



**Sarvodaya Kelavani Samaj managed,
Shri Manibhai Virani and Smt. Navalben Virani Science College
(Autonomous)**

(Affiliated to Saurashtra University, Rajkot)

Re-Accredited at 'A' Level by NAAC

STAR college Scheme & Status by MST-DBT

UGC-College with Potential for Excellence (CPE)

UGC-DDU KAUSHAL Kendra

GAAA –Grade A-1 by KCG, Government of Gujarat

GPCB-Government of Gujarat approved Environment Audit Center

Nodal Center for capacity building by GSBTM

**Department of Chemistry
Syllabi for Semester III**

Department of Chemistry

Discipline Specific Core

For the students admitted from A.Y. 2021-2022 & onwards

Offering Department: Chemistry	Offered to: B.Sc. Chemistry	
Semester - III		
Course Code	Course Title	Course Credit and Hours
	Core-5: Inorganic Chemistry (Ad)	4 Credits - 4 hrs/wk

Course Description:

This course involves knowledge of inorganic chemistry. It includes an overview of quantum chemistry & calculates microstates, ground state of spectral terms and pigeonhole diagram of multi electron system. It also includes the theoretical principles of magneto chemistry & classification, synthesis, chemical properties and important applications of organometallic compounds. This course also reinforces the basic concept of Crystal Field Theory and extension of Crystal Field Theory. The course aims to address SDG No-4 & 9: Quality Education & Industry, Innovation and Infrastructure.

Course Purpose:

This course aims to provide elementary concept of wave mechanics. Students will be able to calculate microstates and find out ground state spectral terms of multi electron system. This course is outline in such a way that students will able to understand preparations, properties and their applications of organometallic compounds and also they can understand the phenomena of magnetism, types of magnetism and Gouy's method. Also students can understand the magnetic behaviour of transition metal complex, splitting of d- orbital and Orgel diagrams. This course is necessary to provide slightly advanced knowledge of inorganic chemistry and its important applications to student in the field of chemistry.

Course Outcomes: Upon completion of this course, the learner will be able to

CO No.	CO Statement	Blooms taxonomy Level (K ₁ to K ₆)
CO ₁	Understand the principle, theory and instrumentation of quantum chemistry.	K ₁ , K ₂
CO ₂	Calculate microstate and ground state spectral term of multi electron system.	K ₃ , K ₄
CO ₃	Remember basic idea of magneto chemistry and understand the properties of organometallic compound.	K ₁ , K ₂

CO ₄	Identify, interpret and evaluate the concepts of crystal field theory	K1, K3
CO ₅	Classify and apply knowledge of crystal field theory.	K3, K4

Course Content:	Hours
Unit-I : Introduction to Quantum Chemistry	14 hrs
<ul style="list-style-type: none"> • Introduction of wave mechanics • Operators, Algebra of operators: Addition and subtraction, Multiplication of operators • Communicative properties: Linear operator, Communicator of operators, Laplacian operator, Momentum operator, Hamiltonian operator • Particle in one dimensional box • Wave function and energy of particle in one dimension box • Energy levels, normalization of Ψ and orthogonality of Ψ • Characteristics of wave function • Utility of the particle in a box model • Particle in three dimensional box • Degeneracy • Wave function and energy for a particle moving in a rectangular box • Wave equation for a hydrogen atom • Separation of variables • Numerical 	
Unit-II: Multi Electron System	12 hrs
<ul style="list-style-type: none"> • Concept of spectral terms and term symbols • S-S coupling, L-L coupling, L-S coupling, J-J coupling and L-S coupling with vector diagram • Derivation of spectral term symbol for p^1, p^2, p^3 and d^1 to d^9 • Microstates: Definition, calculation and derivation of microstates for p^1, p^2, d^1 & d^2 (Pigeonhole diagram) • Hund's rules for the determination of ground state spectral term 	
Unit- III: Magneto Chemistry and Organometallic Compounds	13 hrs
<p>Magneto Chemistry</p> <ul style="list-style-type: none"> • Introduction of magneto chemistry • Magnetic induction • Permeability, Intensity of Magnetism, Magnetic susceptibility, Molar magnetic susceptibility • Magnetic behaviour: Diamagnetism, Paramagnetism, Ferromagnetism and Anti ferromagnetism 	

<ul style="list-style-type: none"> • Effect of temperature on magnetic behaviour of substances • Derivation of equation for total angular magnetic momentum and diamagnetic momentum • Determination of magnetic susceptibility by Gouy's method • Applications of magneto chemistry <p>Organometallic Compounds</p> <ul style="list-style-type: none"> • Introduction of Organometallic Compounds (OMC) • Classification based on nature of M-C Bond • Trans effect for Isomerism in OMC, Effective Atomic Number (EAN) rules & Numerical • Preparation, properties and uses of organolithium (Ph-Li & Bu-Li), organomagnesium (Grignard reagent), organocopper (Gilman reagent), organoaluminium (Ziegler-Natta) 	
Unit- IV: Basic of Crystal Field Theory	9 hrs
<ul style="list-style-type: none"> • Introduction and concept of crystal field theory (CFT) • Splitting of d-orbital in octahedral and tetrahedral crystal field with Crystal Field Stabilization Energy (CFSE) concept • Factors affecting splitting energy • Weak field and strong field ligand • High spin and low spin complexes with pairing energy • Magnetic behaviour of transition metal complexes • Orbital angular momentum contribution to magnetic momentum of complexes • Examples based on CFSE, Pairing energy and magnetic momentum 	
Unit- V: Extension of Crystal Field Theory	12 hrs
<ul style="list-style-type: none"> • Jahn-Teller effect: Statement and explanation • Tetragonal distortion with example • Splitting of d-orbital in square planar complexes with examples • Hole formalism • Splitting of d and f ground terms (using Hole formalism) • Orgel Diagram of d and f states • Selection rules for d-d transition • Types of electronic transition in metal complexes • Application of Orgel Diagram (Spectra of some complexes) 	

Pedagogic Tools:

- Chalk and Talk
- PPT and Videos
- Assignment
- Seminar

Text Books:

1. Puri, B. R.; Sharma, L. R. & Kalia, K. C. (2010-11) *Principles of Inorganic Chemistry*. New Delhi : Milestone (ISBN No. 978-8192143330)
2. Mehrotra, R. C. (2007). *Organometallic chemistry*. New Age International.

Reference Books:

1. Madan, R. L. (2011) *Chemistry for degree student First year*. New Delhi: S. Chand (ISBN: 81-219-3230-0).
2. Lee, J. D. (2002, Fifth edition) *Concise Inorganic Chemistry*. Hoboken: Wiley-Blackwell Science Ltd. (ISBN: 0-632-05293-7).
3. Peter Atkins, Tina Overton, Jonarthan Rourke, Mark Weller & Fraser Armstrong (2010, Fifth edition) *Inorganic Chemistry*. Oxford: Oxford University Press (ISBN: 978-0-19-959960-8).

Suggested reading / E-resources:

- [https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry_\(Petrucci_et_al.\)/08%3A_Electrons_in_Atoms/8.06%3A_Wave_Mechanics](https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry_(Petrucci_et_al.)/08%3A_Electrons_in_Atoms/8.06%3A_Wave_Mechanics)
- [https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_\(Physical_and_Theoretical_Chemistry\)/Spectroscopy/Electronic_Spectroscopy/Spin-orbit_Coupling/Atomic_Term_Symbols](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Electronic_Spectroscopy/Spin-orbit_Coupling/Atomic_Term_Symbols)
- <http://www.chem.ucalgary.ca/courses/350/Carey5th/Ch14/ch14-0.html>
- [https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_\(Inorganic_Chemistry\)/Crystal_Field_Theory/Crystal_Field_Theory](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_(Inorganic_Chemistry)/Crystal_Field_Theory/Crystal_Field_Theory)

Suggested MOOCs:

1. https://swayam.gov.in/nc_details/NPTEL

Methods of Assessing the Course Outcomes

Components of CIA: 40 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 st 2 nd units	1 ^{1/2} hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			10	20
C	Class activity			10	
Grand Total					40
Assignment		<ul style="list-style-type: none">• Abstract and executive summary• Case study writing• Concept mapping• Student generated handbook• Essay writing etc...			
Class activity		<ul style="list-style-type: none">• Presentation (PPT, Poster, Chart)• Seminar• Quiz• Model Making• Think Pair Share• Free writing• Class test• Debate/ Group Discussion• Open Book Test• Class test			

Note: Any other assessment tools or methods can be adopted as per requirement of the course.

Department of Chemistry

Discipline Specific Core

For the students admitted from A.Y. 2021-2022 & onwards

Offering Department: Chemistry	Offered to: B.Sc. Chemistry	
Semester - III		
Course Code	Course Title	Course Credit and Hours
	Core-6: Analytical Chemistry(Ad)	4 Credits - 4hrs/wk

Course Description:

This course gives an introduction to analytical chemistry and an overview of important analytical methods and their applications. It also teaches important analytical quantitative techniques like electrochemical methods, spectrophotometric methods, and separation techniques. The course also includes theory on sampling, analysis of samples and procedures in analytical Chemistry.

Course Purpose:

This course is designed to understand various solvent extraction methods, concept of EMF, types of cell and EMF series. Students will be able to understand the conductometric titration and its applications. This course analysed and described optical activity & optical isomerism. It also helps to study the principles and applications of electro analytical methods like polarography, refractometry and flame photometry.

Course Outcomes: Upon completion of this course, the learner will be able to

CO No.	CO Statement	Blooms taxonomy Level(K ₁ to K ₆)
CO ₁	Learn separation by solvent extraction & fuel analysis techniques	K ₁ , K ₃
CO ₂	Able to differentiate volumetric analysis with known electrochemical cells	K ₂ ,K ₃
CO ₃	Understand the electro analytical methods	K ₃
CO ₄	Summarize the knowledge about various Opto-analytical	K ₄
CO ₅	Understand and compare theory with practical the knowledge of polarimeter in polarography	K ₄

Course Content:	Hours
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Unit-I: Separation Involving Solvent Extraction	12hrs
<ul style="list-style-type: none"> • Introduction, and types of separation process • Separation by precipitation • Separation based on control of acidity • Sulphide separations • Precipitant: Organic and inorganic • Separation of constituents present in trace amounts • Separation by electrolytic precipitation • Applications of extraction procedures • Numericals • Ion exchange separation 	
Unit-II: EMF and Polarography	12hrs
<p>EMF</p> <ul style="list-style-type: none"> • Introduction: Electrochemistry, electrochemical cell, electrolytes, oxidation, reduction, anode, cathode, half-cell, cell potential, concentration cell • Types of reversible and irreversible cell • Nernst equation and its applications • Calculation of equilibrium constant • EMF series • Relation among G, H and K • Types of electrodes and uses • Numericals <p>Polarography</p> <ul style="list-style-type: none"> • Introduction, principle, instrumentation, working & calibration, • Factors affecting the limiting currents, cells, forms of waves and half wave potentials, applications. 	
Unit- III: Conductometry	14hrs
<p>Conductometry</p> <ul style="list-style-type: none"> • Electric transport, conductance in metals and in electrolyte solution • Specific conductance, equivalent conductance • Importance of conductivity electrodes and platinization of electrodes • Variation of specific conductance with dilution as well as area of cross section of dip type electrode and distance between two plates of electrodes etc. • Kohlrausch law and its importance, cell constant and its importance • Conductometric titration: <ul style="list-style-type: none"> ➤ Strong acid-strong base, strong acid-weak base, weak acid-strong base, weak acid-weak base, mixture of strong acid + weak acid-strong base ➤ Precipitation titration: $\text{AgNO}_3\text{-NaCl}$, $\text{BaCl}_2\text{-K}_2\text{SO}_4$, $\text{Ba(OH)}_2\text{-MgSO}_4$ 	

<ul style="list-style-type: none"> ➤ Replacement titration: Salt of weak acid-strong acid, salt of weak base-strong base • Degree of hydrolysis and hydrolysis constant • Determination of solubility and solubility product of sparingly soluble salt, for the measurement of conductivity • Applications • Numericals 	
Unit- IV: Polarimetry and Colorimetry	12hrs
<p>Polarimetry</p> <ul style="list-style-type: none"> • Introduction of polarimetry • Plane polarized light • Theory of optical activity • Types of molecules analysed by polarimeter • Polarimeter: Instrumentation, working principle, calibration & application <p>Colorimetry</p> <ul style="list-style-type: none"> • Introduction, Instrumentation, working principle & calibration • Growth Draper law, Lambert's Law, Beer's Law, Lambert's-Beer's Law and derivation, application and deviation from Lambert's Law • Spectrophotometric titration with graph and proper explanation <ul style="list-style-type: none"> ➤ Deficiency of absorbance by product and titrant ➤ Deficiency of absorbance by product and reagent ➤ Deficiency of absorbance by reagent and titrant ➤ Deficiency of absorbance by product only • Numericals 	
Unit- V: Refractometry and Flame Photometry	10hrs
<p>Refractometry</p> <ul style="list-style-type: none"> • Introduction of refractometry • Abbe refractometer: instrumentation, working & calibration • Optical exaltation • Applications <p>Flame Photometry</p> <ul style="list-style-type: none"> • Introduction, • General principles of flame photometry • Instrumentation, working & calibration • Effect of solvent in flame photometry • Interferences in flame photometry • Limitations of flame photometry • Applications 	

Pedagogic Tools:

- Chalk and Talk
- PPT and Videos.
- Assignment
- Group discussion
- Seminar

Text Books:

1. Sharma, B. K. (2014) Instrumental Method of Chemical Analysis. Meerut: GOEL publishing House (ISBN: 978-81-8283-099-8).

Reference Books:

1. Douglas A. Skoog, West, Holler, Crouch (2004, Eighth edition) Fundamental of Analytical Chemistry. Mexico: Thomson-Brooks/Cole (ISBN: 81-315-0051-9).
2. Bahl, Arun; Bahl, B. S.; Tuli, G. D. (2010) Essential of Physical Chemistry. New Delhi : S. Chand (ISBN No. 81-219-2978-4)
3. Christian, Gary D.; Dasgupta, Purnendu K.; Schug, Kevin A. (2007, Sixth edition) Analytical Chemistry. Hoboken: Wiley-Blackwell Science Ltd. (ISBN: 978-81-265-1113-6).

Suggested reading / E-resources:

- https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004032250571287punit_phy_Polarimetry
- https://www.academia.edu/38341837/Lab_12_Refractometry_doc
- <https://www.vedantu.com/chemistry/polarography>
- <https://blog.hunterlab.com/blog/color-and-appearance-theory/spectrophotometer-vs-colorimeter-whats-the-difference/>

Suggested MOOCs:

1. https://swayam.gov.in/nc_details/NPTEL

Methods of assessing the course outcomes

Components of CIA: 40 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 st 2 nd units	1 ^{1/2} hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			10	20
C	Class activity			10	
Grand Total					40
Assignment		<ul style="list-style-type: none">• Abstract and executive summary• Case study writing• Concept mapping• Student generated handbook• Essay writing etc...			
Class activity		<ul style="list-style-type: none">• Presentation (PPT, Poster, Chart)• Seminar• Quiz• Model Making• Think Pair Share• Free writing• Class test• Debate/ Group Discussion• Open Book Test• Class test			

Note: Any other assessment tools or methods can be adopted as per requirement of the course.

Department of Chemistry

Discipline Specific Core		
For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: Chemistry	Offered to: B.Sc. Chemistry	
Semester - III		
Course Code	Course Title	Course Credit and Hours
	Core-7: Petrochemicals and Polymers (F)	4 Credits - 4 hrs/wk

Course Description:

This course deals with the study of the synthesis, characterization and properties of petroleum and polymer molecules. Provide an overview of the most important processes in a petroleum refinery, petrochemical industry and polymer industry. The course also discusses special purpose materials like rubber, adhesive, and especially polymer composite.

Course Purpose:

This course provides an introduction to principles and techniques of petroleum and petrochemical. It provides the basic knowledge about two most common petrochemical classes which are olefins and aromatics. This course was introduced in the curriculum in order to understand basic concepts such as crude oil, petrochemicals and polymer that are an integral part of the daily life of all of us. The aim is for students to understand and recognize the great usefulness of crude oil, petrochemicals and polymer in several basic necessities on a daily basis and activity. At the successful completion of the course, students will be able to understand the difference in various polymeric materials, rubber, adhesive and composites and how to synthesise and characterize polymers.

Course Outcomes: Upon completion of this course, the learner will be able to

CO No.	CO Statement	Blooms taxonomy Level (K ₁ to K ₆)
CO ₁	Understand and explain fundamental concept of Petroleum and describe basic terminologies of crude oil and petroleum refineries.	K ₁ , K ₂
CO ₂	Understand fundamental technology behind the refinery of petroleum and Interpret the various Processing methods of Petroleum products	K ₄ , K ₁
CO ₃	Summarize, Correlate and synthesizes various of aromatic compounds.	K ₂ , K ₄
CO ₄	Recognize fundamental theory and significance of some industrial polymer and different kind of polymers and their properties	K ₁ , K ₂

CO ₅	Illustrate properties of polymer compound through various methods of their analysis	K1, K4
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Course Content:	Hours
Unit-I : Introduction and Processing of Petroleum & Petrochemicals	12 hrs
<p>Introduction of Petroleum & Petrochemicals</p> <ul style="list-style-type: none"> • Origin and occurrence of petroleum • Classification of petroleum • Composition of petroleum • Important petroleum products <p>Processing Crude Petroleum and Petroleum Product Analysis</p> <ul style="list-style-type: none"> • Overview of treatment methods for petroleum desalting of petroleum • Fractional distillation of crude petroleum • Cracking, Reforming and isomerization of petroleum • Petroleum product analysis • Cuts and composition of fractional distillation 	
Unit-II: : Chemicals from C1, C2 and C3 Compounds	14 hrs
<p>Manufacturing of C1 Hydrocarbons</p> <ul style="list-style-type: none"> • Methanol, Hydrogen cyanide, Carbon disulphide <p>Manufacturing of C2 Hydrocarbons</p> <ul style="list-style-type: none"> • Ethyl chloride, Ethanol, Ethylene glycol, Ethylene oxide, Acetic acid, Styrene, Vinyl acetate <p>Manufacturing of C3 Hydrocarbons</p> <ul style="list-style-type: none"> • Isopropanol, Glycerin, Acrylonitrile, Propylene oxide 	
Unit- III: Chemicals from C4 Compounds, Aromatic Compounds and SNG Production	12 hrs
<p>Manufacturing of C4 Hydrocarbons</p> <ul style="list-style-type: none"> • Butadiene, Isobutane, Butanol, Maleic anhydride, Adipic acid <p>Aromatic Compounds, Syngas and SNG Production</p> <ul style="list-style-type: none"> • Manufacture of the BTX & Naphthalene • Linear alkyl benzenes and their sulphonates • Syngas production: By steam reforming of natural gas and naphtha and by partial oxidation of naphtha 	
Unit- IV: Chemistry of Polymer	12 hrs

<ul style="list-style-type: none"> • Introduction of polymer • Classification of polymers and polymerization • Mechanism and chemical kinetic of polymerization: Addition (chain growth) polymerization, free radical polymerization, ionic polymerization, Ziegler- Natta polymerization (Vulcanization of rubber) • Stereochemistry of polymer • Synthesis and application of polymer: HDPE, Teflon, Bachelite, Melamine, Nylone-6-6, Dextone, PHBV 	
Unit- V: Polymer Technology	10 hrs
<p>Rubber</p> <ul style="list-style-type: none"> • Introduction of natural and synthetic rubber • Synthesis, advantages, disadvantages and application of rubber: Isoprene rubber, Butadiene rubber, Styrene-butadiene rubber, Nitrile-butadiene rubber <p>Adhesive</p> <ul style="list-style-type: none"> • Introduction and classification of adhesive • Manufacturing of adhesive: Protein adhesive, starch adhesive, cellulose adhesive <p>Polymer composites</p> <ul style="list-style-type: none"> • Introduction and classification of polymer composite • Manufacturing of composites <p>Tests for mechanical properties of polymer</p> <ul style="list-style-type: none"> • Tensile strength • Flexural Strength • Compressive strength, impact resistance, flexural modulus, failure load 	

Pedagogic Tools:

- Chalk and Talk
- PPT and Videos.
- Assignment
- Group discussion

Text Books:

1. Sharma, B. K. (1997) "Industrial chemistry", Goel publishing house, 9788187224006.
2. Gowariker, V., Viswanathan N. V., Sreedhar, J., (2005), "Polymer Science", Reprint: New Age International Pvt. Ltd., ISBN: 085226-3074.
3. B.K. Bhaskar Rao " Petrochemicals" Khanna Publishers , Delhi
4. Sarkar Samir " Fuels & Combustion" 2nd Edition , Orient Longman Limited

Reference Books:

1. A.L. Waddams , “Chemicals from Petroleum ” 2nd Edition , ELBS , London
2. Crawford, R. J., “Plastic Engineering”, 3rd Edition: Elsevier, ISBN: 9780080524108.
3. McGraevy C, “Polymer Reactor Engineering”, Chapman & Hall.
4. Brydson J., “Plastic Materials”, 7th edition: Butter worth-Hienemann, ISBN: 0750641320

Suggested reading / E-resources:

- <https://nptel.ac.in/courses/103107081/17>
- <https://nptel.ac.in/courses/103107081/19>
- web.mit.edu/5.33/www/lec/poly.pdf
- <https://www.acs.org/content/acs/en/careers/college-to-career/areas-of-chemistry/polymer-chemistry.html>
- [https://polyacs.org/Polymer chemistry--hysz.nju.edu.cn/wangxl/download-polymer/Polymer% 20Chemistry %20\(Carraher\).pdf](https://polyacs.org/Polymer%20Chemistry%20(Carraher).pdf)

Suggested MOOCs:

1. https://swayam.gov.in/nc_details/NPTEL

Methods of assessing the course outcomes

Components of CIA: 40 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 st 2 nd units	1 ^{1/2} hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			10	20
C	Class activity			10	
Grand Total					40
	Assignment	<ul style="list-style-type: none">• Abstract and executive summary• Case study writing• Concept mapping• Student generated handbook• Essay writing etc...			
	Class activity	<ul style="list-style-type: none">• Presentation (PPT, Poster, Chart)• Seminar• Quiz• Model Making• Think Pair Share• Free writing• Class test• Debate/ Group Discussion• Open Book Test• Class test			

Note: Any other assessment tools or methods can be adopted as per requirement of the course.

Discipline Specific Core		
For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: Chemistry	Offered to: B. Sc. Chemistry	
Semester - III		
Course Code	Course Title	Course Credit and Hours
	Core Practical 3: Combined Practical	3 Credits - 9 hrs/wk

Course Description:

This course contains important aspects of qualitative analysis as well as quantitative analysis in chemistry through experiments. It provides the analysis of metal ion concentration in the given solution by gravimetric analysis and develop skill to synthesis and purify inorganic complexes. Its offers an opportunity to comprehend the applications of various analytical techniques like Colorimetry, Refractometry etc. which helps to know about various parameter of unknown compounds. This course deals with synthesis, characterization and properties of petroleum and polymer molecules. The course aims to address SDG No- 4 & 9: Quality education & Industry, Innovation and Infrastructure.

Course Purpose:

The Students will be able to identify radicals in mixture of inorganic salt and develop skill to prepare and purify inorganic complexes. Students will be capable to determine concentration of metal ion in the given solution by gravimetric analysis. Students will develop skill to determine the concentration of the solution by various instrumental methods. It provides an introduction to principles and techniques of petroleum and petrochemicals. Students can develop skill to synthesize some industrial polymers.

Course Outcomes: Upon completion of this course, the learner will be able to

CO No.	CO Statement	Blooms taxonomy Level (K ₁ to K ₆)
CO ₁	Identify radicals in mixture of inorganic salts.	K2
CO ₂	Determine concentration of metal ion in solution and preparation of inorganic complexes.	K2 K3
CO ₃	Understanding the Calibration and performing of different instruments and also extraction method for various organic compounds.	K2, K3
CO ₄	Understanding the scientific methods for performing and calibration of various instruments.	K2, K3
CO ₅	Understanding, planning and performing experiments for preparation of	K2, K4

<p>pure liquid A, B, C, D.</p> <ul style="list-style-type: none"> ➤ To determine specific refractivity and molecular refractivity of glycerine (10%, 5%, 2.5%) and unknown glycerine solution. ➤ To study the variation of refractive index with composition of given liquid and also determine composition of unknown mixture. <ul style="list-style-type: none"> ● Polarimetry <ul style="list-style-type: none"> ➤ To determine specific rotation of three different concentration (10%, 5%, 2.5%) of dextrose solution. From graph find out the unknown. ➤ Study the inversion rate of sugar in presence of 1 N HCl and determine the rate of reaction. ● UV-Visible Spectrophotometry <ul style="list-style-type: none"> ➤ Find λ max of given solution.(KMnO₄) ● Solvent extraction <ul style="list-style-type: none"> ➤ To extract organic compound in given mixture 	
<p>Petroleum & Polymer Techniques (12 – 15 experiment)</p>	<p>45 hrs</p>
<ul style="list-style-type: none"> ● Petroleum <ul style="list-style-type: none"> ➤ To determine the softening point of Bituminous material (Wax). ➤ To determine the kinematic viscosity of an oil sample using Redwood viscometer. ➤ To determine the kinematic viscosity of an oil sample using Saybolt viscometer. ➤ To determine flash and fire point by using Cleveland open-cup apparatus for Diesel and Kerosene ➤ To determine the % moisture present in a given sample of liquid petroleum by Dean & Stark's method. ➤ Determination of Cloud and Pour point of heavy petroleum product. ➤ To determine the density of given petroleum sample. ● Preparation of some Industrial polymers <ul style="list-style-type: none"> ➤ To prepare primary cellulose acetate from cellulose. ➤ To prepare Urea formaldehyde resin from urea. ➤ To prepare Glyptal resin. ➤ To prepare polyvinyl acetate by suspension polymerization technique. ➤ To prepare polystyrene by bulk polymerization technique. ➤ To prepare Melamine formaldehyde from melamine. ➤ To prepare polymethacrylate (PMMA) by bulk polymerisation. ➤ To prepare polysulphide rubber (Thiokol). 	

Pedagogic Tools:

- Laboratory Experiments
- Chalk and Board
- Video / Interactive E-resources

Text books:

1. AI, V. (1996). *Vogel's qualitative inorganic analysis*.
2. Polymer Science by V. R. Gowariker, N.V. Viswanathan, Jaydev Sreedhar; New Age International Publishers
3. Preliminary Qualitative Identification of Polymers by T. R. Crompton; Springer
4. Gokhale, N. S. (2008, 1st edition). *Practical finite element analysis*. Finite to infinite (ISBN: 978-8190619516).

Reference books:

1. Puri, B. R.; Sharma, L. R. & Kalia, K. C. (2017, 33rd edition) *Principles of Inorganic Chemistry*. New Delhi : Milestone (ISBN No. 978-8192143330).
2. Jeffery, G. H.; Bassett, J.; Mendham, J.; Denny, R.C. (1989) *Vogel's Textbook of Quantitative Chemical Analysis*. Hoboken: John Wiley & Sons (ISBN: 0-582-44693-7).
3. Handbook of Plastics Testing and Failure Analysis by Vishu Shah; John Wiley & Sons, Inc.
4. Handbook for the Chemical Analysis of Plastic and Polymer Additives, Second Edition by Michael Bolgar, Jack Hubball, Joseph Groeger, Susan Meronek; CRC Press; 2015
5. Waring, B; (2016, 2nd edition) *Practical Optimization of Petroleum Production Systems* (ISBN: 978-1523692323).

Suggested reading / E-resources:

1. <https://www.extension.harvard.edu/academics/courses/introduction-chemistry>
2. <https://libguides.reading.ac.uk/chemistry/e-resources>
3. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5>
4. <http://library.iiti.ac.in/>

Suggested MOOCs:

1. https://swayam.gov.in/nc_details/NPTEL

Methods of Assessment & Tools:

Components of CIA: 40 marks

Sr. No	CIA Component	Content	Duration	Marks	Total Marks
1	Test	After Completion of all Assessable Experiments	6 hrs	60 marks (3 Exercise of 20 marks)	30
2.	Observation book & Record	-	-	10	10
Total					40

Note : Any other assessment tools or methods can be adopted as per requirement of the course.

