

॥ सा विद्या या विमुक्तये ॥



स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

“ज्ञानतीर्थ” परिसर, विष्णुपुरी, नांदेड - ४३१६०६ (महाराष्ट्र)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED

“Dnyanteerth”, Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade

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संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील तृतीय वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२१-२२ पासून लागू करण्याबाबत.

परिपत्रक

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, मा. विद्याशाखेने दिनांक ३१ मे २०२१ रोजीच्या बैठकीतील केलेल्या शिफारशीप्रमाणे व दिनांक १२ जून २०२१ रोजी संपन्न झालेल्या ५१ व्या मा. विद्या परिषद बैठकीतील विषय क्र. २६/५१-२०२१च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील तृतीय वर्षाचे खालील विषयांचे C.B.C.S. (Choice Based Credit System) Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२१-२२ पासून लागू करण्यात येत आहेत.

1. B.Sc.-III Year-Biophysics
2. B.Sc.-III Year-Bioinformatics
3. B.Sc.-III Year-Biotechnology
4. B.Sc.-III Year-Biotechnology (Vocational)
5. B.Sc.-III Year-Botany
6. B.Sc.-III Year-Horticulture
7. B.Sc.-III Year-Agro Chemical Fertilizers
8. B.Sc.-III Year-Analytical Chemistry
9. B.Sc.-III Year-Biochemistry
10. B.Sc.-III Year-Chemistry
11. B.Sc.-III Year-Dyes & Drugs Chemistry
12. B.Sc.-III Year-Industrial Chemistry
13. B.C.A. (Bachelor of Computer Application)-III Year
14. B.I.T. (Bachelor of Information Technology)-III Year
15. B.Sc.-III Year-Computer Science
16. B.Sc.-III Year-Network Technology
17. B.Sc.-III Year-Computer Application (Optional)
18. B.Sc.-III Year-Computer Science (Optional)
19. B.Sc.-III Year-Information Technology (Optional)
20. B.Sc.-III Year-Software Engineering
21. B.Sc.-III Year-Dairy Science
22. B.Sc.-III Year-Electronics
23. B.Sc.-III Year-Environmental Science
24. B.Sc.-III Year-Fishery Science
25. B.Sc.-III Year-Geology
26. B. A./B.Sc.-III Year-Mathematics
27. B.Sc.-III Year-Microbiology
28. B.Sc.-III year Agricultural Microbiology
29. B.Sc.-III Year-Physics
30. B. A./B.Sc.-III Year Statistics
31. B.Sc.-III Year-Zoology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या www.srtmun.ac.in या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

‘ज्ञानतीर्थ’ परिसर,

विष्णुपुरी, नांदेड - ४३१ ६०६.

जा.क्र.: शैक्षणिक-१/परिपत्रक/पदवी-सीबीसीएस अभ्यासक्रम/
२०२१-२२/७५

दिनांक : १२.०७.२०२१.

प्रत माहिती व पुढील कार्यवाहीस्तव :

- १) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
- २) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
- ३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
- ४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
- ५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
- ६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.
- ७) अधीक्षक, परीक्षा विभाग विज्ञान व तंत्रज्ञान विद्याशाखा प्रस्तुत विद्यापीठ.

स्वाक्षरित

सहा.कुलसचिव

शैक्षणिक (१-अभ्यासमंडळ) विभाग

Swami Ramanand Teerth Marathwada University, Nanded



B. O. S. IN CHEMISTRY
B. SC. THIRD YEAR (CHEMISTRY)
SEMESTER- V & VI
CBCS Course
Effective from JUNE – 2021

Swami Ramanand Teerth Marathwada University, Nanded
Choice Based Credit System (CBCS) Course Structure
Faculty of Science
B. Sc. Third Year Syllabus
Semester Pattern effective from June 2021
Subject: Chemistry

Semester	Course No	Name of the course	Instruction Hrs/Week	Total Period	CA (Int.)	ESC (Ext.)	Total Marks	Credits
V	DSEC V (Section A)	Theory Paper-XII Organic+Inorganic Chemistry (P-XII)	03	45	10	40	50	02
	DSEC V [(Section B) Elective]	Theory Paper-XIII Physical+Inorganic Chemistry (P-XIII)- B ₁ OR (Elective Paper) Physical+Inorganic Chemistry (P-XIII) B ₂	03	45	10	40	50	02
	DSECP- IV [DSEC V & VI (Section A)]	Practicals based on P-XII & P-XIV (P-XVI)	04 04	Practicals 08 08	05 05	20 20	25 25	01 01
	DSECP III SEC III (Anyone Skill from optional)	(A) Spectroscopic Techniques and Cosmetic Preparation OR (A) Basic Analytical Chemistry	02+01=03	45	25	25	50	(02)*
VI	DSEC VI [(Section A) Elective]	Theory Paper-XIV Organic+Inorganic Chemistry (P-XIV) A ₁ OR (Elective Paper) Organic+Inorganic Chemistry (P-XIV) A ₂	03	45	10	40	50	02
	DSEC VI (Section B)	Theory Paper-XV Physical+Inorganic Chemistry (P-XV)	03	45	10	40	50	02
	DSECP- IV [DECC V & VI (Section B)]	Practicals based on P-XIII & P-XV (P-XVII)	04 04	Practicals 08 08	05 05	20 20	25 25	01 01
	DSEC IV SEC IV (Anyone Skill from optional)	(B) Fuel Chemistry OR (B) Computer Application in Chemistry	02+01=03	45	25	25	50	(02)*
Total credits semester V and VI							12 (04)*	

CCC: Core Course Chemistry, CCCP: Core Course Chemistry Practical, ESE: End of Semester Examination,
CA: Continuous Assessment, SECC: Skill Enhancement Course Chemistry.

Distribution of Credits: 80% of the total Marks for ESE and 20% for CA.

- CA of Marks 10 : 10 Marks for test.
- CA of 25 Marks : 15 Marks for Seminar & 10 Marks for test.

**B. Sc. Third Year: Semester-V
Paper-XII, (DSEC-V, Section A)
Organic + Inorganic Chemistry**

Marks – 50

Periods – 45

Section – A (Organic Chemistry)

Unit: I Heterocyclic Compounds

06 Periods

Introduction, definition, nomenclature and classification.

Simple five membered heterocycles with one hetero atom: Furan, Thiophene and Pyrrole.

Aromatic character and molecular orbital picture of Furan, Thiophene and Pyrrole.

General mechanism of electrophilic substitution reaction with reactivity. Preparation and chemical properties of five membered heterocycles.

- 1) **Furan**: Synthesis from: a) Mucic acid b) Succinaldehyde. Physical Properties, Chemical Properties: Nitration, Gatterman-Koch reaction, Gomberg reaction, Diels-Alder reaction and Reduction reaction.
- 2) **Pyrrole**: Synthesis from: a) Furan b) Succinamide. Physical properties, Chemical Properties: Sulphonation, Gatterman Reaction, Reimer-Tiemann reaction, Ring Expansion, Coupling reaction and Reduction reaction.
- 3) **Thiophene**: Synthesis from: a) n-Butane b) Sodium Succinate, Physical properties. Chemical Properties: Halogenation, Chloromethylation, Mercuration, Reaction with n-Butyl Lithium and Reduction reaction.

Unit: II Six Membered Heterocycles: Pyridine

04 Periods

Introduction, Nomenclature, Aromatic character, Basic character and comparison with Pyrrole , General Mechanism for electrophilic substitution reaction and nucleophilic substitution reaction
Synthesis from: a) Acetylene b) Pentamethylene diamine hydrochloride c) β -Picoline
Chemical Properties: Nitration, Sulphonation, Halogenation, reaction with KOH, Amination reaction.

Unit: III Synthetic Drugs and Dyes

10 Periods

- (1) **Synthetic Drugs**: Introduction, Definition of drugs, qualities of good drug, Classification of drugs based on therapeutic action.
 - a) Pharmacodynamic agents : Antipyretics, Analgesics, Anesthetics, Antidiabetics, Anti-inflammatory, sedatives, hypnotics and tranquilizers.
 - b) Chemotherapeutic agents: Antimalarials, Antibacterials, Antifungals, Antituberculars. Synthesis and uses of the following drugs: a) Paracetamol b) Sulphanilamide c) Aspirin d) Benzocaine e) Isoniazide f) Sulphadiazine.
- (2) **Synthetic Dyes**: Introduction, Definition of dyes qualities of good dye, Classification of dyes based on methods of applications, colour and chemical constitution: a) Witt's theory b) Armstrong's theory.

Synthesis and applications of Azo dyes: methyl orange and congo red (mechanism of diazo coupling); Triphenylmethane dyes: malachite green and crystal violet; Phthalein dyes: Phenolphthalein and Fluorescein dye.

Unit: IV Alkaloids, Vitamins and Pesticides

10 Periods

- (1) **Alkaloids:** Introduction, occurrence and extraction, classification and general properties, determination of chemical constitution of alkaloids. Constitution and Synthesis of the following alkaloids.
 - a) Ephedrine: Synthesis from : 1-Phenyl propane-1, 2-dione
 - b) Nicotine : Synthesis from : Nicotinonitrile
- (2) **Vitamins :** Introduction and classification, Source, structure and deficiency diseases of the following vitamins:
 - a) Vitamin A, D, E and K (Fat Soluble)
 - b) Vitamin B₁, B₂, B₃, B₆, B₁₂ and C (Water Soluble)
- (3) **Pesticides:** Introduction and classification: Insecticides, Herbicides, Fungicides and Rodenticides. Synthesis and technical manufacture and uses of representative pesticides in the following classes : Organochlorines(DDT, Gammexene,); Organophosphates (Malathion), Carbamates (Carbaryl), Quinones (Chloranil), Anilides (Alachlor).

Section – B (Inorganic Chemistry)

Unit–V: Coordination Chemistry (Part-I)

10 Periods

- 1) Introduction: addition or molecular compound, double salt, coordination compound. Comparison of double salt and coordination compound.
- 2) Terminology: complex ion, central metal atom, ligand, types of ligands, coordination number and coordination sphere.
- 3) Nomenclature: Rules of nomenclature of coordination compound, and its applications to nomenclature of simple and bridging complex compounds.
- 4) Werner's theory of coordination compound, postulates, applications with reference to $\text{CoCl}_3 \cdot 6\text{NH}_3$, $\text{CoCl}_3 \cdot 5\text{NH}_3$, $\text{CoCl}_3 \cdot 4\text{NH}_3$, $\text{CoCl}_3 \cdot 3\text{NH}_3$.
- 5) Chelating agents and its classification, difference between metal complex and metal chelate complex.
- 6) Isomerism: Structural isomerism, ionization, hydrate, linkage, coordination isomerism, Geometrical isomerism, optical isomerism in 4 and 6 coordination complex.
- 7) E. A. N. of metal complexes.

Unit-VI: The Chemistry Of Elements In Medicine

05 Periods

- 1) Introduction
- 2) Chelation Therapy
- 3) Cancer Treatment
- 4) Anti-arthritis drugs.
- 5) Imaging agents.

Reference Books:

- 1) Organic chemistry by S.M.Mukherji, S.P.Singh, R.P.Kapoor (Vol. II & III)
- 2) Organic Chemistry by Jagdamba Singh, L.D.S.Yadav (Vol. II & III)
- 3) A text book of organic chemistry by P.L.Soni, H.M.Chawla
- 4) A text book of organic chemistry by K.S.Tewari, S.N.Mehrotra, N.K.Vishnoi
- 5) A text book of organic chemistry by ArunBahl and B.S.Bahl
- 6) Principles of organic chemistry by M.K.Jain
- 7) Heterocyclic chemistry synthesis, reactions and mechanism by Raj K. Bansal
- 8) Reaction mechanism and reagents in organic chemistry by G.R.Chatwal
- 9) Synthetic organic chemistry by G.R.Chatwal

- 10) Natural products by O.P.Agarwal (Vol. I & II)
- 11) Spectroscopy of organic compounds by P.S.Kalsi
- 12) Elementary organic absorption spectroscopy by Y.R.Sharma
- 13) Absorption spectroscopy of organic molecules by V.M.Parikh
- 14) Chemistry of pesticides by K.H.Buchel (T.W.)
- 15) Polymer Science by V.R.Gowarikar, N.V.Viswanathan and JayadevSreedhar
- 16) Medical Chemistry by Burger
- 17) Organic Chemistry by Clayden, Greeves, Warren and Wothers
- 18) Reactions, Rearrangements and reagents by S.N.Sanyal
- 19) Synthetic organic chemistry by KamleshBansal
- 20) A text book of synthetic drugs by O.D.Tyagi, M. Yadav
- 21) Synthetic drugs by G.R.Chatwal
- 22) Synthetic dyes by G.R.Chatwal
- 23) Industrial Chemistry by B.K.Sharma
- 24) Organic Chemistry by Morrison and Boyd
- 25) Organic Chemistry by Carey
- 26) Organic Chemistry by L.G.Wade
- 27) Inorganic chemistry (5th edition) by Shriver Atkins
- 28) Organic Chemistry by Cram D.J. and Hammond G.S.
- 29) Organic Chemistry by I.L.Finar
- 30) Advanced Organic Chemistry by Jerry M
- 31) Inorganic chemistry (5th edition) by Shriver Atkins
- 32) Organic Chemistry by Cram D.J. and Hammond G.S.
- 33) Organic Chemistry by I.L.Finar
- 34) Advanced Organic Chemistry by Jerry March
- 35) Organic Chemistry by Fieser and Fieser
- 36) Principles of Inorganic Chemistry by Puri, Sharma and Kalia.
- 37) Inorganic Chemistry by Gurudeep Raj, Chatwal.
- 38) Advanced Inorganic Chemistry Vol. II by Satyaprakash, Tuli, Basu and Madan.
- 39) Inorganic Chemistry by huheey, Keiter and Keiter.
- 40) Concise Inorganic Chemistry by J.D. Lee.

Objectives:	To understand reaction mechanism in organic Hetrocyclic synthesis. To learn theories and principles related to heterocyclic chemistry. To Understand Classification and structure Activity and relationship of some drugs and dyes To create an interest of students to Vitamins and pesticides To learn the co-ordination Chemistry and the chemistry of elements in Medicine.
Course Outcomes:	
CO1	After completion of this course, student will be able to Organic reaction and mechanism pathways.
CO2	Nomenclature of various heterocycles
CO3	Recognize and comment on different synthetic drugs and dyes
CO4	Able to discuss the uses and synthesis of some vitamins and pesticides
CO5	Understand the basic principle and application of coordination complexes
CO6	Know the application of elements in Medicine

B. Sc. Third Year: Semester-V
Paper-XIII, (DSEC-V, Section B)
(B₁)
Physical & Inorganic Chemistry

Marks – 50

Periods – 45

Section – A (Physical Chemistry)

Unit –I

09 Periods

Spectroscopy-I:

1) Brief introduction to molecular Spectroscopy. Width and intensity of spectral lines. Factors affecting width and intensity of spectral lines.

2) Rotational spectra:

Classification of molecules, Rotational spectra of diatomic molecules.(Rigid rotator model) Moment of inertia, energy levels of rigid rotator, selection rule, spacing between spectral lines of diatomic rigid rotator, isotopic effect. Numericals.

3) Vibrational Spectra:

Infrared spectrum, simple harmonic oscillator model, energy levels of simple harmonic oscillator, selection rule, pure vibrational spectrum, intensity, determination of force constant, qualitative relation between force constant and bond energies. Numericals on force constant.

Unit –II

05 Periods

Spectroscopy-II:

1) Raman spectra:- Raman Effect, Concept of Polarizability, classical and quantum theory of Raman scattering, rotational Raman spectrum of a diatomic molecule. Experimental Raman Spectroscopy.

2) Electronic spectra:- Concept of potential energy curve, Franck-Condon Principle, Types of electronic transitions.

Unit- III

08 Periods

Chemical Kinetics:

1) Introduction, Third order reaction with equal concentration of all reactants, characteristics of third order reaction.

2) Kinetics of complex reaction: i) Opposing reaction ii) Consecutive reaction

3) Kinetics of Photochemical reaction : i) Hydrogen –chlorine reaction

ii) Decomposition of HI iii) Dimerization of anthracene.

Unit -IV

08 Periods

Distribution Law:

1) Introduction, Nernst Distribution law, Solubility and distribution law, Limitations of law.

2) Association and dissociation of solute in solvent.

3) Henry's law.

4) Determination of equilibrium constant from distribution coefficient.

5) Extraction of solvent.

6) Liquid -liquid chromatography.

7) Applications of distribution law.

8) Numericals on distribution law

Section B (Inorganic Chemistry)

Unit- V: Organometallic Compounds

09 Period

- 1) Definition
- 2) Nomenclature and classification of organometallic compounds
- 3) Preparation, properties, structure of organolithium.
- 4) Preparation, properties, structure of ferrocene.

Unit -VI: Metal Carbonyls

06 Period

- 1) Definition, types.
 - a) Mononuclear carbonyls, characteristics and examples.
 - b) Polynuclear carbonyls, characteristics and examples.
- 2) Preparation, properties and structure of Nickel tetra carbonyl.
- 3) Nature of metal carbon bond in metal carbonyl and their evidences.
- 4) Structure of $\text{Fe}_2(\text{CO})_9$, $\text{Fe}_3(\text{CO})_{12}$, $\text{Ir}_4(\text{CO})_{12}$, $\text{Co}_2(\text{CO})_8$.

Reference Books:

1. Physical Chemistry by G. M. Barrow (Tata Mc-Graw Hill publishing Co., Ltd.)
2. Elements of Physical Chemistry by S. Glasstone & D. Lewis (D.vannostrand co. inc.)
3. Physical Chemistry by W. J. Moore (Orient Longman).
4. Principles of Physical Chemistry by S. H. Maron and C. F. Prutton.
5. University General Chemistry by C. N. R. Rao (Mc-Millan).
6. Elements of Physical Chemistry by P. W. Atkins. (Oxford University Press).
7. Physical Chemistry by R. A. Alberty (Wiley Eastern Ltd.).
8. Physical Chemistry through problems by S. K. Dogra, D. Dogra(Wiley Eastern Ltd)
9. Principles of Physical Chemistry by Puri, Sharma and Pathania (Vishal Publication Jalandher, Delhi)
10. Physical Chemistry by A. J. Mee. ELBS & Heinemann Educational Books Ltd.
11. Essentials of Physical Chemistry by ArunBhal, B. S. Bahl and G. D. Tuli. (S. Chand)
12. Chemical Kinetics by K. J. Laidler (Tata Mc-Graw Hill Publishing Co. Ltd).
13. Text Book of Physical Chemistry by Soni-Dharmarha.
14. A Text Book Physical Chemistry by S. Glasstone, (Mac Millan.)
15. Advanced Physical Chemistry by D.N.Bajpai. (S.Chand)
16. Advanced Physical Chemistry by Gurdeep Raj. (Goel publishing house, Meerut).
17. Principles of Inorganic Chemistry by Puri, Sharma and Kalia.
18. Inorganic Chemistry by Gurudeep Raj, Chatwal.
19. Advanced Inorganic Chemistry Vol. II by Satyaprakash, Tuli, Basu and Madan.
20. Inorganic Chemistry by huheey, Keiter and Keiter.
21. Inorganic Chemistry by J.D. Lee.

Objective(s)	To enable the students to acquire basic knowledge in Spectroscopy, Chemical Kinetics, Distribution law, Organometallic Compunds and Metal Carbonyls.
Course Outcome(s)	
CO1	Understand the concepts of molecular Spectroscopy and its applications
CO2	Analyze Rotational, Vibrational and Raman Spectra
CO3	Interpret the theoretical and experimental methods of chemical kinetics
CO4	Know the theory and application of Distribution law
CO5	Explain the Nomenclature, classification and application of Organometallic Compounds
CO6	Illustrate the classification and application of Metal Carbonyls

Elective paper (Semester-Vth)
Paper No. : P-XIII
DSEC-V (Section-B)
(B₂)

Physical + Inorganic Chemistry

Periods: 45

Mark: 50

Unit- I: Solutions of Non Electrolytes-I

07 Periods

- 1) Solutions of liquids in liquids-(only binary liquids)
- 2) Raoult's law.
- 3) Vapour pressure of ideal solutions.
- 4) Total vapour pressure in terms of mole fraction.
- 5) Activity of a component in ideal solutions.
- 6) Chemical potential of an ideal and non ideal solution.

Unit- II: Solutions of Non Electrolytes-II

07 Periods

- 1) Gibb's Duhem-Margules equation and ideal solution.
- 2) Temperature dependence of vapour pressure of solution.
- 3) Thermodynamics of ideal solution.
- 4) Free energy change of mixing, enthalpy change of mixing, entropy change of mixing, volume change of mixing.

Unit- III: Magneto Chemistry And Magnetic Properties of Substance:

06 Periods

- 1) Introduction, Magnetic susceptibility, Specific susceptibility, unit of measurement.
- 2) Types of substances: Paramagnetic, diamagnetic and ferromagnetic.
- 3) Effect of temperature on Paramagnetic, diamagnetic, ferromagnetic substances.
- 4) Measurement of magnetic susceptibility: Gouy's method.

Unit- IV: Polarography:

10 Periods

- 1) Principle and theory of polarography.
- 2) Ilkovic equation and its significance
- 3) Half wave potential and its determination.
- 4) Construction and working of dropping mercury electrode.
- 5) Advantages and disadvantages and DME.
- 6) Applications of polarography: Estimation of organic and inorganic substances, analysis of mixture of compounds, determination of diffusion coefficient, determination of stability constant of metal ion complex.

Section B (Inorganic Chemistry)

Unit- V: Isopoly and Heteropoly acids and anions.

10 Periods

- 1) Introduction.
- 2) Polymerisation of CrO_4^{2-} . Anion. and W_6^{+}
- 3) Isopoly anions and isopoly acids of Mo_6^{+}
- 4) Heteropoly anions and Heteropoly acids.
- 5) Tetrahedral Heteroatom) Polyanions.
- 6) (Tetrahedral Heteroatom) Polyanions.
- 7) (Octahedral Heteroatom) Polyanions.
- 8) (Icosahedral Heteroatom) Polyanions Important Reaction of Isopoly anions and Heteropolyanions.

Unit- VI: Concept of Isolobality and Isolobality analogies.

05 Periods

- 1) Introduction.
- 2) Isolobality organometallic fragments and main group fragments.
- 3) The Isolobality fragments, upon polymerization.
- 4) The structure of $\text{Ir}(\text{CO})_{12}$ and P_4 fragments.
- 5) The structure of $\text{Os}(\text{CO})_4$ and CH_2 fragments

Reference Books:

- 1) Principles of physical chemistry –Puri, Sharma, pathania (VPC) 45th Edition.
- 2) Elements of physical chemistry –P.W. Atkins (oxford University Press)
- 3) Text book of physical chemistry –Soni, Darmarha
- 4) Advanced physical chemistry –Gurudeep Raj (Goel Publishing House)
- 5) Instrumental methods of chemical analysis – Chatwal Anand
- 6) Instrumental methods of chemical analysis – B.K. Sharma.

Objective(s)	Creating awareness among students about the importance of Solution of Non Electrolytes, Magneto chemistry, Polarography, Isopoly and Heteropoly acids and Anions, Concept of Isolobality and Isolobality analogies is the prime aim of the course.
Course Outcome(s)	
CO1	Know the importance of Solutions of Non Electrolytes
CO2	Explain the types of magnetic substances and effect of temperature on it
CO3	Study the theory and application of Polarography
CO4	Analyze the application of Isopoly and Heteropoly acids and anions
CO5	Introduction and application of Isolobality and Isolobality analogies

Practical paper (Semester- V & VIth)
DSECP-IV
DSEC V & VIth (Section-A)
Organic + Inorganic Chemistry
Paper No. : P-XVI

Periods – 120

Laboratory Course – IV (CH-305)

Mark 50

Note: **At least Sixteen experiments to be completed: (Twelve from Section A and four from Section B)**

Section – A (Organic Chemistry)

01. Organic qualitative analysis: (Seven mixtures)

Separation of organic binary mixture containing two solid components (Using NaHCO₃, NaOH and HCl) and analysis of (both/one) components with preparation one derivative of each.

At least one mixture from each of the following types should be given:

- | | |
|---------------------|-------------------|
| a) Acid + Phenol | b) Acid + Base |
| c) Acid + Neutral | d) Phenol + Base |
| e) Phenol + Neutral | f) Base + Neutral |

Following compounds should be used for preparation of mixtures:

A] Acids : Salicylic acid, Phenyl acetic acid, o-Chlorobenzoic acid, aspirin, ophthalmic acid, cinnamic acid, Benzoic acid, m-chlorobenzoic acid.

B] Phenols: α -naphtha, β -naphtha, Resorcinol, p-nitro phenol, m-nitro phenol, Hydroquinone,

C] Bases : o-nitroaniline, m-nitroaniline, p-nitroaniline, p-anisidine, diphenylamine, p-Toluidine, p-chloroaniline

D] Neutrals: Acetanilide, Anthracene, Benzamide, Benzophenone, Biphenyl, Naphthalene, m-Dinitrobenzene, p-Dichloro benzene

02. Organic Preparation: (Any five)

[Weight of crude product, crude % yield, recrystallisation of crude product and its melting point expected]

a) Acetylation: Preparation of Aspirin from salicylic acid

OR

Preparation of β -naphthyl acetate from β -naphthol

b) Electrophilic substitution:

Preparation of p-nitroacetanilide from acetanilide (Nitration)

Preparation of 2, 4, 6 – Tribromoaniline from aniline (Bromination)

OR

Preparation of p-bromo acetanilide from acetanilide (Bromination)

c) Diazotisation : Preparation of Methylorange from sulphanic acid (Coupling)

OR

Preparation of p-iodonitrobenzene from p-nitroaniline (Replacement)

Benzoylation : Preparation of β -naphthyl benzoate from β -naphthol

OR

Preparation of Benzanilide from aniline

e) Osazone formation: Preparation of Glucosazone from Glucose

f) Amide Formation: Preparation of Benzamide from benzoic acid

g) Hydrolysis: Preparation of p-nitroaniline from p-nitroacetanilide

h) Reduction: Preparation of m-nitroaniline from m-Dinitrobenzene

i) Oxidation: Preparation of Benzoic acid from Toluene

j) Polymerisation: Preparation of phenol formaldehyde resin

03. Only demonstrations:

- a) Extraction of clove oil from crushed cloves by steam distillation.
- b) Separation of a mixture of methyl orange and methylene blue by column chromatography
- c) Separation of a mixture of amino acids by ascending paper chromatography.
- d) Separation of various pigments in the extract of spinach leaves by TLC.

Section – B (Inorganic Chemistry)

1. Gravimetric estimation of Iron as Fe_2O_3 .
2. Gravimetric estimation of Ba as BaSO_4
3. Gravimetric estimation of Nickel as $\text{Ni}(\text{DMG})_2$.
4. Gravimetric estimation of Aluminium as $\text{Al}(\text{Oxinate})_3$.
5. Gravimetric estimation of zinc as ZnO
6. Gravimetric estimation of Chloride as AgCl

Reference Books:

- 1) Practical organic chemistry by A.I.Vogel
- 2) Advanced practical organic chemistry by O.P.Agarwal
- 3) Advanced practical organic chemistry by N.K.Vishnoi
- 4) Hand book of organic qualitative analysis by H.T.Clarke
- 5) Experimental practical organic chemistry by P.R.Singh, D.S.Gupta
- 6) A laboratory Hand book of organic qualitative analysis by V.S.Kulkarni
- 7) Hand book of organic qualitative analysis by F.G.Mann, B.C.Sunders
- 8) A text book of Practical Chemistry for B.Sc. by V.V. Nadkarni, A.N. Kothare and Y.V. Lawande.
- 9) Advanced practical Inorganic Chemistry by O.P. Agarwal.

Swami Ramanand Teerth Marathwada University Nanded
B.Sc. III Chemistry Practical Paper (Elective)
Physical + Inorganic Chemistry (XVII)

Periods – 120

Marks 50

Section A: Physical Chemistry

(Instrumental & Non Instrumental any 12)

- 1) To study the variation of Viscosity of Liquid Nitrobenzene with temperature.
- 2) To study the effect of surfactant on surface of water by using Stalagmometer.
- 3) Determination of solubility of an inorganic salt in water at different temperature and hence determine the solubility curve.
- 4) Determination of partition coefficient of iodine between water and CCl_4 .
- 5) To investigate the absorption of acetic acid from aqueous solution by activated Charcoal and examine the validity of Freundlich and Langmuir's isotherm.
- 6) Investigate the reaction kinetics between potassium persulphate and potassium iodide by Colorimetric measurement.
- 7) Determine the relative strength of given two acids by polarimetric measurement.
- 8) Determine the half wave potential of metal ion by polarography.
- 9) To estimate the amount of Cd^{++} ion in an unknown solution by polarography.
- 10) To plot the current voltage curve for 0.05 M sulphuric acid using platinum electrode
- 11) To study the polarographic waves produced by dissolved oxygen.
- 12) Determination of formula and stability constant of metal ion complex by polarography.
- 13) Determine the acid and basic dissociation constant of amino acid and hence determine isoelectric point of acid conductometrically.
- 14) To determine the solubility of sparingly soluble salt at different temperature.

Section B : Inorganic Chemistry

Separation and estimation of any one metal ion from binary mixture. (any 04)

1. Ni^{++} and Cu^{++}
2. Cu^{++} and Fe^{++}
3. Ba^{++} and Mg^{++}
4. Fe^{++} and Zn^{++}
5. Cu^{++} and Ba^{++}

Reference Books:

- 1) Practical organic chemistry by A.I.Vogel
- 2) Advanced practical organic chemistry by O.P.Agarwal
- 3) Advanced practical organic chemistry by N.K.Vishnoi
- 4) Hand book of organic qualitative analysis by H.T.Clarke
- 5) Experimental practical organic chemistry by P.R.Singh, D.S.Gupta
- 6) A laboratory Hand book of organic qualitative analysis by V.S.Kulkarni
- 7) Hand book of organic qualitative analysis by F.G.Mann, B.C.Sunders
- 8) A text book of Practical Chemistry for B.Sc. by V.V. Nadkarni, A.N. Kothare and Y.V. Lawande.
- 9) Advanced practical Inorganic Chemistry by O.P. Agarwal.

SEC III
DSECP-III
DSEC V & VIth (Section-A)
Skill Enhancement Course (A)

Periods – 45

02 Credits

Spectroscopic Techniques and Cosmetic Preparation

1. Instruments in spectroscopy. 15
Instrumentation: Study of UV, IR, NMR and Mass spectroscopy.
2. Determination of structures of organic compounds by using UV, IR, NMR and Mass spectra: 15
Hydrocarbons, unsaturated hydrocarbons, alcohols, amines, aldehydes, ketones, carboxylic acids and esters, acid halides, amides and anhydrides.
1. Preparation of cosmetics 15
- i) Preparation of talcum powder
- ii) Preparation of shampoo
- iii) Preparation of face cream
- iv) Preparation of nail polish and nail polish remover

OR
BASIC ANALYTICAL CHEMISTRY

- 1. Introduction To Analytical And Instrumental Methods** **15**
Analytical chemistry, chemical analysis, instrumental methods, analytical methods on the basis of sample size, sampling, sampling statistics.
- 2. Errors, Evaluation And Statistics** **30**
Types and sources of errors, determinate errors, indeterminate errors, accuracy, absolute and relative error, precision, minimization of errors, significant figures, methods for reporting analytical data, statistical evaluation of data, mean, median and standard deviation, reliability of results, rejection of results, the Q-test, confidence interval, tests of significance, student's t-test, paired t- test, chi- square and f- test, numericals on T-test, Q-test and F-test.

Reference Books:

1. An introduction to analytical chemistry, S. A. Iqbal, M. Satake, Y. Mido and M. S. Shethi.
2. College analytical chemistry: Joshi, Baliga and Shetty, Himalaya Publishing house.
3. Qualitative analysis: Day and Underwood.
4. Qualitative inorganic analysis: A. I. Vogel.
5. Principles of analytical chemistry: Pandit and Soman.
6. Analytical chemistry, G. D. Christian, J. Wiley eastern press Ltd.
7. Analytical chemistry: Alka Gupta.
8. Basic concepts of analytical chemistry: S. M. Khopkar.
9. Advanced practical organic chemistry: Vishnoi.
10. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
11. Christian, G.D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.

Objective(s)	To train the students for the use of analytical and instrumental methods
Course Outcome(s)	
CO1	Able to know analytical and instrumental methods
CO2	Grasp the concept of errors, evaluation and statistics

B. Sc. Third Year: Semester-VI
(DSEC-VI, Section A)

(A₁)

Organic & Inorganic Chemistry
Paper-XIV

Marks – 50

Periods – 45

Section – A (Organic Chemistry)

Unit-I: Spectroscopic Methods:

08 Periods

i) Introduction, Electromagnetic radiations; Characteristics of EMR: a) Wave length
b) Wave number, c) Frequency, d) Energy of EMR.

ii) Electromagnetic spectrum; Meaning of Spectroscopy, types of Spectroscopy and advantages of Spectroscopic methods.

(A) Ultraviolet Spectroscopy:

1.1.1 Introduction.

1.1.2 Types of Electronic Transitions.

1.1.3 Terms used in UV Spectroscopy: Chromophore, Auxochrome, Bathochromic Shift, Hypsochromic Shift, Hypochromic and Hyperchromic effects.

1.1.4 Effect of conjugation on position of UV and Visible bands.

1.1.5 Calculation of λ_{max} by Woodward-Fieser rules for conjugated dienes and enones.

1.1.6 Spectral problems based on UV.

(B) Infra-Red Spectroscopy:

1.2.1 Introduction.

1.2.2 Theory of molecular vibrations (Basic Principles and Types of Vibrations).

1.2.3 Functional group region and Fingerprint region.

1.2.5 Characteristic absorption of various functional groups.

1.2.6 Interpretation of IR spectra of following organic compounds: a) Ethane, b) Ethene, c) Ethyne, d) Benzene, e) 1-Propanol, f) 2-Propanol, g) t-Butyl alcohol, h) Phenol, i) Acetone, j) Acetophenone, k) Acetaldehyde, l) Benzaldehyde, m) Benzoic acid, n) Methylbenzoate and o) Phenylcyanide.

Unit – II:

(A) NMR-Spectroscopy:

08 Periods

2.1 Introduction

2.2 Principle of NMR Spectroscopy

2.3 Magnetic and non-magnetic nuclei

2.4 PMR-Spectroscopy: Spinning nuclei, magnetic moment and magnetic field, precessional motion, energy states for proton in magnetic field (Orientations) and nuclear resonance.

2.5 Equivalent and non-equivalent protons.

2.6 Number of absorption signals in the following compounds: a) Acetone, b) Cyclobutane, c) Methanol, d) Ethylbenzene, e) Ethylamine, f) Mesitylene, g) Diethylether,

2.7 Shielding and deshielding effects: (Example of Acetylene and Benzene)

2.8 Chemical shift, measurement of chemical shift by delta scale and tau scale

2.9 TMS as reference, Advantages of TMS.

2.10 Peak area (integration) and Spin-spin splitting (n+1) rule.

2.11 Interpretation of PMR Spectra of following compounds: a) Ethyl bromide, b) Ethyl alcohol, c) Acetaldehyde, d) 1,1,2-tribromo ethane, e) Ethyl acetate, f) Toluene, g) Acetophenone, h) Ethylamine, i) Acetic acid, j) Benzoic acid.

(B) Applications of IR, UV and NMR for identification of simple organic molecules: 04 Periods

Organic Molecules: a) n-Propyl alcohol, b) *iso*-Propyl alcohol, c) *tert*-Butyl alcohol, d) Acetic acid, e) Ethylamine, f) Ethyl cyanide, g) Ethyl methyl ketone, h) Ethyl acetate, i) Ethyl benzene, j) Phenyl acetaldehyde, k) Phenol, l) Ethyl methyl ether, m) Ethylene glycol, n) Propionamide and o) Propionaldehyde.

Unit – III: Synthetic Polymers: **06 Periods**

- 3.1 Introduction, Homopolymers and Copolymers.
- 3.2 Classification of Polymers on the basis of source.
- 3.3 Types of Polymerisation reactions:
 - a) Addition (Chain-Growth) Polymerisation reaction: (with mechanism)
 - i) Free radical, ii) Cationic and iii) anionic
 - b) Condensation (Step-Growth) Polymerisation reaction
Example: Bakelite (Phenol-formaldehyde resin)
- 3.4 Synthesis and uses of following polymers :
 - a) Nylon-6, 10, b) Polyurethanes, c) Neoprene, d) Polymethylmethacrylate.

Unit – IV: Molecular Rearrangements: **04 Periods**

- 4.1 Introduction, classification of rearrangements: On the basis of migratory group
 - (a) Electrophilic rearrangement (ex. Pinacol-Pinacolone rearrangement)
 - (b) Nucleophilic rearrangement (ex. Favorskii rearrangement)
 - (c) Free Radical rearrangement (ex. Photo-Fries rearrangement)
 - (d) Aromatic rearrangement (ex. Stevens rearrangement)

Section – B (Inorganic Chemistry)

Unit-V: Coordination theory (Part-II) **10 Period**

- 1) Valence bond theory of coordination compounds: Postulates, inner orbital and outer orbital complexes of coordination number 4 and 6. Limitations of VBT.
- 2) Crystal field theory: Shape of d-orbital's, postulates, splitting of d-orbital in octahedral complexes, tetrahedral complexes, tetragonal and square planar complexes. Definition of CFSE, calculations of CFSE for octahedral and tetrahedral complexes.
- 3) Factors affecting $10 Dq$ or magnitude of crystal field splitting: Nature of ligand, oxidation state of metal ion, size of d orbital, geometry of complexes.
- 4) Applications of CFT.
- 5) Jahn teller effect in octahedral complexes of Cu^{++} .
- 6) Limitations of CFT.

Unit- VI: Electronic spectra of Transition metal complexes: **05 Period**

- 1) Types of electronic transition
- 2) Selection rule for d-d transition
- 3) Spectroscopic ground state and spectro-chemical series
- 4) Orgel energy level diagram for d^1 and d^9 states
- 5) Discussion of electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion

Reference Books:

- 1) Organic chemistry by S.M.Mukherji, S.P.Singh, R.P.Kapoor (Vol. II & III)
- 2) Organic Chemistry by Jagdamba Singh, L.D.S.Yadav (Vol. II & III)
- 3) A text book of organic chemistry by P.L.Soni, H.M.Chawla
- 4) A text book of organic chemistry by K.S.Tewari, S.N.Mehrotra, N.K.Vishnoi
- 5) A text book of organic chemistry by Arun Bahl and B.S.Bahl
- 6) Principles of organic chemistry by M.K.Jain
- 7) Heterocyclic chemistry synthesis, reactions and mechanism by Raj K. Bansal
- 8) Reaction mechanism and reagents in organic chemistry by G.R.Chatwal
- 9) Synthetic organic chemistry by G.R.Chatwal
- 10) Natural products by O.P.Agarwal (Vol. I & II)
- 11) Spectroscopy of organic compounds by P.S.Kalsi
- 12) Elementary organic absorption spectroscopy by Y.R.Sharma
- 13) Absorption spectroscopy of organic molecules by V.M.Parikh
- 14) Chemistry of pesticides by K.H.Buchel (T.W.)

- 15) Polymer Science by V.R.Gowarikar, N.V.Viswanathan and Jayadev Sreedhar
- 16) Medical Chemistry by Burger
- 17) Organic Chemistry by Clayden, Greeves, Warren and Wothers
- 18) Reactions, Rearrangements and reagents by S.N.Sanyal
- 19) Synthetic organic chemistry by Kamlesh Bansal
- 20) A text book of synthetic drugs by O.D.Tyagi, M.Yadav
- 21) Synthetic drugs by G.R.Chatwal
- 22) Synthetic dyes by G.R.Chatwal
- 23) Industrial Chemistry by B.K.Sharma
- 24) Organic Chemistry by Morrison and Boyd
- 25) Organic Chemistry by Carey
- 26) Organic Chemistry by L.G.Wade
- 27) Organic Chemistry by Cram D.J. and Hammond G.S.
- 28) Organic Chemistry by I.L.Finar
- 29) Advanced Organic Chemistry by Jerry March
- 30) Organic Chemistry by Fieser and Fieser
- 31) Principles of Inorganic Chemistry by Puri, Sharma and Kalia.
- 32) Inorganic Chemistry by Gurudeep Raj, Chatwal.
- 33) Advanced Inorganic Chemistry Vol. II by Satyaprakash, Tuli, Basu and Madan.
- 34) Inorganic Chemistry by huheey, Keiter and Keiter.
- 35) Concise Inorganic Chemistry by J.D. Lee.

Objective(s):	To familiarize concept and elucidate the structure of organic molecules by UV, IR and PMR Spectroscopy. To understand the concept of polymers its applications. To learn reaction and mechanism Molecular Rearrangements. To learn Co-ordination theory and Electronic Spectra of transition Metal Complexes
Course Outcome(s)	
CO1	Learn the basic principle and terms used in UV, IR & NMR Spectroscopy.
CO2	Apply spectroscopic techniques in analyzing the structure of simple organic molecules.
CO3	Acquire the basic knowledge and synthesis of polymers.
CO4	Describe the types of Rearrangement.
CO5	Postulates and limitations of VBT and CFT
CO6	Calculation of CFSE for Tetrahedral and Octahedral Complexes
CO7	Explain the types of electronic transition and selection rule
CO8	Apply spectroscopic techniques in analyzing the structure of simple organic Molecules

Elective paper (Semester-VIth)
Paper No. : P-XIV
DSEC-VI (Section-A)
(A₂)

Organic + Inorganic Chemistry

Marks – 50

Periods – 45

- | | |
|--|------------------|
| 1. Sugar and Alcohol Industry | 09 Period |
| 1) Manufacturing of raw cane sugar. | |
| 2) Refining of raw sugar. | |
| 3) White sugar. | |
| 4) Biproducts of sugar industry. | |
| 5) Manufacturing of ethyl alcohol from molasses. | |
| 6) Rectified spirit, denatured spirit absolute alcohol and powdered alcohol. | |
| 7) Bi-products of alcohol industry. | |
| 2. Textile Chemistry | 08 Period |
| 1) Introduction and classification of fibers | |
| 2) Sizing: | |
| a) Object of sizing, sizing ingredients and their functions. | |
| b) General idea of properties of starch, softness, synthetic adhesives. | |
| 3) Bleaching: | |
| a) Brief study of outline of the process of bleaching cotton and synthetic material. | |
| b) General idea of processes like singeing, desizing, scouring. | |
| 4) Dyeing: Study of dyeing, dyeing of cellulosic material and synthetic fibres with dyes like direct, vat, reactive and dispersed dyes. | |
| 3. Agro chemistry | 07 Period |
| 1) General idea of agrochemicals including pyrethroides. | |
| 2) Synthesis and uses of following agro-chemicals. | |
| a) Indole-3-acetic acid | |
| b) Ethophan | |
| c) Monochrotophos. | |
| 3) Fertilizers: Introduction and advantages of nitrogenous fertilizers, phosphatic fertilizers, potassic fertilizer and complex fertilizers. | |
| 4. Green Chemistry | 06 Period |
| 1) Introduction: Twelve principles of green chemistry. | |
| 2) Zeolites: Friedel-Craft alkylation and acylation, oxidation of benzene to phenol and benzoquinone, reduction of benzoquinone to hydroquinone. | |
| 3) Biocatalytic reactions: hydroxylation and oxidation using enzymes. | |
| 4) Introduction to microwave assisted reactions. | |
| Section (B) Inorganic Chemistry | |
| 5. Inorganic Polymers | 09 Period |
| 1) Introduction | |
| 2) Basic concepts and definition | |
| i) Polymer ii) Monomer iii) polymerization iv) copolymer | |
| v) Degree of polymerisation | |
| 3) Classification of polymers on basis of: i) Origin ii) composition | |
| iii) properties iv) uses | |
| 4) Comparison between organic and inorganic polymers | |
| 5) Polymer backbone | |
| 6) Homoatomic polymers containing-phosphorus | |
| 7) Heteroatomic polymers i) Silicones ii) phosphonitrilic compounds | |
| iii) Fluorocarbons. | |

6. Nanotechnology

06 Period

- 1) Introduction.
- 2) Properties of nanoparticles.
- 3) Application of nanoparticles.

Reference books:

1. Basic concept of analytical chemistry by S. M. Khopkar, Wiley eastern ltd. Bombay.
2. Industrial chemistry by R. K. Das, Asia publication Mumbai.
3. Riegel's hand book of industrial chemistry by J. A. Kent, Van. Nostrand, London.
4. Chemistry process industries by Shreve and Brinic- Ostim, Magraw Hill New York.
5. Biotechnology and applied microbiology by Alani and Moo-young.
6. Immobilize Biocatalysis by Joy Wleser
7. Introduction to polymer chemistry by Reymano B. Seymour.
8. Advances in green chemistry: chemical synthesis using microwave irradiation by R. S. Varma.
9. Green chemistry: Environment friendly alternatives: by Rashmi Sanghi and M. M. Shrivastav (Eds) © 2003 Narosa publishing house New Delhi India.
10. Textile Science by J. T. Marsh
11. Book of textile by A. J. Hall.
12. Sizing by D. B. Ajagaonakar
13. Bleaching by V. A. Sheni.
14. Dyeing by V. A. Sheni.
15. Chemicals for crop improvement and pest management by Green, Hartly and Weste
16. Chemistry of pesticides by K. H. Buchel (T.W.)
17. Principles of inorganic chemistry by Puri, Sharma and Kalia.
18. Text Book of inorganic chemistry by K. N. Upadhyay Vikas publishing House New Delhi.
19. Progress in inorganic polymer by Laport and Leigh
20. Nanomaterials and nanostructures by Laura Castle, April Feter Dominant publisher 2007
21. Nanoscale materials in chemistry by K. J. Kalbunde (Wiley intersciences)
22. Introduction to Nanoscience and nanotechnology by K. K. Chatopadhyaya. A. N. Banerjee, PHI learning Pvt. Ltd., New Delhi.
23. Introduction to Nanotechnology by Charles P. Poole (Jr.), Frank J. Owen & Wiley students Etd., 2008.
24. Nanotechnology: future technology with futures, BPB publication, New Delhi.

Objective(s)	The aim of this paper is to expose the students with the knowledge in Sugar and Alcohol Industry, Textile Chemistry, Agro Chemistry, Green Chemistry, Inorganic Polymers and Nanotechnology
Course Outcome(s)	
CO1	Understand the Basic concept of Sugar and Alcohol Industry
CO2	Synthesis and uses of Agro Chemicals
CO3	To enable the students to understand the classification of Fibers
CO4	To learn the basic concept and classification of Inorganic Polymers
CO5	Able to understand the theory of green chemistry
CO6	Ability to apply green chemical laboratory techniques
CO7	To stimulate the learner in understanding the basic concepts and applications of nanotechnology.

B. Sc. Third Year: Semester-VI
(DSEC-VI, Section B)
Physical & Inorganic Chemistry
Paper-XV

Marks – 50

Periods – 45

Section – A (Physical Chemistry)

Unit –I Electrochemistry:

12 Periods

- 1) Introduction, concept of electrode potential, single electrode potential, standard electrode potential, oxidization and reduction potential.
- 2) Electrochemical cells, electrolytic and Galvanic cells, reversible and irreversible cells, conventional representation of electrochemical cells.
- 3) EMF of cell, SHE.
- 4) Reference electrodes, indicator electrodes, calomel electrodes.
- 5) Solar cell: Principle, Construction, working and Applications.
- 6) Nernst equation, application of Nernst equation to oxidation half cell and reduction half cell.
- 7) Electrolyte concentration cell, Concentration cell with and without transport.
- 8) Application of EMF measurement in determination of pH by using
 - a) Quinhydrone electrode
 - b) Glass electrode.
- 9) Numericals on Nernst Equation.

Unit II : Thermodynamics I :

08 Periods

- 1) Introduction.
- 2) Work function and free energy function(G): Helmholtz Function (A) or work function, Change of work function (A) at constant temperature, Gibbs' free energy function, relation between G and A, change of G at constant temperature, variation of work function with temperature and volume, variation of free energy function with temperature and pressure. The Gibb's-Helmholtz equation.
- 3) Thermodynamics of open system: partial molar properties; concept of chemical potential, partial molar free energy. Gibb's-Duhem equation. Variation of chemical potential with temperature and pressure. Chemical potential in case of a system of ideal gases.

Unit-III: Thermodynamics II:

04 Periods

- 1) Thermodynamic derivation of law of mass action. Relation between ΔG^0 and K_P , relation between K_P , K_C and K_X .
- 2) Vant-Hoff's reaction isochore. Integrated form of Vant-Hoff's equation.
- 3) Clausius-Clapeyron equation and its applications.
- 4) Numerical on Integrated form of Vant-Hoff's equation.

Unit-IV: Colligative Properties:

06 Periods

- 1) Osmotic pressure.
- 2) Relative lowering of vapor pressure.
- 3) Elevation in boiling point.
- 4) Depression in freezing points and relation of these properties with molecular weight.
Numericals on elevation of boiling point and depression in freezing point.

Section B (Inorganic Chemistry)

Unit -V: Bioinorganic Chemistry

05 Periods

- 1) Essential and trace elements in biological processes.
- 2) Metalloporphyrin with special reference to hemoglobin and myoglobin.
- 3) Biological role of alkali and alkaline earth metal ions.
- 4) Nitrogen fixation.

Unit -VI: Metal cluster

10 Periods

- 1) Boranes.
- 2) Carboranes.
- 3) Metalloboranes.
- 4) Metallo-carboranes.

Reference Books:

1. Physical Chemistry by G. M. Barrow (Tata Mc-Graw Hill publishing Co., Ltd.)
2. Elements of Physical Chemistry by S. Glasstone & D. Lewis (D.van nostrand co. inc.)
3. Physical Chemistry by W. J. Moore (Orient Longman).
4. Principles of Physical Chemistry by S. H. Maron and C. F. Prutton.
5. University General Chemistry by C. N. R. Rao (Mc-Millan).
6. Elements of Physical Chemistry by P. W. Atkins. (Oxford University Press).
7. Physical Chemistry by R. A. Alberty (Wiley Eastern Ltd.).
8. Physical Chemistry through problems by S. K. Dogra, D. Dogra(Wiley Eastern Ltd)
9. Principles of Physical Chemistry by Puri, Sharma and Pathania (Vishal Publication Jalandher, Delhi)
10. Physical Chemistry by A. J. Mee. ELBS & Heinemann Educational Books Ltd.
11. Essentials of Physical Chemistry by Arun Bhal, B. S. Bahl and G. D. Tuli. (S. Chand)
12. Kinetics by K. J. Laidler (Tata Mc-Graw Hill Publishing Co. Ltd).
13. Text Book of Physical Chemistry by Soni-Dharmarha.
14. A Text Book Physical Chemistry by S. Glasstone, (Mac Millan.)
15. Advanced Physical Chemistry by D.N.Bajpai. (S.Chand)
16. Advanced Physical Chemistry by Gurdeep Raj. (Goel publishing house, Meerut).
17. Principles of Inorganic Chemistry by Puri, Sharma and Kalia.
18. Inorganic Chemistry by Gurudeep Raj, Chatwal.
19. Advanced Inorganic Chemistry Vol. II by Satyaprakash, Tuli, Basu and Madan.
20. Inorganic Chemistry by huheey, Keiter and Keiter.
21. Concise Inorganic Chemistry by J.D. Lee.

Objective(s)	To familiarize the students with the concept and principle Electrochemistry, Thermodynamics, Colligative Properties, Bioinorganic Chemistry and Metal Clusters. Bioinorganic Chemistry and Metal Clusters
Course Outcome(s)	
CO1	Basic concepts of electrochemistry and its applications
CO2	Understanding the Nernst heat theorem and the Thermodynamics open system
CO3	Know the Vant-Hoff's Reaction Osochore and numerical on it
CO4	Biological role of alkali and alkaline earth metal ions
CO5	Describe the structures and functions of Metal Cluster

Practical paper (Semester- V & VIth)

DSECP-V

DSEC V & VIth (Section-B)

Physical + Inorganic Chemistry

Paper No. : P-XVII

Periods – 120

Laboratory Course – IV (CH-306)

Mark 50

Note: **At least Sixteen experiments to be completed : (Twelve from Section A and four from Section B)**

Section – A (Physical Chemistry)

Instrumental

1. Determine the normality and strength of oxalic acid conductometrically using standard solution of strong base (NaOH/KOH).
2. Determine the concentration of KCl solution by titrating it with standard solution of AgNO₃ conductometrically.
3. Determine the equivalent conductance of a strong electrolyte at several concentrations and hence verify the Onsager's equation.
4. Determine the normality and strength of acids in mixture [strong acid (HCl/HNO₃) and weak acid (CH₃COOH/HCOOH)] potentiometrically using standard solution of strong base (NaOH/KOH).
5. Determine the dissociation constant of a weak acid (CH₃COOH/HCOOH) potentiometrically using standard solution of strong base (NaOH/KOH).
6. Determination of empirical formula of a complex between Fe⁺³ and 5-sulphosalicylic acid by Job's method colorimetrically.
7. Determination of dissociation constant of an organic acid (CH₃COOH) using various buffers (CH₃COOH + CH₃COONa) pH metrically.
8. To study inversion of cane sugar by polarimetrically.

Non-Instrumental

1. Determine the rate constant of the reaction between potassium persulphate and potassium iodide having equal concentrations of reacting species (a=b).
2. Determine energy of activation of hydrolysis of an ester by acid/base.
3. Investigate the reaction between bromic acid and hydroiodic acid.
4. Determine molecular weight of non volatile solute by Rast method / Beckmann's freezing point method.
5. Determine enthalpy change of neutralization of a strong acid by a strong base.
6. Determine interfacial tension between immiscible liquids, benzene and water by stalagmometer.
7. Determine molecular weight of a polymer by viscosity measurement.
8. Separation of mixture of o- and p-nitro anilines on an alumina column.
9. Determination of iron by solvent extraction techniques in a mixture of Fe(III) + Al(III) or Fe(III) + Ni(III) using 8-hydroxyquinoline reagent.
10. Separation of amino acids from organic acids by ion exchange chromatography.
11. Column chromatographic separation of pigments from green leaves

Section – B (Inorganic Chemistry)

1. Inorganic preparations and estimation of metal ion.
 - a) [Cu(NH₃)₄]SO₄
 - b) [Ni(NH₃)₆]Cl₂
 - c) CoCl₃.4NH₃
 - d) Sodium trioxalato ferrate
 - e) Hg[Co(SCN)₄].
 - f) Mohr's salt, [FeSO₄(NH₄)₂SO₄].6H₂O

Reference Books :

1. Experimental Physical Chemistry by A. Findlay., Longman.
2. Advanced Practical Physical Chemistry by J.B. Yadav.
3. Experiments in Physical Chemistry by R.C. Das and B. Behra, Tata Mc Graw Hill.
4. Advanced experimental Chemistry Vol. I. Physical by J.N. Gurtu and R. Kapoor., S. Chand & Co.
5. Experiments in Physical Chemistry by J.C. Ghosh, Bharati Bhavan.
6. Practical book of Physical Chemistry by Nadkarni, Kothari & Lawande., Bombay Popular Prakashan.
7. Systematic Experimental Physical Chemistry by S.W. Rajbhoj, Chondhekar, Anjali Prakashan.
8. Practical Physical Chemistry by B.D. Khosla & V.C. Garg., R. Chand & Sons.
9. Experiments in Chemistry by D.V. Jagirdar.
10. Practical Chemistry, Physical – Inorganic – Organic and Viva – voce by Balwant Raii Satia., Allied Publishers Pvt. Ltd.
11. College Practical Chemistry by H.N. Patel, S.R. Jakali, H.P. Subhedar, Miss. S.P. Turakhia, Himalaya Publishing House, Mumbai.
12. College Practical Chemistry by Patel, Jakali, Mohandas, Israney, Turakhia, Himalaya Publishing House, Mumbai.
13. A text book of Practical Chemistry for B.Sc. by V.V. Nadkarni, A.N. Kothare and Y.V. Lawande.
14. Advanced practical Inorganic Chemistry by O.P. Agarwal

SEC IV
DSECP-IV
DSEC V & VIth (Section-B)
Skill Enhancement Course (B)

Periods – 45

02 Credits

FUEL CHEMISTRY

1. Introductions, classification of fuel, Characteristics of good fuel, criterion of selection fuel. **5**
2. Solid fuels, natural solid fuels, Advantages of solid fuels over liquid and gaseous fuels, grading of coal or classification of coal based on rank or grade **10**
3. Liquid fuels, origin of petroleum, types of petroleum, grading of petroleum, refining of petroleum. **5**
4. Gaseous fuels, advantages of gaseous fuels over solid and liquid fuels, types of gaseous fuels, water gas & producer gas Natural gas. **10**
5. Calorific value of a fuel, units of calorific value, net and gross calorific value, determination of calorific value of a solid or liquid fuel, bomb calorimeter, Calculation of calorific values of gaseous fuels, flash point and fire point, determination of flash point by Abel's flash point apparatus, Octane number of a fuel. **15**

OR

Computer Application in Chemistry

1. **Use of Softwares:** **15**
 ISIS draw, Chem draw and Chem sketch.
 For drawing the structures, elemental (CHN) analysis, determination of molecular mass, IUPAC name and prediction of spectral data NMR and MASS.
2. **Biological activity and Toxicity evaluation of organic compounds using software:** **15**
 Evaluation of toxicity risk assessment of organic compounds using online software.
 Prediction of different biological activities using online software.
3. **Use of Excel in Chemistry:** **15**
 - a) Functions and formulas: Sum, mean, average, power etc. Understanding formulas, the cell and the formula bar, the formula in action, copying formulas, copying and pasting a formula and complex formula.
 - b) Excel chart and data analysis:
 Visual representation of the data through excel graph, plotting and X-Y data set, create calibration curve, format the view graph, add trend line, equation of line and R-square value, determine the slope of a line, scale adjustment, examples, renaming the chart and worksheet, common charting errors, add a chart title.
 Add regrations and equation to graph, regration analysis, run the regression and interpreting regration results.

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.
3. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).
4. Advanced practical organic chemistry: Vishnoi.
5. list of websites for software and book for UG/PG syllabus:
 - 1) <http://www.acdlabs.com/resources/freeware/chemsketch/>
 Excel for Chemistry Excel in analytical chemistry by Robert de Levie – Book
 - 1) <http://chemed.chem.purdue.edu/genchem/lab/datareports/excel/excel.html>

Objective(s)	To familiarize the students with fuel chemistry To train the students for the use of Software, Excel
Course Outcome(s)	
CO1	Able to know types of fuels
CO2	Grasp the concept of calorific value of a fuel, flash point and fire point
CO3	Able to know the use of software and Excel in Chemistry