemics in history – Green energy initiatives

UNIT–IV : History and Culture of India & Tamil Nadu

i) Ancient India**:** Indus Valley Civilization - The Maurian empire- Age of the Guptas-vardhana empire- Nalanda university

ii) Medieval India : The Delhi Sultanate, Mughals and Marathas - Age of Vijayanagara and Bahmani Kingdoms –South Indian History.

iii) National Renaissance : Early uprising against British rule – sepoy mutiny Indian National Congress - Emergence of leaders- Gandhian Era

iv) Tamil Nadu : History & Culture, Socio-Political Movements

UNIT-V : Indian Polity, Economy and Tamil Nadu Administration

i) Constitution of India - Preamble to the Constitution – Salient features of the Constitution - Citizenship, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy

ii) Union Executive, Union Legislature (Parliament) –State Executive, State Legislature –

Local Governments, Panchayat Raj- Spirit of Federalism - Centre - State Relationships- Election – Judiciary in India – Rule of Law

iii) Indian Economy – Five-year plan models – an assessment – Planning Commission and Niti Ayog - Reserve Bank of India – Fiscal Policy and Monetary Policy – Finance Commission –Goods and Services Tax

iv) Governance in India and Development-Administration in Tamil Nadu

Text Books:

1. TNSCERT Books (Science and Social) from Std VI -X
2. Manorama year Book (Tamil)
3. Arihant General Knowledge, 2022-Manohar Pandey

Part-III (B.Sc. Chemistry) / Semester – VI / Core 11 – ORGANIC CHEMISTRY 1V

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
Part – III	Core – 11	U21CH611	Organic Chemistry 11	70	5	-	4

Contact hours per Semester: 75
Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	**Second**	**25**	**75**	**100**

Preamble

The Course is designed to furnish the students an insight into the Chemistry of carbohydrates, phenols, aromatic aldehydes, ketones and carboxylic acids and molecular rearrangements. It also deals with the general methods of structural elucidation of alkaloids and terpenoids, synthesis and structural elucidation of some important alkaloids and terpenoids. It also equips the students with the basic knowledge on UV, IR and NMR spectroscopy.

Course Outcomes (COs)

On successful completion of the Course, the learners should be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	recall the important definitions, concepts, and reactions of Carbohydrates, phenols, aromatic aldehydes, ketones and aromatic acids, important basic terms and concepts in spectroscopy, molecular rearrangements and alkaioids and terpenoids	K1
CO2	understand the classification of carbohydrates, chemical reactions of glucose and fructose, molecular rearrangements,	K2

	cyclic structure of glucose and fructose, Fischer projection formula for glucose and fructose, chemical structure of sucrose, starch and cellulose, acidic character of phenol, effect of substituents on the acidity of phenol, preparation and uses of various organic compounds given in the syllabus, understand the isoprene rule and general structural elucidation methods of alkaloids and terpenoids, electronic excitation in molecules, woodward-Fischer rule	
CO3	apply the knowledge of chemical reactions of glucose and fructose to chain lengthening and shortening of aldoses and ketoses and inter-conversion of glucose and fructose, apply the chemical knowledge to prepare the important aromatic aldehydes, ketones and carboxylic acids, apply the general structural elucidation methods to elucidate the structures of important alkaloids and terpenoids given in syllabus, apply Woodward Fischer rule to conjugated enes and alpha and beta unsaturated ketones, apply the knowledge to study cis-trans isomerism, conjugation, hydrogen bonding, functional group detection and interpret nmr spectra of simple organic compounds given in syllabus and discuss the applications of UV and IR Spectra	K3
CO4	analyse the constitution of glucose and fructose and structure of glucose, fructose, sucrose, starch and cellulose, analyse the mechanisms of important name reactions and molecular rearrangements, analyse the general methods of structural elucidation of alkaloids and terpenoids, structure of important alkaloids, terpenes and terpenoids prescribed in the syllabus, NMR spectra of simple organic compounds given in the syllabus	K4
CO5	explain the chemical properties of glucose and fructose, Chain lengthening and shortening of aldoses and ketoses, Interconversions of aldoses and ketoses, constitution of glucose and fructose, mechanisms of important name reactions and important rearrangements given in the syllabus, structural elucidation and synthesis of important alkaloids and terpenoids prescribed in the syllabus, interpret	K5

	NMR spectra of simple organic compounds given in the syllabus	

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	3	2	1	2	2
CO2	2	1	3	2	1	2	2
CO3	2	1	2	2	1	2	2
CO4	2	1	2	2	1	2	2
CO5	2	1	2	5	1	2	2
Total Contribution of COs to POs	**10**	**5**	**12**	**11**	**5**	**10**	**10**
Weighted Percentage of COs Contribution to POs	**66.6**	**33.3**	**80**	**73.3**	**33.33**	**66.6**	**66.6**

1- low, 2-moderate 3-high 0-no correlation

COURSE CONTENT

ORGANIC CHEMISTRY – IV

UNIT I - CARBOHYDARATES (L-15 Hrs, T-1 Hr)

Classification – Monosaccharides - constitution of glucose and fructose. Reactions of glucose and fructose – Osazone formation, Mutarotation and its mechanism, cyclic structure, pyronose and furanose forms. Epimerisation - Chain lengthening and shortening of aldoses. Interconversions of aldoses and ketoses. Disaccharides - sucrose- reactions and structure. Polysaccharides – starch and cellulose (elucidation of structure not necessary).

UNIT II - PHENOLS, AROMATIC ALDEHYDES, KETONES AND ACIDS (L-15 Hrs, T-1 Hr)

Phenols

Acidic character of phenols- effect of substituents on acidity of phenol - Mechanisms of Kolbe‘s reaction and Riemer-Tiemann reaction. Preparation of cresols, catechol, resorcinol, quinol and euginol.

Aldehydes and ketones

Preparation and uses of cinnamaldehyde. Coumarin, vanillin, Michler‘s ketone, p-

benzoquinone-Quinone mono oxime tautomerism. Mechanism of Cannizaro reaction, benzoin condensation, Perkin reaction, Claisen reaction, Knoevenagel reaction, Gattermann aldehyde synthesis and Houben –Hoesch synthesis.

Aromatic acids

Ortho effect, preparation of mandelic acid, cinnamic acid and anthranilic acid. Preparation and uses of benzene-1,2- dicarboxylic acid, benzene-1,3- dicarboxylic acid and 1,4- dicarboxylic acid.

UNIT III – REARRANGEMENTS (L-15 Hrs, T-1 Hr)

Rearrangement to electron-deficient carbon – 1,2 shift (Wagner-Meerwein rearrangement, pinacol rearrangement, Wolff rearrangement in Arndt-Eistert synthesis, benzil-benzilic acid rearrangement). Aromatic rearrangements from oxygen to ring carbon (Fries rearrangement, Claisen rearrangement and benzidine rearrangement). Rearrangement to electron-deficient nitrogen (Beckmann rearrangement, Schmidt rearrangement, Hofmann rearrangement, Curtius rearrangement). Rearrangement to electron-deficient oxygen (Baeyer-Villiger oxidation, hydroperoxide rearrangement,cumene hydroperoxide-phenol rearrangement), Dakin reaction.

UNIT IV - TERPENOIDS AND ALKALOIDS (L-15 Hrs, T-1 Hr)

Terpenes and terpenoids: classification - isoprene rule. Elucidation of structure and synthesis of citral, limonene, menthol, α-terpineol and camphor. Alkaloids: Introduction, classification and general methods for the determination of structure. Structural elucidation and synthesis of conine, piperine and nicotine.

UNIT V - ORGANIC SPECTROSCOPY (L-15 Hrs, T-1 Hr)

UV spectroscopy - chromophore – auxochrome – blue shift, red shift – hypochromic shift, hyperchromic shift – applications for studying functional groups, cis-trans isomerism and nature of double bonds- Woodward-Fischer rules as applied to conjugated enes and alpha and beta unsaturated ketones. IR spectroscopy – characteristics of IR absorption frequencies – intermolecular and intramolecular hydrogen bonding – functional group detection. NMR Spectroscopy - interpretation of NMR spectra of simple organic compounds such as acetone, anisole, benzaldehyde, isobutene, mesitylene, 1-chloropropane, ethyl methyl ketone, benzyl alcohol, and propionic acid.

Tutorial Topics:

Unit I : Interconversions of aldoses and ketoses.
Unit II : Acidic character of phenols.
Unit III : Aromatic rearrangements from oxygen to ring carbon.
Unit IV : Terpenes and terpenoids: Classification - isoprene rule.
Unit V : Interpretation of NMR spectra of simple organic compounds.

Text Books

1. K.S. Tewari, N.K. Vishil, S.N. Mehotra – A text book of org. chem – 1st edition, Vikas Publishing House Pvt Ltd., 2001, New Delhi.

2. P.L. Soni, Text Book of Organic chemistry, Sultans Chand, 1991, New Delhi,

Reference Books

1. Bahl and Arun Bahl, Organic Chemistry, S. Chand and Sons, New Delhi, 2005.
2. Gurdeep Chatwal, Reaction mechanisms and reagents in organic chemistry
3. O. P. Agarwal, Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House, 2002.
4. Gurdeep Chatwal, Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House,2002
5. Y.R. Sharma, O.P. Vig, Elementary organic absorption spectroscopy – 1st edition, Goel Pulishers, 1997, Meerut
6. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th Edition, PHI Limited, New Delhi, 1992.
7. Jerry March, Advanced Organic Chemistry, 4th Edition, John Wiley and Sons, New York,1992.
8. S. H. Pine, Organic Chemistry, 5th Edition, McGraw Hill International Edition, Chemistry Series, New York, 1987.

Web resources:

1. https://2012books.lardbucket.org/pdfs/introduction-to-chemistry-general-organic-and-biological/s19-carbohydrates.pdf
2. https://www.uou.ac.in/lecturenotes/science/MSCCH-17/CHEMISTRY%20LN%204%20CARBOHYDRATES-converted%20(1).pdf
3. https://authors.library.caltech.edu/25034/21/BPOCchapter20.pdf
4. https://ncert.nic.in/textbook/pdf/lech203.pdf
5. https://www.nios.ac.in/media/documents/313courseE/L29.pdf
6. https://chem.ucr.edu/sites/default/files/2019-10/Chapter13.pdf
7. https://application.wiley-vch.de/books/sample/3527347852_c01.pdf
8. https://www.researchgate.net/publication/325080016_ADVANCED_ORGANIC_CHEMISTRY-I_MPC_102T_UNIT-I_Rearrangement_reaction
9. https://www.uou.ac.in/lecturenotes/science/MSCCH-17/CHEMISTRY%20LN%208%20NATURAL%20PRODUCTS-converted.pdf
10. https://oms.bdu.ac.in/ec/admin/contents/1_16SCCCH8_2020051904202312.pdf
11. https://www.saurashtrauniversity.edu/docs/eBooks/organic-spectroscopy.pdf
12. http://dl.iranchembook.ir/ebook/organic-chemistry-2747.pdf
13. https://rushim.ru/books/spectroscopia/organic-structures-from-spectra-2008.pdf

Part-III (B.Sc. Chemistry) / Semester – VI/ Core –12 - PHYSICAL CHEMISTRY IV

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – III	Core – 12	U21CH612	Physical Chemistry IV	70	5	-	4

Contact hours per Semester: 75
Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
Third	Sixth	25	75	100

Preamble:

The Course aims at imparting the detailed concepts of Phase rule, Solar energy radiation, conversion and storage and provide comprehensive information about spectroscopic techniques, basic concepts in Collision theory and a Absolute reaction rate theory. It also gives brief idea about buffer solutions, hydrolysis of salts, electrochemical cells, Nernst heat theorem, potentiometric titrations and concentration cells.

Course Outcomes (COs)

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	recall Phase rule - phase, component, degree of freedom, Distribution Law, Solar radiation, Introduction –Definition- solar cell efficiency -Spectroscopy shielding effect, hyperfine splitting, coupling constants, - chemical shift, Identity and Centre of symmetry, Point groups of simple molecules	K1
CO2	understand simple eutectic , formation of compound with congruent melting point, nature, solar radiation at earth surface, Photo voltaic principle, Photo electrochemical cells, various types of molecular spectra - electronic, vibrational and rotational energy levels,mutual exclusion principle, Rayleigh and Raman scattering, Theory of NMR and Mass spectroscopy	K2

CO3	discuss the applications of the distribution law-solvent extraction, Applications of solar PV systems- PV systems for power generation. Born-Oppenheimer approximation- modes of vibrations in polyatomic molecules presentation of ESR spectrum for methyl and benzene radicals, deuterium – applications, UV,IR, NMR and Raman- classification of molecules into point groups- improper rotational axis of symmetry - identity element - groups and their basic properties	K3
CO4	Analyse association ans dissociation of the solute in one of the solvents, crystalline silicon, Thin film and multi junction solar cells advantages and disadvantages of PV systems. finger print region, determination of force constant, qualitative relation of force constant to bond energies, types of transitions in molecules, stretching and bending vibrations,M factors affecting vibrational frequencies, Mc-Lefferty rearrangement, molecular peak, base peak, isotopic peak and meta stable peak, types of fragmentation, factors influencing the fragmentation, types of rotational axes, planes of symmetry and types of planes, Abelian and cyclic groups	K4
CO5	evaluate thermodynamic derivation of phase rule , Phase diagrams of important one and two component systems, Dye sensitized solar cells, design and fabrication, solar cell efficiency, power conversion, efficiency, Determination of bond length and moment of inertia from rotational spectra, selection rule, effect of isotopic substitution, modes of vibrations of H_2O and CO_2, applications, Symmetry operations and symmetry elements H_2O and NH_3 point groups, group multiplication tables	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	1	1	1	1
CO2	3	3	2	1	2	1	1
CO3	2	2	2	2	2	2	2
CO4	2	2	1	2	2	2	2

CO5	2	2	2	1	1	2	1
Total Contribution of COs to POs	**12**	**11**	**9**	**7**	**8**	**8**	**7**
Weighted Percentage of COs Contribution to POs	80	73.33	60	46.66	53.33	53.33	46.66

1- low, 2-moderate 3-high 0-no correlation

COURSE CONTENT
PHYSICAL CHEMISTRY IV

UNIT I - PHASE EQUILIBRIA (L-15 Hrs, T-1 Hr)

Phase rule - phase, component, degree of freedom - thermodynamic derivation of phase rule, One-component system: Phase diagrams of Water and sulphur systems. Two component system: (i) Simple eutectic: Lead-silver system and potassium iodide-water system. (ii) Formation of compound with congruent melting point: Magnesium – zinc system and ferric chloride – water system. Distribution Law - Statement and thermodynamic derivation-association of the solute in one of the solvents- dissociation of the solute in one of the solvents-applications of the distribution law-solvent extraction.

UNIT II - SOLAR ENERGY CONVERSION AND ITS STORAGE (L-15 Hrs, T-1 Hr)

Solar radiation- introduction- nature - solar radiation at earth surface-Liquid flat plate collector - Photo voltaic principle-solar cell efficiency-types of solar cells- crystalline silicon, Thin-film and multi junction solar cells -PV systems for power generation- Applications of solar PV systems- advantages and disadvantages of PV systems-Photo electrochemical cells - dye sensitized solar cells-design and fabrication-power conversion efficiency.

UNIT III - SPECTROSCOPY-I (L-15 Hrs, T-1 Hr)

Introduction – Definition - various types of molecular spectra - electronic, vibrational and rotational energy levels - Born-Oppenheimer approximation. Rotational spectra of diatomic molecules - determination of bond length and moment of inertia from rotational spectra - numerical problems - selection rule, effect of isotopic substitution. UV-Visible spectroscopy: theory - types of transitions in molecules - selection rules for electronic spectra - factors affecting absorption maximum and intensity – applications. IR spectroscopy : theory - stretching and bending vibrations - factors affecting vibrational frequencies - important spectral regions for the characterization of functional groups - finger print region - determination of force constant - qualitative relation of force constant to bond energies - selection rules - modes of vibrations in polyatomic molecules -modes of vibrations of H_2O and CO_2 – applications - numerical problems.

UNIT IV - SPECTROSCOPY-II (L-15 Hrs, T-1 Hr)

Raman spectroscopy: Principle - Rayleigh and Raman scattering - Stokes and Anti-stokes lines - differences between IR and Raman spectroscopy - mutual exclusion principle – selection rule - applications. NMR spectroscopy: Theory of NMR, modes of nuclear spin-relaxation process - shielding effect, hyperfine splitting, coupling constants, - chemical shift - factors affecting chemical shift - internal standard, δ and τ scale - applications of NMR and limitations of NMR. ESR spectroscopy: principle - energy level splitting - presentation of ESR spectrum for methyl and benzene radicals, deuterium – applications. Mass spectroscopy: basic principles of mass spectrum - molecular peak - base peak - isotopic peak - meta stable peak - types of fragmentation - factors influencing the fragmentation - Mc-Lefferty rearrangement – applications.

UNIT V - GROUP THEORY (L-15 Hrs, T-1 Hr)

Concept of symmetry in chemistry - symmetry operations and symmetry elements - rotational axis of symmetry and types of rotational axes - planes of symmetry and types of planes - improper rotational axis of symmetry - identity element - groups and their basic properties – Abelian and cyclic groups - classification of molecules into point groups - the symmetry operations of a molecule form a group – H_2O and NH_3 point groups - group multiplication tables.

Tutorial Topics:

Unit I	: Thermodynamic derivation of phase rule,.
Unit II	: Dye sensitized solar cells-design and fabrication.
Unit III	: determination of bond length and moment of inertia from rotational spectra.
Unit IV	: NMR hyperfine splitting, coupling constants, chemical shift.
Unit V	: Classification of molecules into point groups.

Text books:

1. Principles of Physical Chemistry - B.R. Puri and Sharma - Shobanlal Nagin Chand & Co.,
2. Text Book of Physical Chemistry - P.L. Soni - Sultan Chand.

Reference books:

1. Elements of physical chemistry - Glasstone and Lewis - Macmillan.
2. Physical chemistry - G.W. Castellan - Narosa publishing house.
3. Universal General Chemistry, C.N.R. Rao, Macmillan.
4. Nano: The Essentials Understanding Nano Science and Nanotechnology. T. Pradeep -. Tata Mc Graw-Hill Publishing Company Ltd. New Delhi.
5. Introduction to Nano technology, Charles P Poole Jr. & Frank J Owens, Wiley Interscience
6. Kemp, W. Organic Spectroscopy
7. Jag Mohan, Organic Spectroscopy.

8. Chemical Kinetics-K. J. Laidler, Tata McGraw Hill Publishing Company, New Delhi.
9. Nonconventional energy resources, G.D.Rai, McGraw Hill Eduction India Pvt. Ltd. 3rd Edi. 2017.

Web resources:

1. https://ccsuniversity.ac.in/bridge-library/pdf/Engg-AG-Engg-Chem-2nd-sem-subodh-Lecture-5.pdf,
2. https://www.pacc.in/e-learning-portal/ec/admin/contents/73_BCH53_2020110103152214.pdf
3. https://journals.sagepub.com/doi/pdf/10.3184/003685010X12626410325807.
4. https://nanoscalereslett.springeropen.com/articles/10.1186/s11671-018-2760-6,
5. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Rotational_Spectroscopy/Rotational_Spectroscopy_of_Diatomic_Molecules,
6. https://teaching.shu.ac.uk/hwb/chemistry/tutorials/molspec/uvvisab1.htm,
7. http://www.surendranathcollege.org/new/upload/HARISADHAN_GHOSHIR%20Spectroscopy_final2020-04-26Infrared%20Spectroscopy_HG_SNC.pdf,
8. https://www.ifsc.usp.br/~lavfis2/BancoApostilasImagens/ApLuminescencia/Infrared%20Spectroscop1.pdf,
9. http://www.nou.ac.in/econtent/Msc%20Chemistry%20Paper%20IX/MSc%20Chemistry%20Paper-IX%20Unit-5.pdf,
10. https://egyankosh.ac.in/bitstream/123456789/15798/1/Unit-11.pdf,
11. http://www.nou.ac.in/econtent/Msc%20Chemistry%20Paper%20IX/MSc%20Chemistry%20Paper-IX%20Unit-7.pdf
12. https://instruct.uwo.ca/chemistry/734b/Group%20Theory%20-%20Part%202%20Symmetry%20Operations%20and%20Point%20Groups.pdf,
13. http://mpbou.edu.in/slm/mscche1p4.pdf.

Part-III (B.Sc. Chemistry) / Semester – VI / Core Elective-2- POLYMER CHEMISTRY

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part-III	Core Elective - 2	U21CH6E2A	Polymer Chemistry	70	5	-	4

Contact hours per semester: 75
Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
Third	Sixth	25	75	100

Preamble:

The course is aimed to furnish the students with the understanding about the knowledge of the concept of polymerization, types of polymers, the characteristics of polymers, polymerization techniques and polymer processing, the recent advances in polymer sciences and some individual polymers.

Course Outcomes (COs)

On successful completion of the course, the learners should be able to

S#	Course Outcome	Knowledge Level (RBT)
CO1	gain knowledge about the different types of polymers, characteristics, techniques, plastics and applications of biomedical polymers	K1
CO2	understand the properties and applications of polymers, moulding techniques, thermos plastics and biopolymers and types of linkages	K2
CO3	examine the classification of polymers, chemical reactions, polymer techniques, resins, elastomers and biomedical polymers	K3
CO4	know about polymer processing, rubbers, resins, Chemistry of polymerization, Tg and molecular weight, fire resistant polymers, preparation and properties and uses of polymers	K4
CO5	learn about the methods of polymerization, mechanism of polymerization, Molecular weight of polymers, polymer degradation, polymer processing, thermosetting polymers, silicones - conducting polymers	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	1	1	1
CO2	2	2	2	2	1	1	1
CO3	2	2	2	2	1	1	1
CO4	2	1	2	2	2	1	1
CO5	2	2	2	2	2	1	1
Total Contribution of COs to POs	11	9	10	10	7	5	5
Weighted Percentage of COs Contribution to POs	73.33	60	66.66	66.66	46.66	33.33	33.33

1- low, 2-moderate 3-high 0-no correlation

COURSE CONTENT

POLYMER CHEMISTRY

UNIT I - INTRODUCTION TO POLYMERS (L-14 Hrs, T– 1 Hr)

Definition - Monomer, polymer and polymerisation - classification of polymers on the basis of (i) origin - Natural, semi synthetic, synthetic, (ii) Physical properties and applications - Rubbers, plastic, fibres (iii) Thermal response - thermoplastics, thermosetting (iv) Structure – Homo polymers (linear, branched, cross link or network), Copolymers (Random, Alternate, Block, Graft) (v) Crystallinity - non-crystalline (amorphous), semi-crystalline (vi) Mode of formation - Addition, Condensation Polymerisation (definition and examples only) (vii) Methods of polymerization - Bulk, Solution, Suspension Polymerisation (definition and examples only) Chemistry of polymerization: Chain polymerization, free radical, ionic, co-ordination, step polymerization, poly addition and poly condensation, miscellaneous ring opening and group transfer polymerizations.

UNIT II - CHARACTERISTICS OF POLYMERS (L-14 Hrs, T– 1 Hr)

Glass transition temperature (Tg) - definition – Factors affecting Tg – relationships between Tg and molecular weight and melting point. Importance of Tg. Molecular weight of polymers. Number average, weight average (problems), sedimentation and viscosity average molecular weights. Molecular weights and degree of polymerization - chemical reaction - hydrolysis - hydrogenation - addition - substitution – cross-linking, vulcanization, cyclisation reactions. Polymer degradation - basic idea of thermal, photo

and oxidative degradation of polymers.

UNIT III - POLYMERIZATION TECHNIQUES AND PROCESSING (L-14 Hrs, T– 1 Hr)

Bulk, solution, suspension, emulsion, melt condensation and interfacial poly condensation polymerizations. Polymer processing - calendaring - die-casting, rotational casting - compression moulding - injection moulding - blow moulding - extrusion moulding and reinforcing.

UNIT IV - CHEMISTRY OF SOME COMMERCIAL POLYMERS (L-14 Hrs, T– 1 Hr)

Preparation, properties and uses of the following polymers. Thermoplastics, polyethylene, polypropylene, polystyrene, polyacrylonitrile, polyvinyl chloride, nylon, polyester. Thermosetting plastics: Phenol formaldehyde resin, urea formaldehyde resin, melamine formaldehyde, epoxy resin, polycarbonate. Elastomers: Natural rubber and synthetic rubber, Styrene and neoprene rubber.

UNIT V - ADVANCES IN POLYMERS (L-14 Hrs, T– 1 Hr)

Biopolymers - Biomedical polymers - contact lens, dental polymers, artificial heart, kidney, skin and blood cells - High temperature and fire resistant polymers - silicones - conducting polymers - (elementary idea) - polysulphur nitrile, polyphenylene, polypyrrole and polyacetylene. Polymer industry in India.

Tutorial Topics:

Unit I: Chemistry of polymerization
Unit II: Molecular weight of polymers
Unit III: Polymer processing
Unit IV: Elastomers
Unit V: Conducting polymers

Text books:

1. V.R. Gowarikar, N.V. Viswanathan and J. Sreedhar. Polymer Science, Wiley Eastern, 1995.
2. F.N. Billmeyer, Textbook of Polymer Science, Wiley Interscience, 1971.

References books:

1. Material Science II edition, P.K. Palanisamy SCITECH Publications India Pvt., Ltd., Chennai-600001.
2. Engineering Chemistry, V Srinivasan, S.D. Uma Maheshwari, M. Meena. SCITECH Publications India Pvt., Ltd., Chennai-600001.
3. Introduction to Organic Chemistry. John McMurry Brooks/cole Cenage Learning India Private Limited. First Reprint 2008.
4. Modern Chemistry, David. W. Oxtoby, H.P. Gills, Alan Campion Brooks/cole Cenage Learning India Private Limited. First Reprint 2008.

Web resources:

1. http://www.meerutcollege.org/mcm_admin/upload/1587184940.pdf
2. https://chemistry.pixel-online.org/files/ed_pack/03/info22/introduction%20to%20polymer%20science%20%28book%29.pdf
3. http://indico.ictp.it/event/a07182/session/19/contribution/11/material/0/0.pdf
4. https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781118950623.app1
5. http://www.polymer.hacettepe.edu.tr/webim/msen/polymertechnologylesson/PrincipleCharacteristicsofPolymers.pdf
6. https://www.ch.ic.ac.uk/local/organic/tutorial/steinke/StructurePorpertyRelationships2003.pdf
7. http://www.wright.edu/~nikolai.priezjev/papers/Lecture_notes_Ch_2_Polymerization_Techniques.pdf
8. https://www.princeton.edu/~ota/disk1/1993/9313/931303.PDF
9. https://www.ch.ic.ac.uk/local/organic/tutorial/steinke/4yrPolyConduct2003.pdf
10. http://www.issp.ac.ru/ebooks/books/open/Aspects_on_Fundaments_and_Applications_of_Conducting_Polymers.pdf

Part-III (B.Sc. Chemistry) / Semester – VI / Core Elective - 2 - PHARMACEUTICAL CHEMISTRY

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – III	Core Elective -2	U21CH6E2B	Pharmaceutical Chemistry	70	5	-	4

Contact hours per Semester: 75
Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
III	VI	25	75	100

Preamble:

To understand the concepts and terminologies of pharmaceutical chemistry. To know the mechanism of action and metabolism of drugs. To study the functions of various drugs. To know the important diseases and their treatment. To study the common diseases and important disorders of human beings and the drugs used in the treatment.

Course Outcomes (COs)

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	remember the important terminologies used in pharmaceutical chemistry, classification and assay, mechanisms and metabolisms of drugs, various chemicals used in medicine, diseases, treatment and health care medicines.	K1
CO2	understand the important terminologies used in pharmaceutical chemistry, classification and assay, mechanisms and metabolisms of drugs, various chemicals used in medicine, diseases, treatment and health care medicines.	K2
CO3	discuss the various chemicals used in medicine, common diseases and their medicines, classification, mechanism & metabolism of drugs.	K3
CO4	Analyze toxicology, sources and assay of drugs, the physiological effects of different functional groups in drugs, mechanism of action of analgesics, antibiotics and sulpha drugs, the use of Indian medicinal plants for treatment of common diseases,	K4

	structure of analgesics, antibiotics and sulpha drugs, chemical pathways of metabolisms of drugs, Vitamin deficiency diseases.	
CO5	explain the physiological effects of different functional groups in drugs, chemotherapy and nomenclature of drugs, mechanism and metabolism of drugs, the uses of analgesics, antibiotics and Sulpha drugs, composition of blood, grouping and matching, digestive disorder and respiratory disorder and the deficiency diseases.	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create.

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	1	2	2	3	1	2
CO2	2	2	1	2	2	1	2
CO3	3	2	2	3	3	1	2
CO4	2	2	2	2	2	1	2
CO5	2	2	1	2	1	1	2
Total Contribution of COs to POs	10	9	8	11	11	5	10
Weighted Percentage of COs Contribution to POs	66.6	60	53.3	73.33	73.33	33.3	66.6

1- low, 2-moderate 3-high 0-no correlation

COURSE CONTENT

PHARMACEUTICAL CHEMISTRY

UNIT I - IMPORTANT TERMINOLOGIES, CLASSIFICATION AND ASSAY (L-14 Hrs, T– 1 Hr)

Important terminologies - pharmacology, molecular pharmacology, pharmacophore, metabolites, antimetabolites, virus, bacteria, fungi, actinomycetes, mutation, pharmacognosy, pharmacotherapeutics, toxicology, chemotherapy – classification of drugs – nomenclature of drugs – nonproprietary names – sources of drugs – assay of drugs (biological, chemical, immunological).

UNIT II - MECHANISMS, METABOLISMS AND MEDICINAL PLANTS (L-14 Hrs, T– 1 Hr)

Mechanism of drug action – absorption, drug delivery, drug excretion – Metabolism of drugs –chemical pathways of drug metabolism – phase – I (oxidative, reductive and hydrolytic reactions) and phase - II (conjugate reactions). Physiological effects of different functional groups in drugs –biological role of Na, K, Ca, Cu, Zn and iodine. Indian medicinal plants – Tulsi, neem, Keezhanelli, adathode, thoothuvalai.

UNIT III – CHEMICALS IN MEDICINE (L-14 Hrs, T– 1 Hr)

Analgesics- narcotic analgesics- analgesic action, uses and structure activity of morphine. Non-narcotic analgesics –aspirin and paracetamol. Anaesthetics- local anaesthetics – procaine- General anaesthetics- chloroform and halothane. Antibiotics – Therapeutical values of penicillin, tetracyclines, chloramphenicol and streptomycin. Sulpha drugs – sulphanilide, sulphadiazine and cotrimoxazole. Antiseptics and disinfectants – phenols, chloramines and organicmercurials. Antidepressants – barbiturates – mechanism of action and uses. Antipsychotic drugs – piperazine and benzamides. Cardiovascular drugs - Amyl- nitrate, sorbitrate, Verapamil.

UNIT IV - DISEASES AND TREATMENT (L-14 Hrs, T– 1 Hr)

Composition of blood – blood grouping and matching – Rh factor. Blood pressure – causes, control and treatment- antihypertension drugs- antianginal agents. Cardiovascular drugs, cardiacglycosides, vasodilators (one example for each). Aneaemia – causes and control – antianemic drugs. Diabetes – causes and control – hypoglycemic drugs – insulin – oral hypoglycemic drugs (tolubutamide and chlorpropamide). Cancer- causes and treatment – cobalt therapy – antineoplastic drugs (chlorambucil, methotrexate, plant products and hormones).

UNIT V - COMMON DISEASES AND HEALTH CARE MEDICINES (L-14 Hrs, T– 1 Hr)

Common diseases – causes and treatment of insect borne diseases (Malaria and Filariasis), airborne diseases (Diptheria, Whooping cough, Influenza, common cold, TB) and Water borne diseases (Cholera, Typhoid and Dysentery). Hereditary disease, diabetes, heart disease, cancer, Digestive disorder – Jaundice. Respiratory disorder – Asthma. Nervous system disorder – epilepsy. Other diseases – Leprosy. Health care medicines – Sources and deficiency diseases of Vitamins A, B complex, C, D, E and K.

Tutorial Topics:

UNIT I - Assay of drugs
UNIT II - Physiological effects of different functional groups in drugs
UNIT III - Therapeutical values of some antibiotics
UNIT IV - Cancer - causes and treatment – antineoplastic drugs
UNIT V - Hereditary disease, diabetes, heart disease.

Text Books:

1. A text book of pharmaceutical chemistry Jayashree ghosh 2014 (5) S. Chand & Co,

New Delhi.
2. Pharmaceutical Chemistry S. Lakshmi, 2004 (4) Sultan Chand & Sons, New Delhi.

Reference Books:

1. Medicinal chemistry G.R.Chatwal 2002 (1) Himalaya Publishing House, New Delhi.
2. Drugs G.L.D. Krupadanam, D.V. Prasad, K.V.Rao,K.L.N.Reddy and C.Sudhakar Tata McGraw- Hill Publishing Company, New Delhi.

Web resources:

1. http://www.ddfint.net/search.cfm
2. https://www.rxlist.com/drugs/alpha_a.htm
3. http://www.drugs.com/
4. http://www.rxmed.com/

Part-III (B.Sc. Chemistry)/ Semester –VI /Core Elective- 2 - INDUSTRIAL CHEMISTRY

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – III	Core Elective -2	U21CH6E2C	Industrial Chemistry	70	5	-	4

Contact hours per Semester: 75
Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
III	VI	25	75	100

Preamble:

To gain knowledge about the systems of units and conversion factor. To understand utilities in chemical industries. To know the severity of corrosion and methods of preventing it. To study the industrial process of silicate industry. To acquire the knowledge about the unit process.

Course Outcomes (COs):

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	remember and recall the basic concepts of industrial chemistry such as units and dimensions, material balance, fuels and furnaces, corrosion and protective coating, refractories and abrasives	K1
CO2	understand fundamental and derived quantities, system of units, concept of mole, gas laws, material balance, calorific values, classification of explosives, types of furnaces, factors influencing corrosion, paints and pigments, galvanizing tinning and electroplating, requirements and properties of refractories, types of abrasives.	K2
CO3	discuss the types of fuels, pyrometric effect and nuclear fuels, types of corrosion, characteristics of paints, classification and uses of abrasives, Flue gas analysis, mechanism of corrosion, setting of cement and types of refractories, unit processes.	K3
CO4	explain the fundamental and derived quantities, significance of dimensional analysis, chemical engineering operations, various types of furnaces and explosives, constituents of paints and	K4

	their function, manufacture of cement, plaster of paris and white wares, applications of sulphonates and sulphates, mechanism of hydrolysis and types of oxidation reactions.	
CO5	Demonstrate the importance of fundamental and derived quantities, calorific values of fuels, properties of paints, properties of refractories, liquid phase and vapour phase oxidation, hydrogenation of vegetable oils, batch vs continuous sulphonation, natural and artificial abrasives and chemical engineering operations.	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	1	1	1	1	1	1
CO2	2	2	1	1	1	1	1
CO3	2	2	1	1	2	1	2
CO4	3	2	2	2	1	1	2
CO5	2	2	1	2	1	1	2
Total Contribution of COs to POs	10	9	6	7	6	5	8
Weighted Percentage of COs Contribution to POs	66.6	60	40	46.6	40	33.3	53.33

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT

INDUSTRIAL CHEMISTRY

UNIT I - UNITS AND DIMENSIONS, MATERIAL BALANCE (L-14 Hrs, T– 1 Hr)

Fundamental and derived quantities – System of unit – significance of dimensional analysis – forces – weight – volume – pressure – work – energy – power. Basic chemical calculations: Atomic mass – Molar mass – concept of mole, g/mol, comparison of liquid mixtures and gaseous mixtures, percentage of mass, volume and mol – ideal gas laws – Dalton's law, Amagat's law and Henry's law –

density and pressure measurements. Material balance without chemical reaction: Material balance equation – transient and steady state – simple material balance with and without recycle and bypass or chemical engineering operations such as evaporation, drying, filtration, extraction and crystallization.

UNIT II - FUELS AND FURNACES (L-14 Hrs, T– 1 Hr)

Fuels – types of fuels – calorific values – ignition point – pyrometric effect – explosives range – Flue gas analysis by Orsat's method – explosives – classifications – low explosives – initiating explosives – high explosives – rocket propellants – nuclear fuels. Furnaces – types of furnaces – Kilns – Blast furnace, reverberatory furnace – muffle furnace – electric furnace – regenerative furnace, open hearth furnace – Bessemer converter – vertical retort furnace.

UNIT III - CORROSION AND PROTECTIVE COATING (L-14 Hrs, T– 1 Hr)

Introduction – severity of corrosion – chemical and electrochemical corrosion – mechanism – factors influencing corrosion – control of corrosion – cathodic and anodic protection. Paints – characteristics of paint – constituents of paints - pigments – vehicles – thinners – driers – fillers – plasticizers – anti skinning agents – their function and properties. Metallic coating – removal of surface contamination – removal of superficial corrosion products-polishing – galvanizing – tinning – electroplating.

UNIT IV - SILICATE INDUSTRY (L-14 Hrs, T– 1 Hr)

Refractories – requirements of refractories – properties of refractories – solid refractories – fire clay refractories – magnesite refractories, dolomite bricks, graphite refractories, zirconia refractories, silicon carbide. Abrasives – classifications – natural (diamond, corundum, emery, garnet, quartz and flint) and artificial (carborundum, alundum, boron carbide, metallic abrasives). Uses of abrasives – cement manufacture – setting and hardening of cements – gypsum – plaster of Paris – manufacture – setting and hardening – uses. White wares manufacture – types – glazing.

UNIT V - UNIT PROCESSES IN ORGANIC MANUFACTURE (L-14 Hrs, T– 1 Hr)

Sulphonation – uses and applications of sulphonates and sulphates – sulphonating agents – sulphur trioxide – organic complexes – chemical and physical factors in sulphonation – commercial sulphonation of benzene – batch vs continuous sulphonation. Hydrolysis – hydrolyzing agents – mechanism of hydrolysis. Oxidiation – types of oxidation reactions – oxidizing agents – permanganate and dichromate – liquid phase oxidation – vapour phase oxidation – commercial manufacture of acetic acid. Hydrogenation – catalysts for hydrogenation - hydrogenation of vegetable oils.

Tutorial Topics:

UNIT I - Ideal gas laws
UNIT II - Rocket propellants – nuclear fuels.
UNIT III - Control of corrosion – cathodic and anodic protection.
UNIT IV - White wares manufacture – types – glazing.
UNIT V - Hydrogenation

Text books:

1. Industrial Chemistry, B. N. Chakrabarthy, Oxford & IBH Publishing Co. Pvt. Ltd. Calcutta.
2. Unit Operations I & II K. A. Gavhane, Nirali Prakashan, Pune.
3. Unit Processes in Organic Synthesis, P. H. Groggins, Tata McGraw-Hill PublishingCompany limited, New Delhi.
4. Stoichiometry – B. Z. Bhatt and S. M. Vora.
5. Engineering Chemistry, Jain and Jain

Reference books:

1. Industrial Chemistry, O. P. Vermani, Galgotia Publications Ltd.
2. Industrial Chemistry, B.K.Sharma, Krishna Prakashan Media, 1991
3. Stocchi, E.(1990), Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
4. Felder, R. M.; Rousseau, R. W. (2015), Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
5. Kingery, W. D.;Bowen, H. K.;Uhlmann, D. R. (1976), Introduction to Ceramics, Wiley Publishers, New Delhi.
6. Kent, J. A. (ed) (1997), Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.

Web Resources:

1. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004132159500424ranvij ay_engg_Fuels.pdf
2. https://hithaldia.in/faculty/sas_faculty/Dr_Gora_Das/Class%20Notes%20(CH101%20&CH-201)%20Module-5%20(Industrial%20Chemistry).pdf
3. https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod2.pdf
4. https://www.erforum.net/2016/01/engineering-chemistry-by-jain-and-jain-pdffree-ebook.html
5. https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod2.pdf

Part - IV (B.Sc. Chemistry)/ Semester – VI / Skill Enhancement 2 - COMPUTERS FOR CHEMISTS

Category	Course Type	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credits (C)
Part – IV	Skill Enhancement – 2	U20CH6S2	Computers for Chemists	25	5	-	2

Contact hours per Semester: 30
Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
III	VI	00	50	50

Preamble:

Apply the office packages to gain a better understanding of the computer. Understand the functions of smart devices and online transactions. Analyze the purpose of social networking and cyber security in the e-world. Understand the C programming tools used. Apply the C language tools to write the programs.

Course Outcomes (COs):

On successful completion of the Course, the learners will be able to

S. No.	Course Outcome	Knowledge Level (RBT)
CO1	remember MS office packages, smart devices, social networks, e-commerce and M-commerce, cyber law, cybercrime, data protection and privacy and micro-payment services, fundamentals of C.	K1
CO2	understand MS word, MS excel and MS powerpoint, types of smart phones, components of e-commerce, M-commerce, characteristics, advantages and disadvantages of social networks, functions of C, modes of applications of Chemsketch, 3D viewer, basic structure of C programming.	K2
CO3	apply the knowledge of MS office to create documents and tables, work sheets, charts, PPTs, smart devices and online transactions, C programming to solve chemistry problems, cyber law, intellectual property, templates, draw the structure of simple molecules, calculate the pH of buffer solutions, molarity, molality, empirical formula of hydrocarbons, RMS and average	K3

	velocities.	
CO4	analyze the use of office packages, smart devices, social networking sites, C programming to draw the structures of simple molecules, and IUPAC naming, applications of C programming in chemistry.	K4
CO5	Explain the components of e-commerce, M-commerce, customer's and provider's point of view, applications of e-commerce, M-commerce, payment methods in M-commerce, C programming to solve chemistry problems, cyber security, mobile banking, mobile marketing and advertising, functions of C	K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate

CO-PO Mapping (Course Articulation Matrix)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	1	2	1	2	1	2
CO2	1	1	2	1	2	2	2
CO3	1	1	2	2	3	3	3
CO4	2	2	2	1	1	2	2
CO5	2	3	2	1	2	2	1
Total Contribution of COs to POs	7	8	10	6	10	10	10
Weighted Percentage of COs Contribution to POs	46.66	53.33	66.66	40	66.66	66.66	66.66

1- low 2-moderate 3-high 0-no correlation

COURSE CONTENT
COMPUTERS FOR CHEMISTS

UNIT I - OFFICE PACKAGES (L-5 Hrs, T– 1 Hr)

MS- Word: Creation of Documents (letters, Bio- data, etc). Creation of Tables, Formatting Tables (Time table, Calendar, etc). Working with Mail Merge (Circular letters). MS – Excel: Creation of Worksheet (Mark Sheet, Pay Slip, PF Contribution list, etc). Excel Function (Date, Time, Statistical, Mathematical, Financial Functions). MS- PowerPoint: Creation of Presentations (Duplicate and New slides, Layouts, View, Slide show, etc,).

UNIT II: SMART DEVICES AND ONLINE TRANSACTIONS: (L-5 Hrs, T– 1 Hr)

Smart phone – Types: Tablet PC, Smart TV, Smart Camera, Smart Watch and Smart Oven. Benefits of Smart Phones. Applications of M-Commerce- Mobile ticketing, mobile money transfer, mobile banking, mobile marketing and advertising. Payment methods in M-Commerce Premium rate telephone numbers, Direct mobile dealing, Macro, Micro payment services and mobile wallets.

UNIT III - SOCIAL NETWORKING AND CYBER SECURITY (L-5 Hrs, T– 1 Hr)

Social Networking Sites: Characteristics of Social Networking Website- Examples of Social Networking Services (Facebook, Snap Chat, Instagram, Whatsapp, Pinterest, Tumblr, LinkedIn, Twitter, Quora). Advantages and Disadvantages of Social Network. Cyber law, Cyber Crime, Electronic and Digital devices, Intellectual Property, Data Protection and Privacy. Merits and Demerits of Cyber-crime.

UNIT IV - FUNDAMENTALS OF C (L-5 Hrs, T– 1 Hr)

C programming: Introduction – character set – keywords – constants – operators, input and output in C – control statements – functions of C. Chemsketch: Introduction – modes of applications – templates – drawing structures of simple molecules – 3D viewer – IUPAC naming and calculated properties.

UNIT V - C PROGRAMMING IN CHEMISTRY (L-5 Hrs, T– 1 Hr)

C programming in Chemistry: Basic structure of C programming – conversion of temperature from Kelvin to Celsius – calculation of pH of a buffer solutions using Henderson equation – calculation of Molarity, molality – calculation of electronegativity of an element – calculation of empirical formula of a hydrocarbon – calculation of RMS and Average velocities.

Tutorial Topics:

UNIT I	- MS – Excel: Creation of Worksheet
UNIT II	- Applications of M-Commerce
UNIT III	- Cyber Crime, Intellectual Property
UNIT IV	- IUPAC naming and calculated properties
UNIT V	- Calculation of Molarity, molality

Text Books:

1. Mastering Ms-Office by Bittu Kumar
2. K.V. Raman, “Computers in Chemistry”, Tata McGraw Hill Education Private Limited, 2004.

Reference Books:

1. D. P. Nagpal - Computer Fundamentals - S. Chand & Company Ltd, New Delhi - 1999.
2. V. Rajaraman - Fundamentals of Computers, 3rd edition - Prentice Hall of India Private Limited – 2001.
3. B. Ram - Computer Fundamentals, 3rd edition - New Age International Pvt. Ltd – 2010

Web Resources:

1. https://www.webopedia.com/DidYouKnow/Hardware_Software/mobile-__operatingsystems-mobile-os-explained.html
2. https://makeawebsitehub.com/social-media-sites/
3. https://www.tutorialspoint.com/information_security_cyber_law/information_security_cy ber_law_tutorial.pdf
4. https://www.tutorialspoint.com/information_security_cyber_law/information_security cyber_law_tutorial.pdf
5. https://www.irjet.net/archives/V4/i6/IRJET-V4I6303.pdf
6. http://www.acdlabs.com/download/chemsketch/download.html
http://www.acdlabs.com/chemsketch