A.D.M. COLLEGE FOR WOMEN (AUTONOMOUS)

(Nationally Accredited With 'A' Grade by NAAC 4th Cycle)

(Affiliated to Bharathidasan University, Tiruchirappalli)

NAGAPATTINAM – 611 001

PG & RESEARCH DEPARTMENT OF CHEMISTRY

SYLLABUS

B.Sc. CHEMISTRY

2024-2027

PROGRAMME EDUCATIONAL OBJECTIVE (PEO)

1. To develop the skill in problem solving, critical thinking and enhance the knowledge in chemistry.
2. To provide the students an in-depth understanding of the basic concepts of chemical sciences.
3. To provide a detailed knowledge of terms, concept, methodologies, principles and experimental techniques involved in various fields of chemistry.
4. To prepare the students to pursue higher studies and to develop sustainable innovative solutions for the nation.

Part	Title of the part	No. of Courses	Hours	Credit
I	Language courses (Tamil/Hindi/French/Arabic/Sanskrit)	4	24	12
II	English Language courses	4	24	12
III	Core Courses (T- 9, P-5)	14	70	60
	Minor (Allied T-4/ 5, P-2/1)	6	24	16
	Discipline Specific course	3	10	9
	Project	1	3	3
IV	Skill Enhancement Course	4	8	8
	Ability Enhancement Course	3	6	6
	Multidisciplinary course (NME)	2	4	4
	Environmental Studies	1	2	2
	Value Education	1	2	2
	Soft Skill Development	1	2	2
	Summer Internship / Industrial activities	-	-	2
	Gender Studies	1	1	1
V	Extension Studies	-		1
	Total	**45**	**180**	**140**

EXTRA CREDIT SCHEME STRUCTURE – 2024 - 2027

Courses	Credits	Semester	Marks
Extra Credit Courses I(Professional English) ECPED - ECC I - PROFESSIONAL ENGLISH FOR PHYSICAL SCIENCES **(Physics, Chemistry & Geology)**	2	I	100
Extra Credit Courses II (Skill Course I – Add on)	2	II	100
Extra Credit Courses III(Skill Course II- Add on)	2	III	100
Extra Credit Courses IV(Skill Course III- Add on)	2	IV	100
Value added course I (Multidisciplinary)	2	V	100
Value added Course II (Same disciplinary)	2	VI	100
Total	**12**		

B.Sc Chemistry
Course Structure under CBCS
For the candidate admitted from the year 2024-25 onwards

SEMESTER – I							
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
						CIA	**EXT**
Part I	Language Course I	LC I – Pothu Tamil I	6	3	3	25	75
Part II	English Course I	ELC I –General English I	6	3	3	25	75
Part III	Core Course I	CC I - General Chemistry I	5	4	3	25	75
	Core Practical I	CP I -Quantitative Inorganic Estimation & Inorganic Preparation	3	-	-	-	-
	First Minor Course I	FMC I -Zoology I / Maths I	4	3	3	25	75
	First Minor Practical I	FMP I-Zoology II (P)/ Maths II	2	-	-	-	-
Part IV	Skill Enhancement Course I	SEC I- Fundamentals of Chemistry	2	2	3	25	75
	VE	Value Education	2	2	3	25	75
*Extra Credit I	Extra Credit	Professional English for Physical Sciences		2	-	-	100
	Total	**8+1**	**30**	**17+2**			

SEMESTER – II							
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
						CIA	**EXT**
Part I	Language Course II	LC II- Pothu Tamil II	6	3	3	25	75
Part II	English Course II	ELC II –General English II	6	3	3	25	75
Part III	Core Course II	CC II - General Chemistry II	6	5	3	25	75
	Core Practical I	CP I - Quantitative Inorganic Estimation and Inorganic Preparation	2	3	3	40	60
	First Minor Practical I	FMP I-Zoology II (P)/ Maths II	2	2	3	40/25	60/75
	First Minor Course II	FMC II-Zoology III / Maths III	4	3	3	25	75
Part IV	Skill Enhancement Course II	Industrial Water Pollution Measurement & Remediation	2	2	3	25	75
	EVS	Environmental Studies	2	2	3	25	75
*Extra Credit II	Extra Credit	Certificate Course	-	2	-	-	100
	Total	**8+1**	**30**	**23+2**			

SEMESTER – III							
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
						CIA	**EXT**
Part I	Language Course III	LC III-Pothu Tamil III	6	3	3	25	75
Part II	English Course III	ELC III -General English III	6	3	3	25	75
Part III	Core Course III	CC III -General Chemistry III	6	6	3	25	75
	Core Practical II	CP II - Qualitative Inorganic analysis (P)	2	-	-	-	-
	Second Minor Course I	SMC I- Physics I	4	3	3	25	75
	Second Minor Practical I	SMP I - Physics II (P)	2	-	-	-	-
Part IV	Multi Disciplinary Course I	NME I -Food Chemistry	2	2	3	25	75
	Skill Enhancement Course III	SEC III-Polymer Chemistry	2	2	3	25	75
*Extra Credit III	Extra Credit	Medical Lab Techniques (Theory & Practical)	-	2	-	-	100
	Total	**8+1**	**30**	**19+2**			

SEMESTER – IV							
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
						CIA	**EXT**
Part I	Language Course IV	LC IV – Pothu Tamil IV	6	3	3	25	75
Part II	English Course IV	ELC IV –General English IV	6	3	3	25	75
Part III	Core Course IV	CC IV -General Chemistry IV	5	5	3	25	75
	Core Practical II	CP II - Qualitative Inorganic analysis (P)	3	3	3	40	60
	Second Minor Practical I	SMP I - Physics II (P)	2	2	3	40	60
	Second Minor Course II	SMC II-Physics III	4	3	3	25	75
Part IV	Multi Disciplinary Course II	NME II -Chemistry in Daily life	2	2	3	25	75
	Ability Enhancement Course -I	AEC I -Pharmaceutical Chemistry	2	2	3	25	75
*Extra Credit IV	Extra Credit	Quantitative Aptitude	-	2	-	-	100
	Total	**8+1**	**30**	**23+2**			

SEMESTER – V							
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
						CIA	**EXT**
Part III	Core Course V	CC V - Organic Chemistry I	6	5	3	25	75
	Core Course VI	CC VI - Physical Chemistry I	6	6	3	25	75
	Core Course VII	CC VII - Inorganic Chemistry I	5	4	3	25	75
	Core Practical III	CP III - Organic Qualitative Analysis & Organic Preparation (P)	3	3	3	40	60
	Core Practical IV	CP IV- Physical Chemistry (P)	3	3	3	40	60
	Discipline Specific Elective –I	DSE I - Analytical Chemistry	3	3	3	25	75
Part IV	Ability Enhancement Course - II	AEC II-Applied Chemistry	2	2	3	25	75
	SSD	Soft Skill development	2	2	3	25	75
	Summer Internship/Ind. Training		-	2			
*Extra Credit 5	Extra Credit	Organic Farming (Other Major Students)	-	2	-	-	100
	Total	**9+1**	**30**	**30 +2**			

SEMESTER – VI							
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
						CIA	**EXT**
Part III	Core Course VIII	CC VIII - Organic Chemistry II	6	6	3	25	75
	Core Course IX	CC IX - Physical Chemistry -II	6	6	3	25	75
	Core Practical V	CP V - Gravimetric Analysis, Physical Constant Determination and Spectrophotometry	3	3	3	40	60
	Core Course X	CC X - Project	3	3	3	25	75
	Discipline Specific Elective –II	DSE II - Fundamentals of Spectroscopy	3	3	3	25	75
	Discipline Specific Elective –III	DSE III- Inorganic Chemistry -II	4	3	3	25	75
Part IV	Ability Enhancement Course -II	AEC II - Agricultural Chemistry	2	2	3	25	75
	Skill Enhancement Course SEC -IV	SEC IV - Fuel Chemistry	2	2	3	25	75
Part V	Gender Studies	GS	1	1	3	25	75
		Extension Activity		1	-	-	-
*Extra Credit 6	Extra Credit	Forensic Science (same discipline)	-	2	-	-	100
	Total	**8+1**	**30+6**	**28+2**			

Grand Total – Credit 140 & Extra Credit 12

PROGRAMME SPECIFIC OUTCOMES (PSO)

On successful completion of the programme the students will be able to

PSO1: Acquire in-depth knowledge of the fundamental concepts in all disciplines of chemistry.

PSO2: Disseminate the basics of chemistry and advanced topics and analytical skills in organic, inorganic and physical chemistry.

PSO3: Uphold ethical values in personal life, research and career.

PSO4: Demonstrate laboratory skills, analytical acumen, creatively in academics and research.

PSO5: Apply digital tools to collect, analyze and interpret data and present scientific findings.

PROGRAMME OUTCOMES (PO)

PO 1: Students will possess basic subject knowledge required for higher studies, Professional and applied courses.

PO 2: Students will acquire basic Practical skills & Technical knowledge along with Domain knowledge of different subjects in the science & humanities stream.

PO 3: Students will develop scientific aptitude Integrate skills of analysis, critiquing, Application and creativity.

PO 4: Students will employ appropriate digital tools and techniques necessary in Analysing data and creative design.

PO 5: Students will gain competence to pursue higher learning, research and careers Or will be able to opt for entrepreneurship

Semester-I/ Core Course -I	General Chemistry –I	Course Code:
Instruction Hours : 5	Credits: 4	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	The course aims • To various atomic models and atomic structure • The wave particle duality of matter • Periodic table, periodicity in properties and its application in explaining the chemical behavior • To nature of chemical bonding • To fundamental concepts of organic chemistry

UNIT	CONTENT	HOURS
I	**Atomic structure** History of atom (J. J. Thomson, Rutherford); Moseley's Experiment and Atomic number, Atomic Spectra; Black-Body Radiation and Planck's quantum theory - Bohr's model of atom – Somerfield's extension of Bohr's Atomic model; The Franck - Hertz Experiment; Interpretation of H - spectrum; Photoelectric effect, Compton effect; Dual nature of Matter – De – Broglie wave length – Davisson and Germer experiment Heisenberg's Uncertainty Principle. Numerical problems involving the core concepts.	15
II	**Introduction to Quantum mechanics** Classical mechanics, Wave mechanical model of atom, distinction between a Bohr orbit and orbital; Postulates of quantum mechanics; probability interpretation of wave functions, Formulation of Schrodinger wave equation- Probability and electron density-visualizing the orbitals -Probability density and significance of Ψ and Ψ^2. **Modern Periodic Table** **Cause of periodicity:** Features of the periodic table; classification of elements - Periodic trends for atomic size- Atomic radii, Ionic radii,ionization energy, electron affinity, electronegativity. Problems involving the core concepts.	15
III	**Structure and bonding–I** **Ionic bond -** Lewis dot structure of ionic compounds; properties of ionic compounds; Energy involved in ionic compounds; Born Haber cycle – lattice energies; Ion polarisation– polarising power and polarizability; Fajans' rules Problems involving the core concepts. **Covalent bond –** Shapes of orbitals, overlap of orbitals– σ and Π bonds; directed valency- hybridization; VSEPR theory - Shapes of molecules of $BeCl_2$, BF_3, CH_4, PCl_5, SF_6, IF_7,NH_3, H_2O.Partial ionic character of covalent bond-dipolemoment, application to molecules of the type A_2, AB, AB_2, AB_3, AB_4; percentage ionic character.	15

IV	**Structure and bonding– II** VB theory– application to hydrogen molecule; concept of resonance- resonance structures of some inorganic species– CO_2, NO_2, CO_3^{2-}, NO_3^- ;limitations of VBT; MO theory - bonding, anti-bonding and nonbonding Orbitals, bond order; MO diagrams of H_2, C_2, O_2, O_2^+ ,O_2^- ,N_2 ,NO and HF; magnetic characteristics, comparison of VB and MO theories. Co-ordinate bond: Definition, Formation of a coordinate bond by orbital overlap theory - $NH_3^{4+,}$ O_3, BF_4^-, Al_2Cl_6, Characteristics of coordinate compounds Metallic bond – electron model, VB model; Band theory- mechanism of conduction in solids; conductors, insulator, semiconductor– types, applications of semiconductors.	**15**
V	**Basic concepts in Organic Chemistry and Electronic effects** Types of bond cleavage – heterolytic and homolytic; types of reagents- electrophiles, nucleophiles, free radicals. Inductive effect - reactivity of alkyl halides, acidity of halo acids, basicity of amines; inductometric and electromeric effects. Resonance – resonance energy, conditions for resonance- acidity of phenols, basicity of aromatic amines, stability of carbonium ions, carbanions and free radicals Hyper conjugation – stability of alkenes, bond length. Steric effect – types of steric effect – steric accelerated and steric hindrance.(Basic only)	**15**

Text Books:

1. Madan, R. D. and Sathya Prakash, *Modern Inorganic Chemistry*, 2nded.; S.ChandandCompany: New Delhi, 2003.
2. Rao, C. N. R.University General Chemistry, Macmillan Publication: New Delhi, 2000.
3. Puri,B. R. and Sharma, L. R. *Principles of Physical Chemistry*, 38thed.; Vishal Publishing Company: Jalandhar, 2002.
4. Bruce, P. Y. and Prasad K .J .R. *Essential Organic Chemistry*, Pearson Education: New Delhi, 2008.
5. Dash UN, Dharmarha OP, SoniP. L. Textbook of Physical Chemistry, Sultan Chand & Sons: New Delhi, 2016

Reference Books:

1. Maron, S.H. and Prutton C.P. *Principles of Physical Chemistry*, 4thed.; The Macmillan Company: New York, 1972.
2. Lee, J. D. *Concise Inorganic Chemistry*, 4thed.; ELBS William Heinemann: London, 1991.
3. Gurudeep Raj, *Advanced Inorganic Chemistry*, 26thed.; Goel Publishing House: Meerut, 2001.
4. Atkins, P. W .& Paula, J. *Physical Chemistry*, 10thed.; Oxford University Press: New York, 2014.
5. Huheey, J. E. *Inorganic Chemistry: Principles of Structure and Reactivity*, 4thed.; Addison,

Wesley Publishing Company: India, 1993.

Web-Resources:

1) https://onlinecourses.nptel.ac.in
2) http://www.mikeblaber.org/oldwine/chm1045/notes_m.htm
3) http://www.ias.ac.in/initiat/sci_ed/resources/chemistry/Inorganic.html
4) https://swayam.gov.in/course/64-atomic-structure-and-chemical-bonding
5) https://www.chemtube3d.com/

Course Outcomes :

On completion of the course the students should be able to

CO1: E xplain the atomic structure, wave particle duality of matter, periodic properties bonding, and Properties of compounds.

CO2: Classify the elements in the periodic table, types of bonds,electronic effects inorganic compounds, types of reagents.

CO3: Apply the theories of atomic structure, bonding, to calculate energy of a spectral transition, Δx, Δp electronegativity, percentage ionic character and bond order.

CO4: Construct MO diagrams, predict trends in periodic properties, assess the properties of elements, and explain hybridization in molecules.

CO5: Evaluate the relationship existing between electronic configuration, bonding, geometry of molecules and reactions; structure reactivity and electronic effects

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	M	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

Semester-I& II / Core Practical–I	Quantitative Inorganic Estimation & Inorganic Preparations	Course Code :
Instruction Hours : 3/2	Credit: 3	Exam Hours: 3
Internal Marks: 40	External Marks: 60	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 – Creating**
Course Objectives	This course aims at providing knowledge on • laboratory safety • handling glass wares • Quantitative estimation • Preparation of inorganic compounds

CONTENT

I.INORGANIC ESTIMATIONS:

1. Acid – Base Titration

Estimation of Hydrochloric Acid using Sodium hydroxide.

Estimation of Sodium Carbonate using Sulphuric acid.

2. Permanganometry

Estimation of Oxalic acid using standard ferrous sulphate

Estimation of Ferrous Sulphate using standard Oxalic acid

Estimation of Calcium using standard Oxalic acid

3. Dichrometry

Estimation of ferric alum using standard dichromate (external indicator)

Estimation of ferric alum using standard dichromate (internal indicator)

4. Iodometry

Estimation of copper using standard dichromate

Estimation of Potassium Permanganate using standard dichromate

5. Complexometry

Estimation of hardness of water using EDTA

Estimation of Magnesium using EDTA

Estimation of Zinc using EDTA

II.PREPARATION OF INORGANIC COMPOUNDS:

1.Tetraamminecopper(II) sulphate

2.Hexamminecobalt(III)chloride

III. Preparation of Buffer Solution

1.Sodium Acetate –Acetic acid

2. Ammonium Chloride – Ammonium hydroxide

Text Books:

1. Venkateswaran, V.; Veeraswamy, R.; Kulandivelu, A. R. *Basic Principles of Practical Chemistry*, 2nd ed.; Sultan Chand & Sons: New Delhi, 1997.
2. Nad, A. K.; Mahapatra, B.; Ghoshal, A.; *Anadvanced course in Practical Chemistry*, 3rd ed.; New Central Book Agency: Kolkata, 2007.

Reference Books:

1. Mendham, J.; Denney, R. C.; Barnes, J. D.; Thomas ,M.; Sivasankar, B.; *Vogel's Textbook of Quantitative Chemical Analysis*, 6th ed.;Pearson Education Ltd: New Delhi, 2000.

Web–Resources:

1) http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis
2) https://chemdictionary.org/titration-indicator/

Course Outcomes:

On successful completion of the course the students should be able to

CO1: explain the basic principles involved in titrimetric analysis and inorganic preparations.
CO2: compare them methodologies of different titrimetric analysis.
CO3: calculate the concentrations of unknown solutions in different ways and develop the skill to estimate the amount of a substance present in a given solution.
CO4: assess the yield of different inorganic preparations and identify the end point of various Titrations.

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	S
CO3	S	S	S	M	S	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S

Semester-I / Skill Enhancement Course - I	Fundamentals of Chemistry	Course Code :
Instruction Hours : 2	Credits: 2	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	This course aims at providing knowledge on • matters and its existence • periodic elements • quantitative aspects of analysis • chemical bonding and its theories • fundamental concept of organic chemistry

UNIT	CONTENT	HOURS
I	Matter and its existence – solids, liquids and gases – atoms – constituent of an atom – proton, electron and neutron – elements – molecule – acid – base and salt – pH and its importance.	6
II	**Elements & its Importance in life** Periodic Table – classification – old and modern periodic tables. Extraction of metals, Fe, Au, Pt – role of metal ions in biological systems – haemoglobin (structure only) – Non metals – oxygen – chemistry of respiration, nitrogen cycle and Fixation of atmospheric Nitrogen.	6
III	**Quantitative Aspects of analysis** S.I Units, Distinction between Mass and Weight. Moles, Millimoles, Milli equivalence, Molality, Molarity, Normality, Percentage by Weight and Volume, ppm, ppb. Density and Specific Gravity of Liquids. Stoichiometry Calculations.	6
IV	**Chemical Bonding** Definition –Octet rule – types of bond – ionic bond, covalent bond, coordinate and hydrogen bonding.	6
V	**Structural Representation Of Organic Compounds** Complete, condensed and Bond- line structural formulas, Three dimensional representations of organic molecules – Nomenclature of organic compounds – IUPAC	6

Text Books:

1.Madan, R. D. and Sathya Prakash, *Modern Inorganic Chemistry,* 2nd ed.; S. Chand and Company: New Delhi, 2003.

2.Rao, C. N. R. University General Chemistry, Macmillan Publication: New Delhi, 2000.

3.Puri,B. R. and Sharma, L. R. *Principles of Physical Chemistry,* 38th ed.; Vishal Publishing Company: Jalandhar, 2002.

4.Bahl.B.S.,Arun Bahl, *Advanced Organic Chemistry,* 3rd edition, S.Chand & Company, New Delhi, 2003.

Reference Books:

1.Atkins, P. W. & Paula, J. *Physical Chemistry*, 10th ed.; Oxford University Press: New York, 2014.

2.Huheey, J. E. *Inorganic Chemistry: Principles of Structure and Reactivity* ,4th ed.; Addison, Wesley Publishing Company: India, 1993.

3.Mendham, J.; Denney, R. C.; Barnes, J. D.; Thomas, M.; Sivasankar, B.; *Vogel's Textbook of Quantitative Chemical Analysis*, 6th ed.; Pearson Education Ltd: New Delhi, 2000

Web-Resources:

1.https://onlinecourses.nptel.ac.in

2.http://www.mikeblaber.org/oldwine/chm1045/notes_m.htm

3.http://www.ias.ac.in/initiat/sci_ed/resources/chemistry/Inorganic.html

4.https://swayam.gov.in/course/64-atomic-structure-and-chemical-bonding

Course Outcomes:

On completion of the course the students should be able to

CO1: know the matter, constituents of atoms

CO2: understand periodic table and role of elements in life.

CO3: evaluate the concentration units in solutions

CO4: aware about bonding and its types

CO5: predict the nomenclature of simple organic compounds

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	M	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

Semester-II / Core Course -II	**General Chemistry –II**	**Course Code:**
Instruction Hours : 6	**Credits:5**	**Exam Hours: 3**
Internal Marks: 25	**External Marks: 75**	**Total Marks: 100**

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	This course aims at providing an overall view of the • chemistry of acids, bases and ionic equilibrium • properties of s and p-block elements • chemistry of hydrocarbons • applications of acids and bases • compounds of main block elements and hydrocarbons

UNIT	CONTENT	HOURS
I	**Acids, bases and Ionic equilibrium** Concepts of Acids and Bases – Arrhenius concept, Bronsted-Lowry concept, Lewis concept; Relative strengths of acids, bases and dissociation constant; ionic product of water, pH scale, pH of solutions; Degree of dissociation, common ion effect, factors affecting degree of dissociation; acid base indicators, theory of acid base indicators – action ofphenolphthaleinandmethylorange,titrationcurves-useofacidbaseindicators. Buffer solutions – types, mechanism of buffer action in acid and basic buffer, Henderson-Hasselbalch equation; Salt hydrolysis - salts of weak acids and strong bases, weak bases and strong acids, weak acids and weak bases – hydrolysis constant, degree of hydrolysis and relation between hydrolysis constant. Numerical problems involving the core concepts.	**18**
II	**Chemistry of s & p-Block Elements** **s- Block Elements** - Hydrogen: Position of hydrogen in the periodic table. Alkali metals: Comparative study of the elements with respect to oxides, hydroxides, halides, carbonates and bicarbonates. Diagonal relationship of Li with Mg. Preparation, properties and uses of NaOH, $KClO_3$ alkaline earth metals. Anomalous behavior of Be. **p- Block Elements (Group 13 & 14)** - Boron - Preparation and structure of diborane and borazine. Chemistry of borax. Extraction of Al and it uses. Alloys of Al. Diagonal relationship between B and Si. Comparison of carbon with silicon. Carbon-di-sulphide – Preparation, properties, structure and uses.	**18**
III	**Chemistry of p-Block Elements (Group 15-18)** General characteristics of elements of Group15; chemistry of H_2N-NH_2, NH_2OH, HN_3 and HNO_3. Chemistry of PH_3, PCl_3, PCl_5, $P_2O_5$and oxyacids of phosphorous (H_3PO_3 and H_3PO_4). General properties of elements of group 16 – Structure and allotropy of elements - chemistry of ozone - Classification and properties of oxides – Oxyacids of sulphur (Caro's and Marshall's acids).	**18**

	Chemistry of Halogens: Peculiarities of fluorine Halogen acids (HF, HCl, HBr and HI), oxides and oxy acids ($HClO_4$). Inter-halogen compounds (ICl, ClF_3, BrF_5 and IF_7), pseudohalogens [$(CN)_2$and$(SCN)_2$] Noble gases: Position in the periodic table. Preparation, properties and structure of XeF_2, XeF_4, XeF_6 and $XeOF_4$; uses of noble gases.	
IV	**Hydrocarbon Chemistry - I** **Petroproducts:** Fractional distillation of petroleum; cracking, isomerisation, alkylation, reforming and uses **Alkenes**- Nomenclature, general methods of preparation– Mechanism of elimination reactions– $E_1$and E_2 mechanism- factors in fluencing– stereochemistry – orientation – Hofmann and Saytzeffrules. Reactions of alkenes – addition reactions – mechanisms – Markownikoff's rule, oxidation reactions – hydroxylation, oxidative degradation, epoxidation, ozonolysis; polymerization. **Alkadienes -** Nomenclature- classification–isolated, conjugated and cumulated dienes; stability of conjugated dienes; mechanism of electrophilic addition to conjugated dienes - 1, 2 and 1, 4 additions; free radical addition to conjugated dienes– Diels–Alder reactions. **Alkynes-**Nomenclature; general methods of preparation, properties and reactions; acidic nature of terminalalkynes and acetylene, polymerization and isomerisation. **Cyclo alkanes-**Nomenclature, Relativest ability of cyclo alkanes, Bayer's straintheory and its limitations. Conformational and analysis of cyclohexane, mono and disubstituted cyclohexanes. Geometrical isomerism in cyclohexanes.	**18**
V	**Hydrocarbon Chemistry – II** **Benzene -**Source, structure of benzene, stability of benzene ring, molecular orbital picture of benzene, aromaticity, Huckel's (4n+2) rule and its applications. Electrophilic substitution reactions - General mechanism of aromatic electrophilic substitution - nitration, sulphonation, halogenation, Friedel-Craft's alkylation and acylation. Mono substituted and disubstituted benzene - Effect of substituent – orientation and reactivity. **Polynuclear Aromatic hydrocarbons:** Naphthalene – nomenclature, Haworth synthesis; physical properties, reactions – electrophilic substitution reaction, nitration, sulphonation, halogenation, Friedel – Crafts acylation & alkylation, preferential substitution at ortho and para - position – reduction, oxidation – uses. **Anthracene –** synthesis by Elbs reaction, Diels – Alder reaction and Haworth synthesis; physical properties; reactions - Diels-Alder reaction, uses.	**18**

Text Books:

1. Madan R D, Sathya Prakash, (2003), Modern Inorganic Chemistry, 2nd ed, S. Chandand Company, New Delhi.
2. Sathya Prakash, Tuli G D,Basu S K and Madan R D, (2003), Advanced Inorganic Chemistry, 17th ed., S. Chandand Company, New Delhi.
3. Bahl B S, Arul Bhal, (2003), Advanced Organic Chemistry, 3rd ed., S. Chandand Company, New Delhi.
4. Tewari K S, Mehrothra S N and Vishnoi N K, (1998) ,Textbook of Organic Chemistry, 2nd ed., Vikas Publishing House, New Delhi.
5. Puri B R, Sharma L R, (2002), Principles of Physical Chemistry, 38th ed., Vishal Publishing Company, Jalandhar.

Reference Books:

1. Maron S H and Prutton C P, (1972), Principles of Physical Chemistry, 4th ed., The Macmillan Company, New york.
2. Barrow G M, (1992), Physical Chemistry, 5th ed., Tata Mc GrawHill, New Delhi.
3. Lee J D , (1991), Concise Inorganic Chemistry, 4th ed., ELBS William Heinemann, London.
4. Huheey J E, (1993), Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed., Addison Wesley Publishing Company, India.
5. Gurudeep Raj, (2001), Advanced Inorganic Chemistry Vol–I, 26th ed., Goel Publishing House, Meerut. 6
6. Agarwal O P, (1995), Reactions and Reagents in Organic Chemistry, 8th ed., Goel Publishing House, Meerut.

Web-Resources:

1. https://onlinecourses.nptel.ac.in
2. http://cactus.dixie.edu/smblack/chem1010/lecture_notes/4B.html
3. http://www.auburn.edu/~deruija/pdareson.pdf

Course Outcomes:

On completion of the course the students should be able to

CO1: explain the concept of acids, bases and ionic equilibria; periodic properties of and p block elements, preparation and properties of aliphatic and aromatic hydrocarbons

CO2: discuss the periodic properties of s and p- block elements, reactions of aliphatic and aromatic hydrocarbons and strength of acids

CO3: classify hydrocarbons, types of reactions, acids and bases, examine the properties s and p-block elements, reaction mechanisms of aliphatic and aromatic hydrocarbons

CO4: explain theories of acids, bases and indicators, buffer action and important compounds of s-block elements.

CO5: assess the application of hard and soft acids indicators, buffers, compounds of s and p- block elements and hydrocarbons

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	M	S	S	M
CO3	S	S	S	M	S	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

Semester-II/ Skill Enhancement Course - II	Industrial water pollution measurement and Remediation	Course Code:
Instruction Hours : 2	Credits: 2	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	This course aims at giving an overall view of the • Sources of Contamination in Ground Water • Sources of Water Pollution • Sampling Methods • Protection Rule • Drinking Water Specification

UNIT	CONTENT	HOURS
I	Water Pollution : Definition of water pollution, Pollutants, Physical pollution, Chemical pollution, Biological pollution and Physiological pollution Sources of ground water contamination: Domestic waste, Agricultural waste, Soluble effluents, Industrial wastes, Runoff from urban areas, soluble effluents.	**6**
II	Eutrophication - Causes and effect, Oil contamination of water. Sources of water pollution: Sewage, Industrial effluents, Detergents, Toxic metals.	**6**
III	Sampling methods and associated safety measures for Water Quality Index. Preliminary idea regarding influence of dissolved oxygen, BOD, Causes fecal coliform and temperature.	**6**
IV	Environment Protection Rule, 1986 as amended from time to time by Department of Environment and forest – Government of India. Schedule I – Industrial Discharge allowable limits : (a) Caustic Soda Industry (b) Petroleum refinery (c) Fugitive emission (d) Sugar Industry (e) Thermal Power plants (f)Cotton textile industry (g) Dye and Dye intermediates. Schedule VI – Part A – General Standards for discharge of Environmental Pollutants.	**6**
V	Section 86: Primary water quality criteria from class SW I to SW V water. Introduction of requirements of IS 10500: 1991 edition 2.2 (2003-09) – Drinking water specification.	**6**

Text Books:

1. Water Pollution – B. K. Sharma – GOEL Publishing House, Meerut, 2005.

Reference Books:

1.Field manual for water quality Monitorin – Mark K. Mitchell & William B.Stapp; 9th edition, Thomson – Shore – Printers, Michigam.

2.Environment Protection Rule, 1986.

3. IS 10500: 1991 Edition 2.2 (2003-09) – Drinking water specification.

Course Outcomes:

On completion of the course the students should be able to

CO1:know the sources of contamination of ground water.

CO2: learn the sources of water pollution.

CO3: distinguish the sampling methods and safety measures in water quality index

CO4:acquire knowledge about the environmental protection rule.

CO5: assess the drinking water specification.

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	M	S	S	S	M
CO3	S	S	S	M	S	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

Semester-III / Core Course -III	**General Chemistry –III**	**Course Code:**
Instruction Hours : 6	**Credits: 6**	**Exam Hours: 3**
Internal Marks: 25	**External Marks: 75**	**Total Marks: 100**

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	This course aims to provide a knowledge on • The physical properties of gases, liquids, solids and X-ray diffraction of solids. • Fundamentals of nuclear chemistry and nuclear waste management. • Applications of nuclear energy • Basic chemistry of halo-organic compounds, phenol and other aromatic alcohols. • Preparation and properties of phenols and alcohols.

UNIT	CONTENT	HOURS
I	**Gaseous state** Kinetic molecular model of a gas : postulates and derivation from the kinetic gas equation; The Maxwell –Boltzmann distribution of speed of molecules-average, root mean square and most probable velocity and average kinetic energy, Collision frequency; collision diameter; mean free path and viscosity of gases. Real gases: Deviations from ideal gas behaviour, (Andrew's and Amagat's plots); compressibility factor, Z, and its variation with pressure for different gases. Equations of states for real gases-vander Waal's equation, Boyle temperature; Numerical problems based on equations of states for real gases, isotherms of real gases–critical phenomena–isotherms of CO2- continuity of state– Vanderwaal's equation and the critical state; law of corresponding states-liquefaction of gases; numerical problems involving the core concepts**.**	**18**
II	**Liquid and Solid State** Properties of Liquids Surface tension, viscosity and their applications. Crystalline and amorphous – differences-geometry, isotropy and anisotropy, melting point; isomorphism, polymorphism. Crystals–size and shape; laws of crystallography; symmetry elements–plane, Centre and axis ; Miller indices, unit cells and space lattices; classification of crystal systems; Bravais lattices; X–ray diffraction–Bragg's equation Packing in atomic solids–simple cubic, body centered cubic, face centered and hexagonal close packing ;Co-ordination number in typical structures-NaCl, CsCl, ZnS, TiO2; comparison of structure and properties of diamond and graphite;. numerical problems involving core concepts Defects in solids – stoichiometric and non stoichiometric defects. **Liquid crystals**–classification and applications.	**18**

III	**Nuclear Chemistry** Natural radioactivity –α, β and γ rays; half-life period; Fajan–Soddy group displacement law; Geiger–Nattal rule; isotopes, isobars, isotones; nuclear isomerism; radioactive decay series; magic numbers; units–Curie, Rutherford, Roentgen; nuclear stability-neutron-proton ratio; binding energy; packing fraction; mass defect. Simple calculations involving mass defect and decay constant and $t_{1/2}$ and radioactive series. Isotopes–uses–tracers–determination of age of rocks by radio carbon dating. (Problems to be worked out) Nuclear energy; nuclear fission and fusion – major nuclear reactors in India; radiation hazards, disposal of radioactive waste and safety measures.	**18**
IV	**Halogen derivatives Aliphatic halogen derivatives** Nomenclature and classes of alkyl halides – isomerism, physical properties, Chemical reactions. Nucleophilic substitution reactions– S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent. **Di &Tri Halogen derivatives:** Nomenclature, classification, preparation, properties and applications. **Aromatic halogen compounds:-**Nomenclature, preparation, properties and uses Mechanism of nucleophilic aromatic substitution – benzyne intermediate. **Arylalkyl halides:** Nomenclature, benzylchloride – preparation – preparation properties and uses **Alcohols:** Nomenclature, classification, preparation, properties, use; conversions – ascent and descent of series; test for hydroxyl groups. Oxidation of diols by periodic acid and lead tetraacetate.	**18**
V	**Phenols** Nomenclature; classification, Preparation from diazonium salts, cumene, Dow's process, Raching process; properties – acidic character and effect ofsubstitution on acidity. Reactions – Fries, claisen rearrangement, Electrophilic substitution reactions, Reimer- Teiman, Kolbe, Schmidt, Gatermann synthesis, Libermann, nitro reaction, phthalein reaction. Resorcinol, Catechol, quinol, picricacid–preparation, properties and uses. **Aromatic alcohols** Nomenclature, benzylalcohol– methods of preparation– hydrolysis, reduction of benzaldehyde, Cannizzaro reaction, Grignard synthesis, physical properties, reactions–reaction with sodium, phosphorus pentachloride, thionyl chloride, acetic anhydride ,hydrogen iodide, oxidation – substitution on the benzene nucleus, uses.	**18**

Text Books:

1. B. R. Puri, L. R. Sharma, M. S. Pathania; *Principles of Physical Chemistry*, 46th edition, Vishal

Publishing, 2020.
2. B. R. Puri, L. R. Sharmaand K. C. Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers and Distributors, New Delhi, thirtieth edition, 2009.
3. P. L. Soniand Mohan Katyal, *Textbook of Inorganic Chemistry*, Sultan Chand & amp; Sons, twentieth edition, 2006.
4. M. K. Jain, S. C. Sharma, *Modern Organic Chemistry*, Vishal Publishing, fourth reprint, 2003.
5. S. M. Mukherji, and S. P. Singh, *Reaction Mechanism in Organic Chemistry* ,Macmillan India Ltd., third edition, 1994.

Reference Books

1. T. W. Graham Solomons, *Organic Chemistry*, John Wiley & amp; Sons, fifth edition, 1992.
2. A. Carey Francis, *Organic Chemistry*, Tata Mc Graw- Hill Education Pvt., Ltd., New Delhi, seventh edition, 2009.
3. I. L. Finar, *Organic Chemistry*, Wesley Longman Ltd, England, sixth edition,1996.
4. P. L. Soni, and H. M. Chawla – *Text Book of Organic Chemistry*, New Delhi, Sultan Chand & Sons, twenty ninth edition, 2007.
5. J. D. Lee, *Concise Inorganic Chemistry*, Black well Science, fifth edition, 2005.

Web Resources

1. https://nptel.ac.in/courses/104104101Solidstatechemistry
2. https://nptel.ac.in/courses/103106071Nuclear industries and safety
3. https://nptel.ac.in/courses/104106119 Introduction to organic chemistry

Course Outcomes

On completion of the course the students should be able to

CO1: explain the kinetic properties of gases by using mathematical concepts.

CO2: describe the physical properties of liquid and solids; identify various types of crystals with respect to its packing and apply the XRD method for crystal structure determinations.

CO3: investigate the radioactivity, nuclear energy and it's production, also the nuclear waste management.

CO4:write the nomenclature, physical & chemical properties and basic mechanisms of haloorganic compounds and alcohols.

CO5: investigate the named organic reactions related to phenol; explain the preparation and properties of aromatic alcohol including thiol.

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	M
CO3	S	S	S	M	S	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

Semester-III & IV/ Core Practical–II	Qualitative Inorganic Analysis	Course Code:
Instruction Hours : 2/3	Credits: 3	Exam Hours: 3
Internal Marks: 40	External Marks: 60	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 – Creating**
Course Objectives	This course aims to develop the skill on systematic analysis of simple inorganic salts and mixture of salts.

CONTENT

1. Analysis of simple acid radicals: Carbonate, sulphide, sulphate, chloride, bromide, iodide, nitrate
2. Analysis of interfering acid radicals: Fluoride, oxalate, borate, phosphate, arsenate, arsenite.
3. Elimination of interfering acid radicals and Identifying the group of basic radicals
4. Analysis of basic radicals (group wise): Lead, copper, bismuth, cadmium, tin, antimony, iron, aluminium, arsenic, zinc, manganese, nickel, cobalt, calcium, strontium, barium, magnesium, ammonium
5. Analysis of a mixture - I to VIII containing two cations and two anions (of which one is interfering type)

Group Experiments:

1. pH Measurement- Measurements of different solutions like aerated drinks, fruit juices, shampoos and soaps using pH meter. (Note: Use dilute soaps and dilute shampoos)
2. Qualitative analysis of Natural food colours- caramel, Cochineal, Turmeric, Annatto, Chorololphyl and Betain

Text Books:

1. V. Venkateswaran, R. Veeraswamy and A. R. Kulandivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, New Delhi, second edition,1997.

Reference Books:

1. G. Svehla- Vogel's Quantitative Analysis 7th edition Pearson education Ltd.,
2. J. Mendham, R. C. Denney, J. D. Barnes & M. J. K. Thomas- Vogel's Textbook of quantitative Chemical analysis 6th edition Pearson education Ltd.,

Web-Resources:

1. https://www.bookrix.com.

Course Outcomes:

On successful completion of the course the students should be able to

CO1: acquire knowledge on the systematic analysis of Mixture of salts.

CO2: identify the cations and anions in the unknown substance.

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	S

Semester-III/ Multi Disciplinary Course I	NME I - Food Chemistry	Course Code:
Instruction Hours : 2	Credits: 2	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	This course aims at giving an overall view of the ● Types of food ● Food adulteration and poisons ● Food additives and preservation

UNIT	CONTENT	HOURS
I	**Food Adulteration** Sources of food, types, advantages of food additives and disadvantages of Food adulterants - Common adulterants – adulterants and their detection - Detection of adulterated foods by simple analytical techniques- Black Pepper, Chill powder, Coffee, Common Salt, Dals, Edible oils, Ghee or butter, Honey, Milk, Wheat, Food grains.	**6**
II	**Food Poison** Food poisons – natural poisons - sources and symptoms of food borne germs –Chemical poisons -pesticides, (DDT, BHC, Malathion)-First aid for poison consumed victims.	**6**
III	**Food Additives** Food additives- artificial sweeteners – Saccharin – Cyclomate and Aspartate Food flavours - esters, aldehydes and hetero cyclic compounds – Food colours – Emulsifying agents – preservatives.	**6**
IV	**Beverages** Beverages – soft drinks – soda –fruit juices- alcoholic beverages- examples. Carbonation- addiction to alcohol – diseases of liver and social problems.	**6**
V	**Edible Oils** Fats and oils – production of refined vegetable oils – preservation - Reuse and reheating of cooking oil - Saturated and unsaturated fats - iodine value determination of iodine value, RM value, saponification values and their significance.	**6**

Text Books:

1. Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishing house, 2010.
2. Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand & Co. Publishers, second edition, 2006.
3. Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishning house, 2010.
4. Food Chemistry, Dr. L. Rakesh Sharma, Evince publishing, 2022.
5. Food processing and preservation, G. Subbulakshmi, Shobha A Udipi, Pdmini S Ghugre, New age international publishers, second edition, 2021.

ReferenceBooks

1. H.- D. Belitz, Werner Grosch, Food Chemistry Springer Science & Business Media, 4th Edition, 2009.
2. M. Swaminathan, Food Science and Experimental Foods, Ganesh and Company, 1979.
3. Hasenhuettl, Gerard. L.; Hartel, Richard. W. Food Emulsifiers and their applications Springer New York 2nd ed. 2008.
4. Food Chemistry, H.- D. Belitz, W. Grosch, P. Schieberle, Springer, fourth revised and extended edition, 2009.
5. Principles of food chemistry, John M. deMan, John W. Finley, W. Jefferey

Hurst, Chang Yong Lee, Springer, Fourth edition, 2018.

Course Outcomes:

On completion of the course the students should be able to

CO1: learn about Food adulteration – contamination of Wheat, Rice, Milk, Butter.

CO2: get an awareness about food poisons like natural poisons (alkaloids- nephrotoxin) pesticides, DDT, BHC, Malathion

CO3: get an exposure on food additives, artificial sweeteners, Saccharin, Cyclomate and Aspartate in the food industries.

CO4: acquire knowledge on beverages, soft drinks, soda, fruit juices and alcoholic beverages examples.

CO5: study about fats and oils – Sources of oils – production of refined vegetable oils - preservation. Saturated and unsaturated fats – MUFA and PUFA

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	M	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

Semester- III / Skill Enhancement Course-III	Polymer Chemistry	Course Code:
Instruction Hours : 2	Credits: 2	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	This course aims to provide comprehensive knowledge on 1. chemistry of polymers 2. polymer structure, properties and molecular weight determination 3. kinetics of polymers 4. natural and synthetic polymer 5. constituents and importance of plastics and resins

UNIT	CONTENT	HOURS
I	**INTRODUCTION** Introduction to polymers and Macro molecules. Molecular forces and Chemical bonding in polymers. General methods of preparation of polymers and classification of polymers.	6
II	**MOLECULAR WEIGHT OF POLYMERS** Polymer structure - Linear, branched and cross linked polymers Stereo chemistry of polymers – Isotactic, syndiotatic and Atactic. Properties of Polymers. Molecular weight of Polymers - Number average molecular weight and weight average molecular weight. Viscosity and molecular weight. Osmometry.	6
III	**KINETICS** Co polymerization - Definitions –homo and copolymers, Block copolymers and graft copolymers. Kinetics of polymerization - Kinetics of free radical polymerization kinetics of cationic polymerization. Mean kinetic chain length. Degree of polymerization. Inhibition and retardation. Chain transfer.	6
IV	**NATURAL & SYNTHETIC POLYMER** Natural and synthetic rubbers, constitution of natural rubber. Thiocol, Polyurethane and silicone rubbers. Thermocole polymers related to natural rubber – Chlorinated rubber, oxidized rubber, cyclised rubber and ebonite.. Acrilic polymers - Polymers of acrylic acid, methacrylic acid, and poly acrylates.	6
V	**PLASTICS & RESINS** Plastics and Resins - Definitions, Thermoplastic and thermo setting resins. Constituents of plastics fillers, dyes, pigments, plasticizers, lubricants and catalysts. Important thermoplastic resins acrylics, polyvinyl and cellulose derivatives. Important thermo setting resins – Phenolic resins, amino resins, epoxy resins, alkyd resins and silicone resins.	6

Text Books:

1. V. R. Gowarikar, N. V. Viswanathan "Polymer science", Wiley Eastern Ltd., New Delhi, 1978.
2. M. G. Arora, M. Singh and M. S. Yadav " Polymer Chemistry" 2nd Revised edition, Anmol Publications Private Ltd., New Delhi, 1989

Reference Books

1.F. W. Bilmeyer, "Text book of Polymer Science", Jr. John Wiley and Sons, 1984.
2. B. K. Sharma "Polymer Chemistry", Goel Publishing House, Meerut, 1989.

Web site and e-learning sources

1. https:// www.chemistryguide.org/
2. https://chemcollective.org/home

Course Outcomes:

On completion of the course the students should be able to

CO1: help students explore about polymers and macromolecules
CO2: assess the molecular weight of polymers structure and its stereochemistry
CO3: recognize the kinetics of polymerization
CO4: distinguish the natural and synthetic polymers
CO5: how to know plastics and resins

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	M	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

Semester-IV / Core Course -IV	General Chemistry –IV	Course Code:
Instruction Hours : 5	Credits: 5	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 – Creating**
Course Objectives	This course aims to provide a comprehensive knowledge on • thermodynamic concepts on chemical processes and applied aspects. • Thermochemical calculations • Transition elements with reference to periodic properties and group study of transition metals. • The organic chemistry of ethers, aldehydes and ketones • The organic chemistry of carboxylic acids

UNIT	CONTENT	HOURS
I	**Thermodynamics I** Terminology – Intensive, extensive variables, state, path functions; isolated, closed and open systems; isothermal, adiabatic, isobaric, isochoric, cyclic, reversible and irreversible processes ; First law of thermodynamics – Concept and significance of heat(q), work(w), internal energy(E), enthalpy(H); calculations of q, w, E and H for reversible, irreversible expansion of ideal and real gases under isothermal and adiabatic conditions; relation between heat capacities (Cp & Cv) ; Joule Thomson effect - inversion temperature. Thermochemistry- heats of reactions, standard states; types of heats of reactions and their applications; effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions; Hess's lawand its applications; determination of bond energy; Measurement of heat of reaction Zeroth law of thermodynamics – Absolute Temperature scale.	**18**
II	**Thermodynamics II** Second Law of thermodynamics - Limitations of first law, spontaneity and randomness; Carnot's cycle; Concept of entropy, entropy change for reversible and irreversible processes, entropy of mixing, calculation of entropy changes of an ideal gas and a van der Waals gas with changes in temperature, volume and pressure, entropy and disorder. Free energy and work functions -Need for free energy functions, Gibbs free energy, Helmholtz free energy – their variation with temperature, pressure and volume, criteria for spontaneity; Gibbs-Helmholtz equation –derivations and applications; Maxwell relationships.	**18**

III	**General Characteristics of d – block elements** **Transition Elements** – Electronic configuration – General periodic trend variable valency, oxidation states, stability of oxidation states, colour, magnetic properties, catalytic properties and tendency to form complexes. Comparative study of transition elements and non-transition elements – comparison of II and III transition series with I transition series. Group study of Titanium, Vanadium, Chromium, Iron, Nickel and Zinc groups	**18**
IV	**Ethers, Thioethers, Epoxides and carbonyl compounds** Nomenclature, isomerism, general methods of preparations, reactions involving cleavage of C-O linkages, alkyl group and ethereal oxygen. Zeisel's method of estimation of methoxy group. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$- Thioethers- nomenclature, structure, preparation, properties and uses. **Aldehydes and Ketones** Nomenclature, structure and reactivity of aliphatic and aromatic aldehydes and ketones; general methods of preparation and physical properties. Nucleophilic addition reactions, base catalysed reactions with mechanism- Aldol, Cannizzaro's reaction, Perkin reaction, Benzoin condensation, Haloform reaction, Knoevenagel reaction. Oxidation of aldehydes. Baeyer – Villiger oxidation of ketones. Reduction : Clemmensen reduction,Wolf-Kishner reduction, Meerwein – Pondorf Verley reduction, reduction with $LiAlH_4$ and $NaBH_4$.	**18**
V	**Carboxylic Acids**: Nomenclature, structure, preparation and reactions of aliphatic and aromatic monocarboxylic acids. Physical properties, acidic nature, effect of substituent on acidic strength. HVZ reaction, Claisen ester condensation, Bouveault Blanc reduction, decarboxylation, Huns diecker reaction. Formic acid-reducing property. Reactions of dicarboxylic acids, hydroxyl acids and unsaturated acids. **Carboxylic acid Derivatives:** Preparations of aliphatic and aromatic acid chlorides, esters, amides and anhydrides. Nucleophilic substitution reaction at the acyl carbon of acyl halide, anhydride, ester, amide. Schottan-Baumann reaction.Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement. **Active methylene compounds:** Keto–enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate	**18**

Text Books:

1. B. R. Puri and L. R. Sharma, *Principles of Physical Chemistry*, Shoban Lal Nagin Chand and Co., Thirty three edition,1992.
2. K. L. Kapoor, *A Textbook of Physical chemistry*, (volume – 2 and 3), Macmillan, India Ltd, third edition, 2009.
3. P. L. Soni and Mohan Katyal, *Textbook of Inorganic Chemistry*, Sultan Chand & Sons, twentieth edition, 2006.
4. M. K. Jain, S. C. Sharma, *Modern Organic Chemistry*, Vishal Publishing, fourth reprint, 2003.
5. S. M. Mukherji, and S. P. Singh, *Reaction Mechanism in Organic Chemistry*, Macmillan India Ltd., third edition, 1994.

Reference Books:

1. Maron, S. H. and Prutton C. P. *Principles of Physical Chemistry,* 4th ed.; The Macmillan Company: New york, 1972.
2. Lee, J. D. *Concise Inorganic Chemistry* ,4th ed.; ELBS William Heinemann: London, 1991.
3. Gurudeep Raj, *Advanced Inorganic Chemistry,* 26th ed.; Goel Publishing House: Meerut, 2001.
4. Atkins, P. W. & Paula, J. *Physical Chemistry,* 10th ed.; Oxford University Press: New York, 2014.
5. Huheey, J. E. *Inorganic Chemistry: Principles of Structure and Reactivity,* 4th ed; Addison Wesley Publishing Company: India, 1993.

Web-Resources:

1. https://nptel.ac.in/courses/112102255Thermodynamics
2. https://nptel.ac.in/courses/104101136Advanced transition metal chemistry

Course Outcomes:

On completion of the course the students should be able to

CO1: explain the terms and processes in thermodynamics; discuss the various laws of thermodynamics and thermochemical calculations.

CO2: discuss the second law of thermodynamics and its application to heat engine; discuss third law and its application on heat capacity measurement.

CO3: investigate the chemistry of transition elements with respect to various periodic properties and group wise discussions.

CO4: discuss the fundamental organic chemistry of ethers, epoxides and carbonyl compounds including named organic reactions.

CO5: discuss the chemistry and named reactions related to carboxylic acids and their derivatives;

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

Semester-IV / Multi Disciplinary Course II	NME II -Chemistry in Daily life	Course Code:
Instruction Hours : 2	Credits: 2	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	This course aims at providing an overall view of the • Importance of Chemistry in everyday life • Chemistry of building materials and food • Chemistry of Drugs and pharmaceuticals

UNIT	CONTENT	HOURS
I	General survey of chemicals used in everyday life for household purposes. Air- components and their importance; photosynthetic reaction, air pollution, green - house effect and its impact in our life style. Water- Sources of water, qualities of potable water, soft and hard water, Removal of hardness by Reverse Osmosis.	**6**
II	Building materials - cement, ceramics, glass and refractories - definition, composition and application only. Plastics-Thermosetting & Thermoplastic – Classification & application.	**6**
III	Food and Nutrition - Carbohydrates, Proteins, Fats -definition and their importance as food constituents– balanced diet–Calories, minerals, enzymes and vitamins (sources and their physiological importance).	**6**
IV	Cosmetics –toothpaste, face powder, soaps and detergents, shampoos, nail polish, perfumes – preparations- possible hazards of cosmetic use.	**6**
V	Pharmaceutical drugs- analgesics and anti pyretics – paracetamol and aspirin. Colour chemicals - pigments and dyes – classification examples and applications.	**6**

Text Books:

1.Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishing house, 2010.
2.A textbook of pharmaceutical chemistry by Jayashree Ghosh, S Chandpublishing, 2012.
3.S. Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
4.B. K, Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.
5.Introduction to forensic chemistry, Kelly M. Elkins, CRC Press Taylor & Francis Group, 2019.
6.Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand & Co. Publishers, second edition, 2006.

Reference Books:

1. Randolph. Norris Shreve, Chemical Process Industries, Mc Graw - Hill, Texas, fourth edition, 1977.
2.W. A. Poucher, Joseph A. Brink, Jr. Perfumes, Cosmetics and Soaps, Springer, 2000.
3.A. K. De, Environmental Chemistry, New Age International Public Co., 1990.

Course Outcomes:

On completion of the course the students should be able to

CO1: learn about the chemicals used in everyday life as well as air pollution and water pollution.
CO2: get knowledge on building materials cement, ceramics, glass and plastics.
CO3: acquire information about Food and Nutrition. Carbohydrates, Proteins, Fats.
CO4: awareness about Cosmetics Toothpastes, face powder, soaps and detergents.
CO5: have an idea about the pharmaceutical drugs analgesics and antipyretics

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	M
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

Semester-IV / Ability Enhancement Course-I	Pharmaceutical Chemistry	Course Code:
Instruction Hours : 2	Credits: 2	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 – Creating**
Course Objectives	The course aims at providing an overall view of • Drugs design and drug metabolism • Important Indian medicinal plants and antibiotics • Important common diseases and antibiotics • Drugs for major diseases like cancer and diabetes • Drugs for major diseases like Hypertension, AIDS and anemia

UNIT	CONTENT	HOURS
I	**Introduction** Important terminologies – drug, pharmacognosy, pharmacy, pharmacology, pharmacodynamics, pharmacokinetics, clinical pharmacology, pharmacotherapeutics, chemotherapy, toxicology, pharmacophore, antimetabolites, mutation, bacteria, virus, fungi, actinomycetes, vaccines, and therapeutic index. Sources of drugs – routes of administration.	6
II	**Indian medicinal plants & Antibiotics** Some important Indian medicinal plants – tulsi, neem, kizhanelli, adadodai and thoothuvalai – uses. **Antibiotics –** Definition – classification – structure and therapeutic uses of penicillin, streptomycin and chloramphenicol.	6
III	**Common diseases and their treatment** Causes, prevention and treatment of the following diseases: Insect borne diseases – malaria, plague; Air borne diseases – diphtheria, whooping cough, common cold, tuberculosis; Water borne diseases – cholera, typhoid, dysentery. Digestive system – jaundice; Respiratory system – asthma; Nervous system – epilepsy.	6
IV	**Drugs for Major diseases I** Cancer – common causes – chemotherapy – anti neoplastic agents - classification – adverse effects of cytotoxic agents ; alkyl malignant agents– chloram bucil; anti metabolites – methotrexate, fluouracil; Vinca alkaloids – vincristine. Diabetes– types –Management of diabetes – insulin ; oral hypoglycemic agents- sulphonyl ureas – chlorpropamide; biguanides – metformin.	6
V	**Drugs for Major diseases II** Cardio vascular drugs – cardio glycosides; anti arrhythmic agents – quinidine, propanol hydrochloride; anti- hypertensive drugs- Aldomet,	6

	vasodilator- tolazoline hydrochloride, sodium nitro prusside. AIDS– causes-symptoms and prevention– anti HIV drugs - AZT, DDC. Anaemia – causes, types and control – anti anaemic drugs.	

Text Books:

1. Jayashree Ghosh, (1999), A textbook of pharmaceutical chemistry, 2nd ed., S. Chand & company, New Delhi.
2. Lakshmi S, (2004), Pharmaceutical chemistry, 3rd ed., Sultan chand & sons, Delhi.
3. Tripathi K D, (2018), Essentials of medical pharmacology, 8th ed., Jaypee brothers medical publishers (P) Limited, New Delhi.
4. Ashutosh Kaur, (2018), Medicinal chemistry, 7th ed., New age international (P) Limited, Publishers, New Delhi.

Reference Books:

1. Chatwal G R, (2013), Pharmaceutical chemistry, inorganic (vol-I) 6th ed., Himalaya Publishing house, Bombay.
2. Chatwal G R, (1991), Pharmaceutical chemistry, organic (vol-II)., Himalaya publishing house, Bombay.
3. Patrick G, (2002), Instant Notes Medicinal Chemistry, Viva Books Private Limited, NewDelhi.

Web-Resources:

1. http://www.pharmacy.umaryland.edu/faculty/amackere/courses/phar531_delete/lectures/qsar_1.pdf
2. http://www.indianmedicinalplants.info/
3. https://www.wipo.int/about-ip/en/

Course Outcomes:

On completion of the course the students should be able to

CO1: Define the pharmaceutical terminologies; describe the principles in pharmacological activity, drug development.

CO2: Discuss the development of drugs, structural activity.

CO3: Apply the principles involved in structural activity and drug designing.

CO4: explain classification of analgesics and anasthetics, and physiological functions of plasma Proteins

CO5: explain the significance of clinical tests like blood urea, serum proteins and coronary risk index

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

Semester- V/ Core Course -V	Organic Chemistry - I	Course Code:
Instruction Hours : 6	Credits: 5	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	This course aims to provide an understanding of • stereoisomerism in chirals and geometric isomerism in olefins, conformations of ethane and butane • preparation and properties of aromatic and aliphatic nitro compounds and amines • preparation of different dyes, food colour and additives • preparation and properties of five membered heterocycles like pyrrole, furan and thiophene • preparation and properties of six membered heterocycles like pyridine, quinoline and isoquinoline.

UNIT	CONTENT	HOURS
I	**Stereochemistry** Fischer Projection, New mann and Saw horse Projection formulae and their interconversions; Geometrical isomerism: cis – trans, syn – anti isomerism, E / Z notations. **Optical Isomerism:** Optical activity, specific rotation, asymmetry, enantiomers, distereoisomers, meso structures - molecules with one and two chiral centres, racemisation – methods of racemisation; resolution - methods of resolution. C.I.P rules. R and S notations for one and two chirality (stereogenic) centres. Molecules with no asymmetric carbon atoms – allenes and biphenyls. Conformational analysis of ethane and butane.	15
II	**Chemistry of Nitrogen Compounds – I** **Nitroalkanes** Nomenclature, isomerism, preparation from alkylhalides, haloacids, alkanes; physical properties; reactions – reduction, halogenations, Grignard reagent, Pseudoacid character. Nitro – acinitro tautomerism. **Aromatic nitro compounds** Nomenclature, preparation – nitration, from diazonium salts, physical properties; reactions – reduction of nitrobenzene In different medium, Electrophilic substitution reactions, TNT. **Amines: Aliphatic amines** Nomenclature, isomerism, preparation – Hofmanns' degradation reaction, Gabriel's phthalimide synthesis, Curtius Schmidt re-arrangement. Physical properties, reactions – alkylation, acylation, carbylamines reaction, Mannich reaction, oxidation, basicity of amines.	15

III	**Chemistry of Nitrogen Compounds – II** **Aromatic amines** – Nomenclature, preparation – from nitro compounds, Hofmann's method; Schmidt reaction, properties – basic nature, ortho effect; reactions – alkylation, acylation, carbylamines reaction, reaction with nitrous acid, aldehydes, oxidation, Electrophilic substitution reactions, diazotization and coupling reactions; sulphanilic acid-zwitter ion formation. Diazonium compounds - Diazomethane, Diazo acetic ester - preparations and synthetic applications. **Dyes –**Theory of colour and constitution; classification based on structure and application; preparation – Martius yellow, aniline yellow, methylorange, alizarin, indigo, malachite green.	**15**
IV	**Hetero cyclic compounds** Nomenclature and classification. General characteristics – aromatic character and reactivity. **Five – membered hetero cyclic compounds** Pyrrole – preparation – from succinimide, Paal Knorr synthesis; reactions – reduction, basic character, acidic character, electrophilic substitution reactions, ring opening. Furan – preparation from mucic acid; reactions – hydrogenation, reaction with oxygen, Diels Alder reactions, formation of thiophene and pyrrole; Electrophilic substitution reaction. Thiophene synthesis - fromacetylene; reactions – reduction; oxidation; electrophilic substitution reactions.	**15**
V	**Six – membered heterocyclic compounds** Pyridine – synthesis - from acetylene, Physical properties; reactions –basic character, oxidation, reduction, electrophilic substitution reactions; nucleophilic substitution - uses **Condensed ring systems** - Quinoline – preparation - Skraup synthesis and Friedlander's synthesis; reactions – basic nature, reduction, oxidation; electrophilic substitutions; nucleophilic substitutions– Chichibabin reaction - Isoquinoline – preparation by the Bischler – Napieralski reaction, reduction, oxidation; electrophilic substitution.	**15**

Text Books:

1. M. K. Jain, S. C. Sharma, Modern Organic Chemistry, Vishal Publishing, fourth reprint, 2009.
2. S. M. Mukherji, and S. P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan India Ltd., third edition, 2009.
3. Arun Bahl and B. S. Bahl, Advanced organic chemistry, New Delhi ,S. Chand & Company Pvt. Ltd., Multicolour edition, 2012.
4. P. L. Soniand H. M. Chawla, Text Book of Organic Chemistry, Sultan Chand & Sons, New Delhi, twenty ninth edition, 2007.
5. .C. N. Pillai, Text Book of Organic Chemistry, Universities Press (India) Private Ltd., 2009.

Reference Books:

1.R. T. Morrison and R. N. Boyd, Organic Chemistry, Pearson Education, Asia, sixth edition, 2012.

2. T. W. Graham Solomons, Organic Chemistry, John Wiley & Sons, eleventh edition, 2012.
3. A. Carey Francis, Organic Chemistry, Tata Mc Graw – Hill Education Pvt. Ltd., New Delhi, seventh edition, 2009.
4. I. L. Finar, Organic Chemistry, Vol. (1&2), England, Wesley Longman Ltd, sixth edition, 2006.
5. J. A. Joule, and G. F. Smith, Heterocyclic Chemistry, Wiley, Fifth Edition, 2010.

Web - Resources:

1.www.epgpathshala.nic.in

2. www.nptel.ac.in

3. http:/swayam.gov.in

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

Semester-V/ Core Course -VI	Physical Chemistry - I	Course Code:
Instruction Hours : 6	Credits: 6	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 – Creating**
Course Objectives	The course aims at providing an overall view of • Gibbs free energy, Helmholtz free energy and partial molar properties • Chemical kinetics and different types of chemical reactions • adsorption, homogeneous and heterogeneous catalysis • colloids and macromolecules • photochemistry, fluorescence and phosphorescence.

UNIT	CONTENT	HOURS
I	**Thermodynamics–III** Third law of thermodynamics – Nernst heat theorem; Applications of third law - evaluation of absolute entropies from heat capacity measurements, exceptions to third law. Partial molar properties –chemical potential, Gibbs Duhem equation, variation of chemical potential with temperature and pressure, chemical potential of a system of ideal gases, Gibbs -Duhem-Margules equation. **Chemical equilibrium** Law of mass action – thermodynamic derivation – relationship between K_p and K_C – application to the homogeneous equilibria – dissociation of PCl_5 gas, N_2O_4 gas – equilibrium constant and degree of dissociation –formation of HI, NH_3,and SO_3 –heterogeneous equilibrium –decomposition of solid calcium carbonate –Lechatelier principle – van't Hoff reaction isotherm – temperature dependence of equilibrium Constant – van't Hoff reaction isochore – Clayperon equation–Clausius Clayperon equation and its applications.	**15**
II	**Chemical Kinetics** **Rate of reaction -** Order and molecularity of simple and complex reactions, Rate laws- Rate constants – derivation of rate constants and characteristics for zero, first order, second and third order (equal initial concentration) Derivation of time for half change with examples.Methods of determination of order of Volumetry, manometry and polarimetry. Effect of temperature on reaction rate – temperature coefficient - concept of activation energy - Arrhenius equation. Theories of reaction rates–Collision theory – derivation of rate constant of bimolecular gaseous reaction – Failure of collision theory. Lindemann's theory of unimolecular reaction. Theory of absolute reaction rates – Derivation of rate constant for a bimolecular reaction – significance of entropy and free energy of activation. Comparison of collision theory and ARRT.	**15**

III	**Adsorption and Catalysis** Adsorption – Chemical and physical adsorption and their general characteristics - distinction between them Different types of isotherms – Freundlich and Langmuir. Adsorption isotherms and their limitations –BET theory, kinetics of enzyme catalysed reaction –Michaelis- Menten equation. Catalysis – general characteristics of catalytic reactions, auto catalysis, promoters, negative catalysis, poisoning of a catalyst–theories of homogenous and heterogeneous catalysis – Kinetics of Acid – base and enzyme catalysis. Heterogenous catalysis	**15**
IV	**Colloids and Surface Chemistry** **Colloids:**Types of Colloids, Characteristics of Colloids (Lyophilic and Lyophobic sols), Preparation of Sols-Dispersion methods, aggregation methods, Properties of Sols- Optical properties, Electrical properties – Electrical double layer, Electro Kinetic properties- Tyndall effect, Electro-osmosis, Electrophoresis, Coagulation or precipitation, Stability of sols, associated colloids Emulsions, Gels – preparation of Gels, Applications of colloids Macromolecules : Molecular weight of Macromolecules-Number average molecular weight- average molecular weight, Determination of Molecular weight of molecules	**15**
V	**Photochemistry** Laws of photochemistry – Lambert–Beer, Grotthus–Draper and Stark–Einstein. Quantum efficiency. Photochemical reactions – rate law– Kinetics of H_2- Cl_2 and H_2- I_2 reactions, comparison between thermal and photochemical reactions. Jablonski diagram – radiative and non radiative transitions. Fluorescence – applications - phosphorescence – applications - chemiluminescence and photosensitization– examples Chemistry of Vision–cis retinal–vitamin A as a precursor – colour perception of vision	**15**

Text Books:

1. B. R. Puriand L. R. Sharma, Principles of Physical Chemistry, Chand and Co., forty eighth edition, 2021.
2. Peter Atkins, and Juliode Paula, James Keeler, Physical Chemistry, Oxford University press, International eleventh edition, 2018.
3. Arun Bahl, B. S. Bahl, G. D. Tuli Essentials of physical chemistry, 28th edition 2019, S, Chand & Co.
4. S. K. Dograand S. Dogra, Physical Chemistry through Problems: New Age International, fourth edition, 1996.
5. J. Rajaramand J. C. Kuriacose, Thermodynamics, Chand and CO., 1986.

Reference Books:

1. J. Rajaram and J. C. Kuriacose, Chemical Thermodynamics, Pearson, 1st edition, 2013.
2. Keith J. Laidler, Chemical kinetics, third edition, Pearson, 2003.
3. P. W. Atkins, and Juliode Paula, Physical Chemistry, Oxford University press, seventh edition, 2002.

4. K. L. Kapoor, A Textbook of Physical Chemistry, Macmillan India Ltd, third edition, 2009.
5. B. R. Puri, L. R. Sharma and M. S. Pathania, Principles of Physical Chemistry, Chand and Co. Jalendhar, forty first, edition, 2001

Web-Resources:

1. https://nptel.ac.in
2. https://swayam.gov.in
3. www.epgpathshala.nic.in

Course Outcomes:

On completion of the course the students should be able to

CO1: explain Gibbs and Helmholtz free energy functions and partial molar quantities

CO2: apply the concepts of chemical kinetics to predict the rate of the reaction and order of the reaction, demonstrate the effect of temperature on reaction rate.

CO3: compare chemical and physical adsorption, Freundlich and Langmuir adsorption isotherms, and differentiate between homogenous and heterogeneous catalysis.

CO4: demonstrate the types and characteristics of colloids, preparation of sols and emulsions, and determine the molecular weights of macromolecules.

CO5: utilize the concepts of photochemistry in fluorescence, phosphorescence, chemiluminescence and color perception of vision.

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	M	S	S	M	S
CO3	S	S	S	M	S	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

Semester-V/ Core Course- VII	Inorganic Chemistry-I	Course Code:
Instruction Hours : 5	Credits: 4	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	The course aims to provide knowledge on • nomenclature, isomerism and theory of co ordination compounds, and chelate complexes • crystal field theory, magnetic properties, stability of complexes and Jahn Teller effect • preparation and properties of metal carbonyls • Lanthanoids and actinoids • Preparation and properties of inorganic polymers

UNIT	CONTENT	HOURS
I	**Co – ordination Chemistry - I** Definition – Coordination Chemistry – Comparison of coordination complexes and double salt –IUPAC Nomenclature of coordination compounds, Isomerism in co ordination compounds – types of ligands. Werner's co ordination theory – EAN rule –interpretation of geometry and magnetic properties by Pauling's theory – geometry of co-ordination compounds with co – ordination number 4 & 6 - limitations of VBT. Role of metal chelates In living systems – haemoglobin and chlorophyll (structure only).	12
II	**Co- ordination Chemistry - II** Crystal field theory – Crystal field splitting of energy levels in octahedral and tetrahedral complexes, Crystal field stabilization energy (CFSE), spectrochemical series - calculation of CFSE in octahedral and tetrahedral complexes – factors influencing the magnitude of crystalfield splitting, crystal field effect on ionic radii, lattice energies, interpretation of magnetic properties, spectra of $[Ti(H_2O)6]^{3+}$ - Jahn – Teller distortion and its consequences. Stability of complexes in aqueous solution, stability constants- factors affecting the stability of a complex, thermodynamic and kinetic stability (elementary idea). Comparison of VBT and CFT	12
III	**Metal Carbonyls** Synergetics metal carbonyls – Mono and poly nuclear carbonyls, General methods of preparation of carbonyls – general properties of binary carbonyls – Preparation, structure and bonding in carbonyls of Ni and Fe. Ferrocene – Methods of preparation and structure.	12
IV	**Inner transition elements (Lanthanoids and Actinoids)** General characteristics of f – block elements - Occurrence, Oxidation states, Magnetic properties, Colour and spectra- Lanthanoids and Actinoids,	12

	Separation by ion – Exchange and Solvent extraction methods – Lanthanoids contraction – Chemistry of thorium and Uranium - Ores, Extraction and uses.	
V	**Inorganic polymers** General properties – classification of inorganic polymers based on element in the backbone (Si, S, B and P) - preparation and properties of silicones (polydimethyl siloxane) phosphorous based polymer (polyphosphazines), boron based polymers (borazine polymers) – industrial applications of inorganic polymers.	**12**

Text Books:

1. Puri B R, Sharma L R, Kalia K C (2011), Principles of Inorganic Chemistry, 31th Edition, Milestone Publishers & Distributors, Delhi.
2. Satya Prakash, Tuli G. D., Basu S. K., Madan R. D. (2009), Advanced Inorganic Chemistry, 18th Edition, S. Chand & Co., New Delhi
3. Lee J D, (1991), Concise Inorganic Chemistry, 4th Edition, ELBS William Heinemann, London.
4. W V Malik, G D Tuli, R D Madan, (2000), Selected Topics in Inorganic Chemistry, S. Chand and Company Ltd.
5. A. K. De, Textbook of Inorganic Chemistry, Wiley East Ltd, seventh edition, 1992

Reference Books:

1. Madan R D, Sathya Prakash, (2003), Modern Inorganic Chemistry, 2nd ed . , S. Chandand Company, New Delhi.
2. Gopalan R, (2009) Inorganic Chemistry for Undergraduates, Ist Edition, University Press (India) Private Limited, Hyderabad
3. Sivasankar B, (2013) Inorganic Chemistry. Ist Edition, Pearson, Chennai
4. Alan G. Sharp (1992), Inorganic Chemistry, 3rd Edition, Addition - Wesley, England
5. Peter Atkins, Tina Overton, Jonathan Rourke and Mark Weller, Inorganic Chemistry, Oxford University Press, sixth edition, 2014.

Web-Resources:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in

Course Outcomes:

On completion of the course the students should be able to

CO1: explain isomerism, Werner's Theory and stability of chelate complexes
CO2: discuss crystal field theory, magnetic properties and spectral properties of complexes.
CO3: explain preparation and properties of metal carbonyls
CO4: give a comparative account of the characteristics of lanthanoids and actinoids
CO5: explain properties and uses of inorganic polymers of silicon, sulphur, boron and Phosphorous

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	M
CO3	S	S	S	M	S	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

Semester-V/ Core Practical - III	Organic Qualitative Analysis and Organic Preparation (P)	Course Code:
Instruction Hours : 3	Credits: 3	Exam Hours: 3
Internal Marks: 40	External Marks: 60	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	This course aims at providing • Methods of preparing organic compounds • Techniques of organic qualitative analysis. • Derivatives of organic analysis.

CONTENT

ORGANIC QUALITATIVE ANALYSIS AND ORGANIC PREPARATION:

Analysis of Simple Organic compounds

(a) characterization of functional groups

(b) confirmation by preparation of solid derivatives / characteristic colour reactions.

ORGANIC PREPARATION: (ANY FOUR)

Preparation of Organic Compounds involving the following chemical conversions.

1. Oxidation 2. Reduction 3. Hydrolysis 4. Nitration 5. Bromination 6. Diazotization
7. Osazone formation

Text Books:

1. Venkateswaran V, Veeraswamy R., Kulandaivel A.R., "Basic Principles of Practical Chemistry", 2nd edition, Sultan chand & sons, (1997)
2. Furniss, B. S., et al.,"Vogel's textbook of Practical Organic Chemistry", 7th edition, ELBS, London (1984).

Web Resources:

1. http://www.vlab.co.in/index.php

Course Outcomes:

On completion of the course the students should be able to

CO1: know the techniques of organic qualitative analysis.

CO2: Preparation of organic compounds.

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S

Semester-V/ Core Practical IV	Physical Chemistry (P)	Course Code:
Instruction Hours : 3	Credits: 3	Exam Hours: 3
Internal Marks: 40	External Marks: 60	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	This course aims at providing • basic principles of physical chemistry experiments • hands on experience in carrying out the experiments

CONTENT

1. Simple eutectic – determination of eutectic temperature and composition of naphthalene - diphenylamine or naphthalene – diphenyl system
2. Determination of transition temperature of a salt hydrate.
3. Determination of upper critical solution temperature of phenol – water system
4. Determination of concentration of sodium chloride using phenol – sodium chloride system
5. Determination of molecular weight of an organic compound by Rast method using naphthalene or diphenyl as solvent
6. Determination of the distribution co efficient of iodine between carbon tetrachloride and water.
7. Determination of rate constant of acid catalysed hydrolysis of an ester (Methyl acetate)
8. Conductometric titration of hydrochloric acid against sodium hydroxide
9.Determination of cell constant

Water Quality parameters

1. Alkalinity
2. Hardness
3. Chloride
4. Dissolved Oxygen
5. TDS, TSS, TS and pH of the given water sample.

Text Books:

1. Venkateswaran V, Veeraswamy R, Kulandaivelu A. R, "Basic Principles of Practical Chemistry", (2nd edition), Sultan Chand &Sons, New Delhi (1997).

Reference Books:

1. D. P. Shoemaker, C. W. Garland & J. W. Nibler, " Experiments in Physical Chemistry" 5th edition, McGraw Hill, 1989.
2.V. D. Athawala & P. Mathur, "Experimental Physical Chemistry", New age International publisher, 2001.
3. Findlay. A, " Practical Physical Chemistry", 7th edition, London, Longman, 1959.
4. Ahluwalia V. K, Dingra. S & Gulati. A, "College Practical Chemistry", Orient Longman Pvt Ltd., Hyderabad, 2005.

Web- Resources:

1. http://www.vlab.co.in/index.php

Course Outcomes:

On completion of the course the students should be able to

CO1: Describe the principles and methodology for the practical work.

CO2: Explain the procedure, data and methodology for the practical work

CO3: Apply the principles of phase rule and electrochemistry for carrying out the practical work

CO4: Demonstrate laboratory skills for safe handling of the equipment and chemicals

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	M	S	S	S	M
CO3	S	S	S	M	S	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S

Semester-V / Discipline Specific Elective – I	Analytical Chemistry	Course Code:-
Instruction Hours: 3	Credits: 3	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1-Acquire / Remember** **K2-Understanding** **K3-Apply K4-Analyze** **K5-Evaluate** **K6-Create**
Course Objectives	• Students shall learn the storage and handling of various chemicals and first aid procedures. • Students shall demonstrate competence in collecting and interpreting data from their knowledge on analytical techniques. • Students know the separation and purification technique of solvents. • Students learn about thermo gravimetric analysis, differential thermal analysis, analytical electrochemistry and its applications. • Students learn about colorimetric analysis, coulometry analysis and its application.

UNIT	CONTENT	HOURS
I	**LABORATORY SAFETY PRACTICES** Laboratory Hygiene and safety: Storage and handling of corrosive, flammable, explosive, toxic, carcinogenic and poisonous chemicals. Simple first aid procedure from accident: Acid in eye, alkali in eye, acid burns, alkali burns, bromine burns, poisoning, inhalation of gases, cut by glasses and heat burns**.**	**9 Hrs**
II	**DATA ANALYSIS** Errors in chemical analysis, classification of errors, determinant errors, instrumental errors, personal errors, constant errors, and proportional errors – correction of determinant errors, random errors. Precision, accuracy and rejection of data questioned. Significant figures. Mean and standard deviation. Curve fitting.	**9 Hrs**
III	**SEPARATION & PURIFICATION TECHNIQUE** General principles involved in the separation of precipitates. Solvent extraction**.** Chromatography: Principles involved in adsorption, partition and ion exchange, paper, thin layer, column, Electrophoresis applications. Desiccants, vacuum drying, distillation, fractional distillation, steam distillation, azotropic distillation, crystallization and sublimation – principles and techniques**.**	**9 Hrs**
IV	**THERMO ANALYTICAL METHODS & ANALYTICAL ELECTROCHEMISTRY** Thermo analytical Methods: Principles involved in TGA and DTA – instrumentation. Characteristics of TGA (CaC_2O_4. H_2O, $CuSO_4.5H_2O$) and DTA curves ($CaC_2O_4.H_2O$). Factors affecting TGA and DTA curves. Thermometric titration of HCl Vs NaOH	**9 Hrs**

	Analytical Electrochemistry: Redox potential – measurement and applications. Interpretation of chemical behavior. Electrolytic separations. Principles of Electrode position. Electro gravimetric (estimation of Cu and Ag).	
V	**COLORIMETRIC ANALYSIS** Colorimetric analysis: Laws of colorimetry – instrumentation. Nessler's and photoelectric colorimetric method- operation and application. Estimation of Ni, Cu and Fe.Techniques in kinetics: Principles and techniques used to follow the kinetics of ordinary and fast- photochemical reactions.	**9 Hrs**

Text Book:

1..R. Gopalan, P.S. Subramanian, and K. Rengarajan – "Elements of Analytical Chemistry", 2nd edition, Sultan chand & Co.,
2. Vogel. A" Text book of Quantitative Inorganic analysis", 4th edition, English language book society

Reference Books:

1. B.K. Sharma, "Instrumental methods of chemical analysis", Goel Publishing House, Merrut (1997).
2. Gurdeep Chatwal and Sham Anand , "Instrumental methods of chemical analysis" Himalaya publishing house (2005).
3. D.A. Skoog and D.M.West, "Fundamentals of analytical chemistry", 7th edition, Hartcourt College Publishers.
4. R.A. Day and A.L. Underwood – Quantitative analysis.
5. Mendham J, Denny R.C., Barnes J.D., Thomas M, " Vogel's Text book of quantitative chemical analysis", 6th edition, Pearson education.

Web- Resources:

1. http://www.chemexper.com

Course Outcomes:

On completion of the course the learner will be able

CO1: Aware of Laboratory hygiene and safety
CO2: Predict the data analysis in analytical techniques
CO3: Learn about separation and purification techniques
CO4: Recognize the thermo analytical methods such as TGA,DTA and analytical electrochemistry
CO5: Understand the colorimetric analysis and techniques in kinetics

Mapping of Course Outcomes with Programme Outcomes / Programme Specific Outcomes:

CO/PO	PO					**PSO**							
	1	2	3	4	5	1	2	3	4	5	6	7	8
CO1	S	S	M	S	S	S	S	S	M	W	S	W	S
CO2	S	S	S	M	S	S	S	S	S	W	S	S	S
CO3	S	S	S	S	S	S	S	S	M	S	S	S	S
CO4	S	S	S	M	S	S	S	S	M	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S

Semester-V / Ability Enhancement Course – II	Applied Chemistry	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create
Course Objectives	• Students learn about types and hardness techniques of water. • Students learn how to determine TDS,COD and BOD. • Students understand about the application of Leather Chemistry. • Students shall know about the physiochemical properties of milk. • Students understand about the constituent of diary products.

UNIT	CONTENT	HOURS
I	**WATER CHEMISTRY I** Water – types of water - soft and hard water – hardness, degree of hardness - Reverse osmosis and ion exchange methods – principles and techniques.	**6 Hrs**
II	**WATER CHEMISTRY II** Water Analysis - Determination of TDS, Total hardness by EDTA, BOD and COD.	**6 Hrs**
III	**LEATHER CHEMISTRY** Introduction, chief process used in leather manufacture, structure of hide and skin , leather processing – process before tannage – tanning process – vegetables tanning and chrome tanning.	**6 Hrs**
IV	**DIARY CHEMISTRY I** Milk – Definition, physiochemical properties of milk, constituents of milk, boiling, pasteurization, sterilization and homogenization.	**6 Hrs**
V	**DIARY CHEMISTRY II** Definition of creams, butter, ghee and ice creams. Milk powder – definition, need for making Powder. Principles involved in drying	**6 Hrs**

Text Books:

1. B. K. Sharma, Industrial Chemistry, 13th edition, Goel Publishing House, Reprint 2008.
2. M Mathur, Datta Roy D, Dinakar P, "Text book of Diary Chemistry", Indian council of Agricultural Research, New Delhi.

Reference Books:

1. Dilip Kumar Das, Introductory Soil Science, 1st Edition, Kalyani Publishers, Reprint 2002.
2. Lakshmanan, "Agricultural Chemistry", VV Publishers.

Web- Resources:
1. https:// www.chemistryguide.org/
2. http://chemcollective.org/home

Course Outcomes:
On completion of the course the learner will be able

CO 1: Develop an understanding about type of water.
CO 2: Experience in water analysis such as TDS, Total hardness, BOD and COD
CO 3: Expertise in Leather manufacture and processing.
CO 4: Learn about constituent physical and chemical properties of milk.
CO 5: Skills in preparation of dairy products such as butter, ghee, ice-cream.

Mapping of Course Outcomes with Programme Outcomes / Programme Specific Outcomes:

CO/PO	PO					**PSO**							
	1	2	3	4	5	1	2	3	4	5	6	7	8
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S

Semester-VI / Core Course-VIII	Organic Chemistry-II	Course Code:
Instruction Hours : 6	Credits: 6	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 – Creating**
Course Objectives	This course aims at providing knowledge on • classification, isolation and discussing the properties of alkaloids and terpenes. • Preparation and properties of saccharides. • Different molecular rearrangement. • Preparation and properties of organometallic compounds. • principles of green chemistry

UNIT	CONTENT	HOURS
I	**Alkaloids** Classification, isolation, general properties – Hofmann Exhaustive Methylation; Structure elucidation – Coniine, piperine, nicotine. **Terpenes:** Classification, Isoprenerule, isolation and structural elucidation of Citral, α - terpineol, Menthol, Geraniol and Camphor.	**18 Hrs**
II	**Carbohydrates** Definition and Classification of Carbohydrates with examples. Determination of configuration. Definition of enantiomers, diastereomers, epimers and anomers with suitable examples. **Monosaccharides** – configuration – D and L hexoses – aldohexoses and ketohexoses. Glucose, Fructose – Occurrence, preparation, properties, reactions, structural elucidation and uses. Interconversions of sugar series – ascending, descending, aldose to ketose and ketose to aldose. **Disaccharides** – sucrose, lactose, maltose - preparation, properties and uses (structural elucidation not required). **Polysaccharides** – Source, constituents and biological importance of homopolysaccharides – starch and cellulose.	**18 Hrs**

III	**Molecular rearrangements** Molecular Rearrangement: Types of rearrangements, Mechanism for Benzidine, Favorskii, Clasien, Fries, Hofmann, Curtius, Schmidt, Beckmann, Pinacol - pinacolone and dienone – phenol rearrangement.	**18 Hrs**
IV	**Special reagents in organic synthesis** DCC, DIBAL, DMAP, NBS / NCS, PCC **Organometallic compounds in Organic Synthesis** Preparation, Properties and applications: Grignard Reagents, Organo Lithium Compounds, Ziegler – Natta, Wilkinson, Metal Carbonyl, Zeiss's Salt.	**18 Hrs**
V	**Green Chemistry** Principles, chemistry behind each principle and applications in chemical synthesis. Green reaction media – green solvents, green reagents and catalysts; tools like microwave and ultra - sound in chemical synthesis.	**18 Hrs**

Text Books:

1. M. K. Jain, S. C. Sharma, Modern Organic Chemistry, Vishal Publishing, 4th reprint, 2009.
2. S. M. Mukherji, and S. P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan India Ltd., 3rd edition, 2009
3. Arun Bahl and B. S. Bahl, Advanced organic chemistry, New Delhi, S. Chand & Company Pvt. Ltd., Multi colour edition, 2012.
4. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, Sultan Chand & Sons, New Delhi, 29th edition, 2007.
5. C Bandyopadhya; An Insight into Green Chemistry; Published on 2020.

Reference Books:

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, Pearson Education, Asia, 6th edition, 2012.
2. T. W. Graham Solomon, Organic Chemistry, John Wiley & Sons, 11th edition, 2012.
3. A. Carey Francis, Organic Chemistry, Tata Mc Graw – Hill Education Pvt. Ltd., New Delhi, 7th edition, 2009.
4. I. L. Finar, Organic Chemistry, Vol. (1&2), England, Wesley Longman Ltd, 6th edition, 2006.
5. J. A. Joule, and G. F. Smith, Heterocyclic Chemistry, Wiley, 5th Edition, 2010.

Web-Resources:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in
4. Virtual Textbook of Organic Chemistry.

Course Outcomes:

On completion of the course the learner will be able

CO 1: The importance of alkaloids and terpenoids.

CO 2: The classification, properties, structure and configuration of mono, di and polysaccharides

CO 3: Predicting the molecular rearrangements with its types and mechanism.

CO 4: To use reagents in organic synthesis.

CO 5: Apply the knowledge of green reagents in organic synthesis

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

Semester- VI/ Core Course - IX	Physical Chemistry -II	Course Code:
Instruction Hours : 6	Credits: 6	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 – Creating**
Course Objectives	The course aims at providing an overall view of the • Phase diagram of one and two component systems. • Colligative properties and separation techniques for binary liquid mixtures. • Electrical conductance and transport number. • Galvanic cells and significance of electrochemical series. • Measurement of EMF and industrial component.

UNIT	CONTENT	HOURS
I	**Phase rule** Definition of terms; derivation of phase rule; application to one component systems – water and sulphur- super cooling, sublimation; two component systems – solid liquid equilibria - simple eutectic (lead –silver and bismuth-cadmium), freezing mixtures (potassium iodide - water), compound formation with- congruent melting points (magnesium – zinc and ferric chloride – water system), peritectic Change (sodium – potassium), solid solution (gold - silver); copper Sulphate – water system.	**18 Hrs**
II	**Colligative properties & Binary liquid mixtures** Relative lowering of vapour pressure, osmosis, law of osmotic pressure, derivation of elevation of boiling point and depression of freezing point. Determination of molecular masses using colligative properties. Abnormal molecular masses, molecular dissociation – degree of dissociation – molecular association. **Binary liquid mixtures** Ideal liquid mixtures – non ideal solutions – azeotropic mixtures – Fractional distillation – partially miscible mixtures – phenol - water, Triethylamine - water, nicotine – water – effect of impurities on critical solution temperature; immiscible liquids – steam distillation; Nernst Distribution law – applications.	**18 Hrs**
III	**Electrical Conductance and Transference** Arrhenius theory of electrolytic dissociation – Ostwald's dilution law, limitations of Arrhenius theory ; behavior of strong electrolytes–inter ionic effects – Debye Huckel theory – Onsager equation (no derivation), significance of Onsager equation, Debye Falkenhagen effect, Wien effect. Ionic mobility – Discharge of ions on electrolysis (Hittorf's theoretical device), transport number – determination –Hittorf's method, moving boundary method – factors affecting transport number–determination of ionic mobility ; Kohlrausch's law -applications; molar ionic conductance and	**18 Hrs**

	viscosity (Walden's rule); applications of conductance measurements.	
IV	**UNIT IV** : **Galvanic Cells and Applications** Galvanic cell, representation, reversible and irreversible cells, EMF and its measurement – standard cell; relationship between electrical energy and chemical energy; sign of EMF and spontaneity of a reaction, Thermodynamics and EMF–calculation of ΔG, ΔH, and ΔS from EMF data; reversible electrodes, electrode potential, standard electrode potential, primary and secondary reference electrodes,Nernst equation for electrode potential and cell EMF; types of electrodes – metal/metal ion, metal amalgam / metal ion, metal, insoluble salt / anion, gas electrode, redox electrode; electro chemical series – applications of electrochemical series. Chemical cells with and without transport, concentration cells with and without transport.	**18 Hrs**
V	**UNITV : Applications of EMF measurements** Applications of EMF measurements – determination of activity coefficient of electrolytes, transport number, valency of ions, solubility product, pH using hydrogen gas electrode, quinhydrone electrode and glass electrode, potentiometric titrations – acid base titrations, redox titrations, precipitation titrations, ionic product of water and degree of hydrolysis; redox indicators – use of diphenylamine indicator in the titration of ferrous iron against dichromate. **Industrial component** Galvanic cells - lead storage, Ni - Cd, Li and Zn - air, Al - air batteries Fuel cells – H_2 - O_2 cell – efficiency of fuel cells Corrosion – mechanism, types and methods of prevention.	**18 Hrs**

Text Books:

1. B.R. Puri and L.R. Sharma, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., Forty eighth edition, 2021.
2. Peter Atkins, and Juliode Paula, James Keeler, Physical Chemistry, Oxford University press, International eleventh edition, 2018.
3. Arun Bahl, B.S. Bahl, G.D. Tuli, Essentials of physical chemistry, 28th edition 2019, S.Chand & Co.
4. S.K. Dogra and S. Dogra, Physical Chemistry through Problems : New Age International, fourth edition,1996.
5. J.Rajaram and J.C. Kuriacose, Thermodynamics, ShobanLal Nagin Chand and CO. 1986.

Reference Books:

1. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan India Ltd, third edition, 2009.
2. Gilbert.W.Castellen, Physical Chemistry, Narosa Publishing House, third edition,1985.
3. P.W. Atkins and Juliode Paula, Physical Chemistry, Oxford University press, seventh edition, 2002
4. B.R. Puri, L.R.Sharma and M.S.Pathania, Principles of Physical Chemistry, Shoban lal Nagin Chand and Co.Jalendhar, forty first,edition,2001
5. D.N. Bajpai, Advanced Physical Chemistry, S. Chand & Co.,2001

Web-Resources:

1. https://nptel.ac.in
2. ttps://swayam.gov.inhttps://archive.nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_07_m.pdf
3. Thermodynamics-NPTELhttps://www.youtube.com/watch?v=f0udxGcoztE
   Introduction to chemical equilibrium – MIT open courseware

Course Outcomes:

On completion of the course the students should be able to

CO1: Construct the phase diagram for one component and two component systems.

CO2:. Identify an appropriate distillation method for the separation of binary liquid mixtures

CO3:. Explain the significance of Arrhenius theory, Debye-Huckel theory, Onsager equation and Kohlrausch's law.

CO4: Construct electrochemical cell with the help of electrochemical series and calculate cell EMF

CO5:.Demonstrate the applications of EMF and significance of potentiometric titrations, galvanic cells.

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

Semester-VI / Core Practical -V	Gravimetric Analysis, Physical Constant Determination and Spectrophotometry	Course Code:
Instruction Hours : 3	Credits: 3	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 – Creating**
Course Objectives	The course aims at providing an overall view of the • Techniques of gravimetric analysis. • Determination of physical constant of compounds • Techniques of Spectrophotometry

CONTENT

GRAVIMETRIC ANALYSIS:

1. Estimation of Lead as lead chromate.
2. Estimation of Barium as barium chromate.
3. Estimation of Nickel as Nickel - DMG complex.
4. Estimation Lead as Lead sulphate
5. Estimation of Barium as barium sulphate

DETERMINATION OF PHYSICAL CONSTANTS

Determination of boiling /melting points by semimicro method.

SPECTROPHOTOMETRY ANALYSIS

1.Determination of Nickel as Nickel-DMG Complex
2.Determination of Iron as Iron(III) thiocyanate
3.Determination of Mg by EBT-Method

GROUP EXPERIMENTS

One pot microwave synthesis 2,3-diphenyl quinoxaline and dibenzalpropanone.

Text Books:

1.Venkateswaran V, Veeraswamy R., Kulandaivel A.R., "Basic Principles of Practical Chemistry", 2nd edition, Sultan chand & sons, (1997)
2. Furniss, B.S., et al., " Vogel's textbook of Practical Organic Chemistry", 7th edition, ELBS, London (1984).

Web Resources:

1. http://www.vlab.co.in/index.php

Course Outcomes:

On completion of the course the students should be able to

CO1: learn the principles of gravimetric analysis

CO2:. learn the determination of physical constants of organic compounds

CO3: know the techniques of spectrophotomteric analysis

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	S	S	M	S	S	S

Semester- VI / Core Course X	**Project**	**Course Code:**
Instruction Hours : 3	**Credits: 3**	**Exam Hours: -**
Internal Marks: 25	**External Marks: 75**	**Total Marks: 100**

Semester-VI/ Discipline Specific Elective - II	Fundamentals of Spectroscopy	Course Code:
Instruction Hours : 3	Credits: 3	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 – Creating**
Course Objectives	This course is designed to provide knowledge on • Electrical and magnetic properties of organic and inorganic compounds. • Basic principles of UV - Visible spectroscopy. • Basic principle and instrumentation of infrared spectrometry • Basic principle and instrumentation of NMR spectrometry. • Basic principle and instrumentation of mass spectrometry.

UNIT	CONTENT	HOURS
I	**Microwave spectroscopy** Rotation spectra – diatomic molecules (rigid rotator approximation) selection rules – determination of bond length, effect of isotopic substitution – instrumentation and applications	**9 Hrs**
II	**Ultra violet and Visible spectroscopy** Electronic spectra of diatomic molecules (Born Oppenheimer approximation) – rotational fine structure of electronic vibration transitions – Frank Condon principle – dissociation in electronic transitions – pre-dissociation transition – Types of transitions. Applications of UV – Woodward – Fieser rules as applied to conjugated dienes and α, β – unsaturated ketones. Elementary Problems.	**9 Hrs**
III	**Infrared spectroscopy** Selection rules, vibrations of polyatomic molecules– stretching and bending vibrations (example : Water, carbon – di - oxide – applications – determination of force constant, moment of inertia and internuclear distance – isotopic shift –application of IR spectra to simple organic and inorganic molecules – (group frequencies)	**9 Hrs**
IV	**Nuclear magnetic resonance spectroscopy:** NMR – theory of NMR – instrumentation – number of signals – chemical shift– peak areas and proton counting – spin-spin coupling – Applications, shielding and deshielding of protons, chemical shifts of protons in hydrocarbons, and in simple mono functional organic compounds	**9 Hrs**
V	**Mass spectrometry** Principle – different kinds of ionization – instrumentation – the mass spectrum – types of ions – determination of molecular formula - fragmentation and structural elucidation – McLafferty rearrangement; Retro Diels Alder reaction	**9 Hrs**

	– illustrations with simple organic molecules.	

Text Books:

1. Gopalan, R.; Subramaniam, P. S.; Rengarajan, K. *Elements of Analytical Chemistry*; S Chand: New Delhi, 2003.
2. Usharani, S. *Analytical Chemistry*, 1st ed.; Macmillan: India, 2002.
3. Banwell, C. N.; McCash, E. M. *Fundamentals of Molecular Spectroscopy*, 4th ed.; Tata McGraw Hill, New Delhi, 2017.
4. U. N. Dash, Analytical Chemistry Theory and Practice, Sultan Chand & Sons, 2nd Ed., 2005
5. B. K. Sharma, Spectroscopy, 22nd ed., Goel Publishing House, 2011.

Reference Books:

1. Sriva stava, A. K.; Jain, P. C. *Chemical Analysis an Instrumental Approach*, 3rd ed.; S. Chand, New Delhi, 1997.
2. Robert D Braun. *Introduction to Instrumental Analysis*; Mc. Graw Hill: New York, 1987.
3. Skoog, D. A.; Crouch, S. R.; Holler, F.J.; West, D. M. *Fundamentals of Analytical Chemistry*, 9th ed.; Harcourt college Publishers: USA, 2013.
4. Madan, R. L.; Tuli, G. D. *Physical Chemistry*, 2nd ed.; S. Chand: New Delhi, 2005.
5. Puri, B. R.; Sharma, L. R.; Pathania, M. S. *Principles of Physical Chemistry*, 43rd ed.; Vishal Publishing: Delhi, 2008.

Web-Resources:

1. http://vallance.chem.ox.ac.uk/pdfs/SymmetryLectureNotes2004.pdf
2. http://chemistry.rutgers.edu/undergrad/chem207/SymmetryGroupTheory.html
3. www.epgpathshala.nic.in
4. www.nptel.ac.in
5. http:/swayam.gov.in

Course Outcomes:

On completion of the course the students should be able to

CO1: explain electrical and magnetic properties of materials and microwave spectroscopy
CO2: apply selection rules to understand spectral transitions, explain Woodward – Fieser's rule for the calculation of wavelength maximum of conjugated dienes
CO3: explain theory, instrumentation and applications of Infrared spectroscopy
CO4: explain theory, instrumentation and applications of NMR spectroscopy
CO5: explain theory, instrumentation and applications of Mass spectrometry

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	M
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

Semester-VI / Discipline Specific Elective - III	Inorganic Chemistry-II	Course Code:
Instruction Hours : 4	Credits: 3	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	The course aims to provide knowledge on • Trace elements and their role in the biological system. • Iron transport and storage • Metallo enzymes, oxygen transport. • Silicates and their applications • Industrial applications of refractories, alloys, paints and pigments.

UNIT	CONTENT	HOURS
I	**Bioinorganic Chemistry** Essential and trace elements: Role of Na^+, K^+, Mg^{2+}, Ca^{2+}, Fe^{3+}, Cu^{2+} and Zn^{2+}in biological systems. Effect of excess intake (Toxicity) of Metal ions – trace elements - As, Cd, Pb, Hg.	**12 hrs**
II	**Metal ion transport and storage** Iron – storage, transport – Transferrin and Ferretin; Iron – porphyrins – myoglobin, haemoglobin – oxygen transport –Bohr effect ; Sodium / potassium pump, calcium pump; transport and storage - Copper and Zinc.	**12 hrs**
III	**Metalloenzymes** Isomerase and synthetases, structure of cyanocobalamin (Vitamin B_{12}),nature of Co-C bond; Metalloenzymes – functions of carboxy peptidase A, zinc metalloenzyme – mechanism and uses, Zn-Cu enzyme - structure and function, carbonic anhydrase, Vitamin B_{12} as transferase and isomerase – Iron – sulphur proteins - 2Fe - 2S – rubredoxin, 4Fe-2S – ferridoxin, Iron sulphur cluster enzymes. Invivo and Invitro nitrogen fixation – biological functions of nitrogenase and molybdo enzymes.	**12 hrs**
IV	**Silicates** Introduction – general properties of silicates, structure –types of silicates – ortho silicates (zircon), pyro silicates (thortveitite), chain silicates (pyroxenes), ring silicates (beryl), sheet silicates (talc, mica, asbestos), silicates having three dimensional structure (feldspars, zeolites, ultramarines)	**12 hrs**
V	**Industrial Applications of Inorganic Compounds** Refractories, pyrochemical, explosives. Alloys, Paints and pigments – requirements of a good paint; classification, constituents of paints – pigments, vehicles, thinners, driers, extenders, anti-skinning agents, plasticizers, binders - application; varnishes - oils, spirit; enamels. Nano composite Hydrogels: synthesis, characterization and uses.	**12 hrs**

Text Books:

1. Puri B R, Sharma L R, Kalia K C (2011), Principles of Inorganic Chemistry, 31th ed., Milestone Publishers & Distributors, Delhi.
2. Satya Prakash, Tuli G. D., BasuS. K., Madan R. D. (2009), Advanced Inorganic Chemistry, 18th Edition, S. Chand & Co., New Delhi
3. Lee J D, (1991), Concise Inorganic Chemistry, 4th ed., ELBS William Heinemann, London.
4. W V Malik, G D Tuli, R D Madan, (2000), Selected Topics in Inorganic Chemistry, S. Chand and Company Ltd.
5. A. K. De, Textbook of Inorganic Chemistry, Wiley East Ltd, seventh edition, 1992.

Reference Books:

1. Madan R D, Sathya Prakash, (2003), Modern Inorganic Chemistry, 2nd ed., S. Chand and Company, New Delhi.
2. Gopalan R, (2009) Inorganic Chemistry for Undergraduates, Ist Edition, University Press (India) Private Limited, Hyderabad.
3. Sivasankar B, (2013) Inorganic Chemistry. Ist Edition, Pearson, Chennai.
4. Alan G. Sharp (1992), Inorganic Chemistry, 3rd Edition, Addition - Wesley, England.
5. Peter Atkins, Tina Overton, Jonathan Rourke and Mark Weller, Inorganic Chemistry, Oxford University Press, sixth edition, 2014.

Web-Resources:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in

Course Outcomes:

On completion of the course the students should be able to

CO1: ability to explain the importance of tracer elements on biological system.

CO2: explain the metal ion transport, Bohr effect, Na, K, Ca pump.

CO3: explain the function of Vitamin B12, Zn – Cu enzyme, ferredoxin, cluster enzymes.

CO4: classification and structure of silicates.

CO5: explain the manufacture of refractories, explosives, paints and pigments.

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

Semester- VI / Ability Enhancement Course - III	Agricultural Chemistry	Course Code:
Instruction Hours : 2	Credits: 2	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	This course aims to providing the students 1. Students learn about the composition of soil. 2. Students understand the properties of soil. 3. Students understand the source and properties of Micronutrient fertilizer. 4. Students study about the pest management and its control. 5. Students know the chemistry of Fungicide, Herbicide and Acaricide.

UNIT	CONTENT	HOURS
I	**COMPOSITION AND PROPERTIES OF SOIL** Definition of soil – soil composition. Soil Physical Properties - soil texture and structure, soil air, soil temperature, soil water. Soil chemical properties – soil colloids – Inorganic colloids – clay minerals – amorphous – organic colloids – significance on soil fertility, soil reaction .	**6 Hrs**
II	**MICRONUTRIENT FERTILIZER** Secondary and micronutrient fertilizers – complex and mixed fertilizers – sources, manufacture, properties and reactions in soils.	**6 Hrs**
III	**GREEN MANURE** Green manures – green leaf manure – bulky organic and concentrated organic manures – compost –composting of coir pith; sugarcane trash, leaf litters and farm wastes – oil cakes, bone meal, fish meal, guano poultry manures - fertilizer use efficiency – integrated nutrient management.	**6 Hrs**
IV	**PEST MANAGEMENT & CONTROL** Pesticides, classification of pesticides – mode of action – characteristics – uses and safety measures in the analysis and handling of pesticides. Insecticides. Inorganic Pesticides – borates. Organic pesticides – organ chlorine compounds – D.D.T. structure and mode of action.	**6 Hrs**
V	**FUNGICIDES,HERBICIDES & ACARICIDES** Fungicides – inorganic – sulphur compounds – Boredeaux mixture. Herbicides : Inorganic herbicides – Arsenical compounds - Organic herbicides - Nitro-compounds – urea . Acaricides – Rodenticides – Attractance – Repellants – Fumigants Defoliants.	**6 Hrs**

Text Books:

1. N.C. Brady, The nature and properties of soils Eurasia publishing house, (P) Ltd. 9th Ed. 1984.
2. Colling G.H., Commercial Fertilizers McGraw publishing house., 1955

Reference Books:

1. Biswas, T.D. and Mukeherjee S.K. Text book of soil science 1987.
2. A. J. Daji A. Text book of soil science Asia publishing house, Madras (1970).
3. Donahue, R. L. Miller, R. W. and shickluna, J. C. soils – An introduction to soils and plant Growth – Prentice Hall of India (P) Ltd., New Delhi 1987.
4. Colling G.H. , Commercial Fertilizers McGraw publishing house 1955.
5. Lakshmanan, "Agricultural Chemistry", VVPublishers.,

Web Resources:

1. http://www.chemistryguide.org/
2. http://chemcollective.org/home

Course Outcomes:

On completion of the course the students should be able to

CO1: teach about the composition of soil
CO2: explain the properties of soil
CO3: Know micronutrient of soil.
CO4: acquire knowledge about pest management and control
CO5: study about Fungicide, Herbicide and Acaricides

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	M	S	S	S	M
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

Semester-VI/ Skill Enhancement Course - IV	Fuel Chemistry	Course Code:
Instruction Hours : 2	Credits: 2	Exam Hours: 3
Internal Marks: 25	External Marks: 75	Total Marks: 100

Cognitive Level	**K1 – Recalling** **K2 – Understanding** **K3 - Applying** **K4 – Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives	The course aims to provide knowledge on • Classification of fuels. • Composition of coal and its uses. • Refining of petroleum and its products. • Properties and uses of petrochemicals. • Determination of lubricants.

UNIT	CONTENT	HOURS
I	**Review of energy sources:** Introduction, Definition of Renewable and non – renewable energy sources – Classification, characteristics of fuels and their calorific value	**6 hrs**
II	**Coal:** Uses of coal (fuel and nonfuel) in various industries, its composition, carbonizations of coal. Coal gas, producer gas and water gas – composition and uses. Proximate and ultimate analysis of coal.	**6 hrs**
III	**Petroleum :** Composition of crude petroleum, Refining different types of petroleum products and their applications. Reforming petroleum and non- petroleum fuels (LPG, CNG, LNG, bio – gas, fuels derived from biomass).	**6 hrs**
IV	**Petrochemicals:** Vinyl acetate, Propylene oxide, Isoprene, Butadiene - Preparation, Properties and Uses.	**6 hrs**
V	**Lubricants:** Classification of lubricants, properties and their determination.	**6 hrs**

Text Book:

1. Sharma, B. K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

Reference Books:

1. Stocchi, E. Industrial Chemistry, Vol – I, Ellis Horwood Ltd. UK (1990).
2. Jain, P. C. & Jain, M. Engineering Chemistry Dhanpat Rai & Sons, Delhi. 75

Course Outcomes:
On completion of the course the learner will be able

CO1: Review the energy sources.
CO2: Applications of coal.
CO3: Learn about refining of petroleum.
CO4: Know about the Petrochemicals.
CO5: Understand the Properties of lubricants.

Mapping of Course Outcomes with Programme Outcomes / Programme Specific Outcomes:

CO/PO	PO					**PSO**							
	1	2	3	4	5	1	2	3	4	5	6	7	8
CO1	S	S	M	S	S	S	S	S	M	S	S	S	S
CO2	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	M	S	S	S	S
CO4	S	S	S	M	S	S	S	S	M	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S