THIRUVALLUVAR UNIVERSITY MASTER OF SCIENCE M.Sc. CHEMISTRY DEGREE COURSE

UNDER CBCS

With effect from 2020-2021

The Course of Study and the Scheme of Examinations

S. No.	Study Components Course Title		Ins. Credit		Title of the Paper	Maximum Marks		
			Hrs/ week					
SEMEST	rer i					CIA	Uni. Exam	Total
1.	Core Theory	Paper-1	4	4	Organic Chemistry- I	25	75	100
2.	Core Theory	Paper-2	4	3	Inorganic Chemistry- I	25	75	100
3.	Core Theory	Paper-3	4	3	Physical Chemistry- I	25	75	100
	Core Practical	Paper-1	4	0	Organic Chemistry Practical- I	-	-	-
	Core Practical	Paper-2	4	0	Inorganic Chemistry Practical- I	-	-	-
	Core Practical	Paper-3	4	0	Physical Chemistry Practical- I	-	-	-
			Internal E	ective for	same major students			
4.	Core Elective	Paper-1	3	3	(to choose 1 out of 3) A. Advanced Polymer Chemistry B. Heterocyclic Chemistry C. Materials Chemistry	25	75	100
External Elective for other major stu					dents (Inter/multi disciplinary papers)			
5.	Open Elective	Paper-I	3	3	(to choose 1 out of 3) A. Chemistry in Agriculture B. Food Chemistry C. Industrial chemistry-I	25	75	100
			30	16		125	375	500
SEMESTI	ER II					CIA	Uni. Exam	Total
6.	Core Theory	Paper-4	3	3	Organic Chemistry- II	25	75	100
7.	Core Theory	Paper-5	3	4	Inorganic Chemistry- II	25	75	100
8.	Core Theory	Paper-6	3	3	Physical Chemistry- II	25	75	100
9.	Core Practical	Paper-1	5	3	Organic Chemistry Practical- I	25	75	100
10.	Core Practical	Paper-2	5	3	Inorganic Chemistry Practical- I	25	75	100
11.	Core Practical	Paper-3	5	3	Physical Chemistry Practical- I	25	75	100
12.	Compulsory paper		2	2	Human Rights	25	75	100

Internal Elective for same major students								
13.	Core Elective	Paper-2	2	3	 (to choose 1 out of 3) A. Green Chemistry B. Supramolecular and Nanochemistry C. Modern Separation Techniques 	25	75	100
	Ext	ernal Elective	for other	major stu	dents (Inter/multi disciplinary pape	ers)		
14.	Open Elective	Paper-II	2	3	(to choose 1 out of 3)A. Medicinal ChemistryB. Textile chemistryC. Diary Chemistry	25	75	100
15.	* Field Study		-	2		-	-	100
			30	29		225	675	1000
SEMEST	ER III					CIA	Uni. Exam	Total
16.	Core Theory	Paper-7	3	3	Organic Chemistry- III	25	75	100
17.	Core Theory	Paper-8	4	4	Inorganic Chemistry- III	25	75	100
18.	Core Theory	Paper-9	4	4	Physical Chemistry- III	25	75	100
	Core Practical	Paper-4	5	0	Organic Chemistry Practical- II	-	-	-
	Core Practical	Paper-5	5	0	Inorganic Chemistry Practical- II	-	-	-
	Core Practical	Paper-6	5	0	Physical Chemistry Practical- II	-	-	-
			Internal El	ective for	same major students			
19.	Core Elective	Paper-3	2	3	 (to choose 1 out of 3) A. Scientific Research Methodology B. Advanced Bioinorganic Chemistry C. Advanced analytical techniques 	25	75	100
	Ext	ernal Elective	for other	major stu	dents (Inter/multi disciplinary pape	ers)		
20.	Open Elective	Paper-3	2	3	(to choose 1 out of 3) A. Industrial Chemistry-II B. Science of Photography C. Energy Resources	25	75	100
21.	** MOOC Courses		-	-		0	0	100
			30	17		125	375	600
SEMEST	ER IV					CIA	Uni. Exam	Total
22.	Core Theory	Pape-10	4	4	Organic Chemistry- IV	25	75	100
23.	Core Theory	Paper-11	4	4	Physical Chemistry- IV	25	75	100
24.	Core Practical	Paper-4	5	3	Organic Chemistry Practical- II	25	75	100
25.	Core Practical	Paper-5	5	3	Inorganic Chemistry Practical- II	25	75	100
26.	Core Practical	Paper-6	5	3	Physical Chemistry Practical- II	25	75	100

27.	Core	Project	5 Internal E	5 lective for	Project with viva voce (Compulsory) same major students	1 (75 F +25	.00 Project viva)	100
28.	Core Elective	Paper-4	2	3	(to choose 1 out of 3) A. Inorganic Chemistry-IV B. Environmental Chemistry C. Medicinal Chemistry and Drug Design	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
29.	Open Elective	Paper-4	2	3	(to choose 1 out of 3) A. Polymer and plastics B. Basics of Forensic science C. Health Science	25	75	100
				28		175	525	800
				90				2900

* Field Study

There will be field study which is compulsory in the first semester of all PG courses with 2 credits. This field study should be related to the subject concerned with social impact. Field and Topic should be registred by the students in the first semester of their study along with the name of a mentor before the end of the month of August. The report with problem identification and proposed solution should be written in not less than 25 pages in a standard format and it should be submitted at the end of second semester. The period for undergoing the field study is 30 hours beyond the instructional hours of the respective programme. Students shall consult their mentors within campus and experts outside the campus for selecting the field and topic of the field study. The following members may be nominated for confirming the topic and evaluating the field study report.

- (i). Head of the respective department
- (ii). Mentor
- (iii). One faculty from other department

****Mooc Courses**

Inclusion of the Massive Open Online Courses (MOOCs) with zero credits available on SWAYAM, NPTEL and other such portals approved by the University Authorities.

SECOND YEAR SEMESTER III PAPER - 7 ORGANIC CHEMISTRY III

OBJECTIVE:

To understand the concepts of spectral techniques and to apply these techniques for the quantitative and structural analysis of organic compounds. To understand the concept of Photochemical and Pericyclic Reactions. To study the synthesis of heterocycles, vitamins and steroids.

OUTCOMES:

The student will be able to

- Visualize the importance of UV-Visible and IR spectroscopy.
- Acquire knowledge of vibrational transition and identify various functional groups
- Apply the concept of Mass spectroscopy to different compounds
- Elucidate the structure of organic compounds using NMR
- Solve photochemical and pericyclic problems
- Illustrate the synthesis of heterocycles

UNIT-I: UV AND IR SPECTROSCOPY AND THEIR APPLICATIONS

Ultraviolet-Visible spectroscopy: Types of electronic transitions - chromophores and auxochromes - factors influencing the positions and intensity of absorption bands - absorption spectra of dienes, polyenes and unsaturated carbonyl compounds - Woodward - Fieser rules and its applications.

Infra Red Spectroscopy: Vibrational frequencies and factors affecting them - identification of functional groups - intra and inter molecular hydrogen bonding – functional group region- finger print region.

UNIT-II: NMR SPECTRA AND ITS APPLICATIONS

Nuclear spin - magnetic moment of a nucleus - nuclear energy levels in the presence of magnetic field - basic principles of NMR experiments - CW and FT NMR - ¹H NMR - Chemical shift and coupling constant - factors influencing proton chemical shift and vicinal proton - proton coupling constant- ¹H NMR spectra of simple organic molecules such as CH3CH2Cl and CH3CHO. AX and AB spin system - nuclear overhauser effect- chemical exchange.

¹³C NMR - proton decoupling and Off resonance decoupling spectra - factors affecting ¹³C NMR chemical shift - ¹³C NMR spectra of simple organic molecules.

UNIT-III: PHYSICAL METHODS OF STRUCTURAL DETERMINATION

Mass spectroscopy - Principles - measurement techniques - (EI, CI, FD, FAB, SIMS) - presentation of spectral data - molecular ions - isotope ions - fragment ions of odd and even electron types - factors affecting cleavage patterns - simple and multicentre fragmentation – Mc Lafferty rearrangement - Mass spectra of hydrocarbons, alcohols, phenols, aldehydes and ketones. ORD and its applications - Octant rule - Cotton effect - Axial halo ketone rule - Problem solving (for molecules with a maximum number of C10).

UNIT-IV: PHOTOCHEMISTRY AND PERICYCLIC REACTIONS

Photochemical excitation - fate of the excited molecules - Jablonskii diagram - study of photochemical reactions of ketone - photo reduction - photo cycloaddition - Paterno - Buchi reaction - di pi-methane rearrangement - Pericyclic analysis of electrocyclic - cyclo addition and sigmatropic reactions - correlation diagrams for butadiene - cyclobutene system - hexatriene to cyclohexadiene systems - structure of Bullvalene - fluxional molecule - Cope and Claisen rearrangement.

UNIT-V: HETEROCYCLES, VITAMINS AND STEROIDS

Synthesis of imidazole, oxazole, thiazole, flavones, isoflavones, anthocyanins, pyrimidines (cytocine, uaracil only) and purines (adenine, guanine only). Synthesis of Vitamin-A1 using Wittig method. Conversion of cholesterol to progesterone, estrone and testosterone.

RECOMMENDED BOOKS

1. Francis A. Carey and Richard J. Sundberg, Advanced organic chemistry, III Edition (1990). G.A Swan,Introduction to alkaloids

2. I.L. Finar, Organic chemistry, Vol. II, 5thedition ELBS publication.

3. J. Dyer, Application of absorption spectroscopy of organic compounds, Prentice and Hall of India, Pvt., New Delhi.

4. J. March, Advanced organic reaction mechanism and structure, Tata McGraw Hill.

5. Neil S. Issac, Physical organic chemistry, ELBS publication 1987.

6. O.P. Agarwal, Chemistry of organic Natural Products, Goel Publishing House, Meerut.

7. P.S. Kalsi, Spectroscopy of organic compounds, Wiley Eastern Ltd., Chennai.

8. R.M. Silverstein, G.d. Bassler and Monsu, Spectrometric identification of organic compounds, John Wiley and Sons, New York.

9. S.M. Mukherji and S.P. Singh, Organic Reaction Mechanism, MacMillan India Ltd., Chennai (1990).

10. Schliemann, Introduction to the spectroscopic methods for the identification organic compounds, 2 volumes, Pergamon Press.

11. W. Kemp, Spectroscopy, Macmillan Ltd.,

12. Y.R. Sharma, Structural identification of organic compounds, S. Chand & Co.

13. R.O.C. Norman, J.M. Coxon, Principle of Organic Synthesis, ELBS Publications, 1994.

14. R. T. Morrison and R. N. Boyd, Organic chemistry, 6th edition, Prentice Hall of India Limited., New Delhi, 1992

15. Heterocyclic Chemistry, Vol. 1-3, R. R. Gupta, M. Kumar and V.Gupta, Spinger Verlag.

16. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.

17. Heterocyclic Chemistry, J. A. Joule, K. Mills and G. F. Smith, Chapman and Hall.

18. Heterocyclic Chemistry, T. L. Gilchrist, Longman Scientific Technical.

19.Charles H.Depey and Orville, Molecular Reaction and Photochemistry, L. Chapman, Prentice Hall of India Pvt., Ltd., New Delhi.

PAPER- 8 INORGANIC CHEMISTRY III

OBJECTIVE:

To study about the Coordination complexes, Substitution in Coordination complexes and Inorganic Photochemistry.

OUTCOMES:

The student will be able to

- Explain about carbon donors
- Describe the structure and bonding of metallocenes (ferrocenes)
- Illustrate the different types of reaction of organo metallic compounds.
- Discuss the various catalysis processes in organo metallic chemistry.
- Explain the Electron transfer reactions of co-ordination compounds.
- Describe the various substitution reactions of coordination compounds.
- Analyse various types of photochemical reactions.

UNIT-I: ORGANO METALLIC CHEMISTRY - I

Carbon donors: Alkyls and aryls metallation, bonding in carbonyls and nitrosyls, chain and cyclic donors, olefins, acetylene and allyl system. Synthesis, structure and bonding of metallocenes (ferrocene only).

Reactions: Association, substitution, addition and elimination reactions, ligand protonation, electrophilic and nucleophilic attack on ligands. Carbonylation, decorboxylation, oxidative addition and fluxionality.

UNIT-II: ORGANO METALLIC CHEMISTRY - II

Catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (Oxo process), oxidation of olefins to aldehydes and ketones (Wacker process), polymerization (Zeigler - Natta Catalyst); cyclo oligomerisation of acetylene using nickel catalyst (Reppe's catalyst); polymer-bound catalysts.

UNIT-III: COORDINATION CHEMISTRY - IV

Electron transfer reactions, outer and inner sphere processes; atom transfer reaction, formation and rearrangement of precursor complexes, the bridging ligand, precursor and successor complexes. Marcus theory. Complementary, non-complementary and two electron transfer reactions.

UNIT-IV: COORDINATION CHEMISTRY - V

Substitution Reactions: Substitution in square planar complexes, reactivity of platinum complexes, influences of entering, leaving and other groups, the Trans effect.

UNIT-V: COORDINATION CHEMISTRY - VI

Substitution of octahedral complexes of cobalt and chromium, replacement of coordinated water, solvolytic (acids and bases) reaction applications in synthesis (platinum and cobalt complexes only).

Inorganic Photochemistry: Photo-substitution, Photoredox and isomerisation process, application of metal complexes in solar energy conversion.

Text books

1. R.C. Mehrothra, A. Singh, Organo Metallic Chemistry, Wiley Eastern Co., (1992).

2. F. Basolo and R.G. Pearson, Mechanism of Inorganic Reaction, Wiley NY (1967).

- 3. J. Huheey, Inorganic Chemistry, Harper and Collins, NY IV Edition, (1993).
- 4. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, W. Saunders Co., (1977).

5. S. FA Kettle, Coordination Chemistry, ELBS, (1973).

6. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, John Wiley and Sons, V Edition (1988).

7. D.F. Shrivers, Pw. Atkins and C.H. Langford, Inorganic Chemistry, OUP (1990).

8. Guillermo J. Ferraudi, Elements of inorganic photochemistry, Wiley (1988).

9. Arthur W. Adamson, Paul D. Fleischauer, Concepts of inorganic photochemistry, Wiley(1975).

Suggested References

1. G. Coates M.I. Green and K. Wade. Principles of Organometallic chemistry, Methven Co., London (1988).

2. P. Powell, Principles of Organometallic chemistry, Chappman and Hall. (1998).

3. G.S. Manku, Theoretical Principles of Inorganic Chemistry, McGraw-Hill Education, (1984).

4. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, Van Nostrand Co., New York (1974).

5. R.B. Heslop and K. Jones, Inorganic Chemistry, Elsevier Scientific Publ., (1976).

6. F. Basolo and R.G. Pearson, Mechanism of Inorganic Reaction, Wiley NY (1967).

7. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, Van Nostrand Co., New York (1974).

8. B.E. Dogulas DH McDaniel's and Alexander, Concepts and Models of Inorganic Chemistry, Oxford IBH (1983).

9.WU. Mallik, G.D. Tuli, R.D. Madan, Selected topics in Inorganic Chemistry, S. Chand and Co., New Delhi (1992).

PAPER-9 PHYSICAL CHEMISTRY III

OBJECTIVES:

To study the electrochemical kinetics, over potential, corrosions and fuel cells. To know the solid state and its properties. To Study the principles and applications of spectroscopy. To study statistical thermodynamics, *OUTCOMES:*

The student will be able to

- Derive Butler-Volmer equation and explain Pourbaix and Evan's diagram of corrosion.
- Explain electrical and magnetic properties of solids.
- Describe the basic principles and applications of microwace, vibrational, Raman, NMR and electronic spectroscopy.
- Compare Maxwell-Boltzmann and Fermi-Dirac and Bose-Einstein statistics.

UNIT-1: ELECTROCHEMISTRY- III

Mechanism of electrode reactions - polarization and over potential - the Butler-Volmer equation for one step and multistep electron transfer reactions - significance of electron exchange current density and symmetry factors - transfer coefficient and its significance - mechanism of the hydrogen and oxygen evolution reactions.

Corrosion and passivation of metals - Pourbaix diagram - Evan's diagram - fuel cells - electrodeposition - principle and applications.

UNIT-II: SOLID STATE

Classification of solids - Imperfection in solids - point, line and plane defect - Electrons and holes - Non-stoichiometry - Imperfection and physical properties of solids (brief study). **Electrical properties** - electrical conductivity - Hall effect - dielectric properties piezo electricity, Ferro electricity and conductivity; **Optical properties** - Photo conductivity -luminescence - color center - lasers - refraction - birefringence; **Magnetic properties** - diamagnetism - paramagnetism - ferro - antiferro and ferrimagnetisms. Calculation of magnetic moments. Mechanical and thermal properties.

UNIT-III: SPECTROSCOPY - I

Microwave spectroscopy – Rotational spectroscopy of rigid rotator - non rigid rotator - diatomic and polyatomic molecules.

Vibrational spectroscopy - Harmonic oscillator - anharmonicity - vibrational spectra of polyatomic molecules - vibrational frequencies - group frequencies - vibrational coupling-overtones - Fermi resonance.

Raman Spectroscopy- Raman effect, Stoke's and Anti-stoke's lines, rotational and vibrational Raman spectra.

Electronic spectroscopy - Progressions and sequences, selection rules, Franck - Condon principle, types of electronic transitions - solvent effects.

UNIT-IV: SPECTROSCOPY- II

Resonance spectroscopy - Zeeman effect - equation of motion of spin in magnetic fields - chemical shift - spin-spin coupling - NMR of simple AX and AMX type molecules calculation of coupling constants - ¹³C, ¹⁹F, ³¹P NMR spectra - applications - a brief discussion of Fourier Transformation Resonance Spectroscopy.

UNIT-V: STATISTICAL THERMODYNAMICS-I

Objectives of statistical thermodynamics - concept of thermodynamic and mathematical probabilities - permutations and combinations, distribution of distinguishable and non-distinguishable particles. Stirling approximation, Maxwell - Boltzmann distribution law - Fermi - Dirac and Bose - Einstein statistics - comparison with Maxwell -Boltzmann distribution law and their applications - radiation law - electron gas in metals.

Partition function - evolution of translational, vibrational and rotational partition functions for mono and diatomic ideal gases.

Text Books

S.Glasstone, Introduction to Electrochemistry, Affiliated East West Press, New Delhi (1960).

D.R. Crow, Principles and Applications to Electrochemistry, Chapman and Hall (1991).

S. Glasstone, Introduction to Electrochemistry, Affiliated East West Press, New Delhi (1960).

P.H.Rieger, Electrochemistry, Chapman and Hall, New York (1994).

R.Crow, Principles and Applications to Electrochemistry, Chapman and Hall (1991).

Lesley E.Smart, Elaine A.Moore, Solid State Chemistry - An Introduction

Charles Kittel - Introduction to Solid State Physics

Anthony R. West - Solid State Chemistry and its Applications

C.N. Banwell and E.M. McCash, Fundamentals of Molecular spectroscopy, IV - Edition, Tata McGraw Hill (2005).

N. Sathyanarayana, Vibrational Spectroscopy, New Age International Publishers (2004).

Caringtion and Ad. Mclachlan, Introduction to Magnetic Resonance, Harper and Row, New York (1967).

M. C.Gupta, Statistical thermodynamics, Wiley Easter, New Delhi (1990).

R.Hasee, Thermodynamics Of Irreversible Process, Addition Wesley, Reading, Mass (1969).

Suggested References

J.O.M. Bokris and A. K. N. Reddy, Electrochemistry, Vol. 1 and 2, Plenum, New York (1977).

P. Dalahay, Electrode Kinetics and Structure of Double Layer, Inter Science, New York (1965).

J.Robbins, Ions in Solution-An Introduction to Electrochemistry, Clarendon Press, Oxford (1993).

H.Reiger, Electrochemistry, Chapman and Hall, New York (1994).

W.J. Moore, Physical Chemistry, Orient Longman, London (1972).

J.M. Murrell, S.F.A. Kettle and J.M. Tedder, The Chemical Bond, Wiley (1985).

R.C. Ropp, Solid State Chemistry

C N. Banwell, Fundamentals of Molecular Spectroscopy, Mc Graw Hill (1966).

Raymond Chang, Basic Principles of Spectroscopy, McGraw Hill Ltd., New York (1971).

G M. Barrow, Introduction to Molecular Spectroscopy, Mc Graw Hill, New York (1962).

W. Kemp, NMR in Chemistry, Mc Millan Ltd., (1986).

D. Mclauchlan, Magnetic Resonance, Oxford Chemistry Series, Oxford (1970).

P. Staughan and S. Walker, Spectroscopy, Vol. I, II & III, Chapman and Hall (1976).

J.K. Sanders and B.K. Hunter, Modern NMR Spectroscopy, A Guide for Chemists, Oxford University Press, Oxford (1987).

Jk.M. Sanders, E.C. Constable and B.K. Hunter, Modern NMR Spectroscopy - a Work Book of Chemical Problems, Oxford (1989).

Francis W Sears and Gerhard L Salinger, Thermodynamics, kinetic theory, and statistical thermodynamics.

P. Dalahay, Electrode Kinetics and Structure of Double Layer, Inter Science, New York (1965).

CORE ELECTIVE PAPER-3 (to choose 1 out of 3)

A. Scientific Research Methodology

OBJECTIVES:

To study about the importance of research, literature survey, error analysis, statistical treatment. To study about the conventions of writing thesis. *OUTCOMES:*

Understanding the importance of research and literature sources. Knowledge on isolation and purification techniques. Adequate knowledge on assessing the quality of analytical data. Working knowledge on report writing.

UNIT-I: INTRODUCTION

Nature and importance of research - aims, objective, principles and problems - selection of research problem - survey of scientific literature - primary and secondary sources - citation index for scientific papers and journals - patents.

UNIT-II: CONDUCT OF RESEARCH WORK

Physical properties useful in analysis and methods of separation prior to analysis - Isolation techniques - extraction - Soxhlet extraction, crystallization, sublimation - methods for vacuum sublimation and distillation under reduced pressure.

Chemistry of working with hazardous materials - acid / base / water sensitive, corrosive, toxic, explosive and radioactive materials.

UNIT-III: EVALUATION OF ANALYTICAL DATA

Precision and accuracy - Reliability - determinate and random errors - distribution of random errors - normal distribution curve.

UNIT-IV: STATISTICAL TREATMENT OF ANALYTICAL DATA

Statistical treatment of finite samples - the students test and F test - criteria for rejection of an observation - the Q test, significant figures and computation rules - data plotting - least square analysis.

UNIT-V: THESIS AND ASSIGNMENT WRITING

Conventions of writing - the general format - page and chapter format - use of quotations and footnotes - preparation of tables and figures - referencing - appendices - revising editing and evaluating the final product - proof reading - meanings and examples of commonly used abbreviations.

REFERENCES

1. Douglas A. Skoog and Donald, M. West, Fundamental of analytical chemistry, Halt Saundersons International Edition.

2. J. Anderson, H.M. Durston and M.Poole, Thesis and assignment writing - Wiley Eastern Ltd., (1970).

3. J. March, Advanced organic chemistry - reactions, Mechanism & Structure. McGraw Hill Student Edition.

4. Vogel's Textbook of quantitative chemical analysis, ELBS edition.

5. Rajammal P. Devados, Research Methodolgy.

CORE ELECTIVE PAPER-3 B. ADVANCED BIOINORGANIC CHEMISTRY

OBJECTIVES:

- 1. To learn the importance of Bioinorganic Chemistry
- 2. To learn the role of metal ions in the biologically important complexes
- 3. To learn mechanism of photosynthesis

OUTCOMES:

Understand the principles of bioinorganic chemistry. Knowledge on metalloporphyrins and metalloenzymes. Understand the role of metals in medicine. Have knowledge on nitrogenfixation and photosynthesis.

UNIT - I: SCOPE OF BIOINORGANIC CHEMISTRY

Introduction: Trace elements, complex formation, hard and soft acids and bases (HSAB), inert and labile complexes. Amino acids and proteins - structure of proteins, peptide bond - enzymes - nucleic acid - carbohydrates - blood - plasma.

Concepts of essentiality - evolution of essential trace elements - future essential trace elements - role of minerals - working of essential trace elements - essential ultra trace elements - essential ultra trace nonmetals.

UNIT - II: METALLOPORPHYRINS

Respiratory proteins: Hemoglobin and Myoglobin - structure and functions - oxygenation reactions - structure and functions relationship - structural models for dioxygen binding synthetic models for oxygen binding - models for Hemoproteins – Hemerythrin -Hemocyanin. Non-redox metalloenzymes: Peroxidase, Catalayse and Alcohol Dehydrogenase (Structure, mechanism of action and model compound)

UNIT - III: METALLOENZYMES

Copper enzymes: Superoxide dismutase, cytochrome oxidase and ceruplasmin - Molybdenum enzymes: Pyridoxyal oxidase and xanthine oxidase. Zinc enzymes: Carbonic

anhydrase and carboxy peptidase. Cobalt enzyme: Vitamin B_{12} . Biomineralization – Siderophores - Ferritin and Transferrin,

UNIT - IV: METALS IN MEDICINE

Metal deficiency and disease - toxicity of mercury, cadmium, lead, beryllium, selenium and arsenic - biological defence mechanism - meaning and example of chelation therapy - Metals used for diagnosis (Tc, Fe and Co) - Metals in medicine: platinum complexes as anticancer drugs, Pt-DNA binding, complexes of gold, copper, zinc, mercury, arsenic and antimony as drugs.

UNIT - V: NITROGEN FIXATION AND PHOTOSYNTHESIS

Nittogenase enzyme: Reactivity, reduction involving nitride / diazene intermediate, dinitrogen complexes and their reactivity in vitro nitrogen fixation. Photosynthesis: Structure of chlorophyll in green plants (Z-Scheme) - ATP synthesis - Role of manganese complex in oxygen evolution - dark reaction (Calvin cycle).

TEXT BOOKS

1. K. Hussain Reddy, Bioinorganic Chemistry, New Age international publishers (2007)

2. S. J. Lippard & J. M. Berg. Principles of Bioorganic Chemistry, Panima Publ. Corpn. (2005). 3. E. I. Ochiai. Bioinorganic Chemistry – An Introduction, Allyn and Bacon Inc. (1977).

4. M.N. Hughes, Inorganic Chemistry of Biological Processes, John Wiley &Sons, 2nd Edition, 1985

5. R.P. Hanzlik. Inorganic Aspects of Biological and Organic Chemistry, Academic Press (1976)

REFERENCE BOOKS

1. H. Kraatz & N. Metzler-Nolte (Eds.). Concepts and Models in Bioinorganic Chemistry, Wiley (2006).

2. I. Bertini, H. B. Gray, S. J. Dippard & J. S. Valentine, Bioinorganic Chemistry, Viva Books Pvt. Ltd. (2004).

3. A.W. Addison, W.R. Cullen, D. Dolphin & B.R. James (eds.). Biological Aspects of Inorganic Chemistry, John Wiley (1977).

4. R.J.P. Williams & J.R.R.F. Dasilva. New Trends in Bioinorganic Chemistry, Academic Press (1978).

5. A. E. Martel. Inorganic Chemistry in Biology and Medicine, ACS Symp. Series, ACS (1980).

6. S. J. Lippard. Progress in Inorganic Chemistry: Bioinorganic Chemistry, Vol. 38, John Wiley (1990).

7. N. Kaim & B. Schwederski. Bioinorganic Chemistry: Inorganic Elements in the Chenistry of Life, John Wiley (1994).

8. Advanced Inorganic Chemistry, F.A. Cotton and G. W. Wilkinson. John Wiley & Sons, 5th Ed. 1988.

9. Inorganic Chemistry, Principles of Structure and Reactivity, J. E. Huheey, E.A. Keiter 4th Ed. Harper Collins, 1993.

10. Bioinorganic chemistry, R. W. Hay, Halsted Press, 1984.

11. Principles of Bioinorganic Chemistry, S. J. Lippard and J.M. Berg, Panima Publishing Corporation, 2nd Ed., 1995.

CORE ELECTIVE

PAPER-3 C. ADVANCED ANALYTICAL TECHNIQUES

OBJECTIVES:

On the completion the course the students will have the knowledge of various instrumental techniques. The students should have learnt data analysis and electroanalytical techniques.

OUTCOMES:

Have knowledge on electro analytical techniques. Understand the use of non-destructive method of chemical analysis. Knowledge on basic and advanced microscopic techniques. Adequate knowledge on thermal and radiochemical analytical methods.

UNIT-1: ELECTROANALYTICAL TECHNIQUES:

Voltametry - coulometry - amperometry - potentiometry - polarography - electrolytic conductivity - impedance spectroscopy.

UNIT-1I: CHEMICAL ANALYSIS:

Non-destructive techniques: Wavelength and energy dispersive X-ray fluorescence spectroscopy (WDS and EDS) - X-ray absorption spectroscopy (XANES and EXAFS) - secondary ion mass spectrometry (SIMS) - temperature programmed desorption (TPD) - thermal desorption spectroscopy (TDS).

Destructive techniques: Atomic absorption spectroscopy (AAS) - inductively coupled plasma-atomic emission spectroscopy (ICP-AES).

UNIT-11I: IMAGING AND DEPTH PROFILING:

Basic concepts in surface imaging - secondary electron microscopy (SEM) - secondary Auger microscopy (SAM) - scanning probe microscopy (SPM) - scanning tunneling microscopy (STM) - transmission electron microscopy (TEM) - surface imaging - depth profiling. Associated techniques of microscopy and spectroscopy.

UNIT- IV: THERMAL ANALYSIS:

Thermo gravimetric and differential thermal analysis - thermometric titrations - differential scanning colourimetry - basic instrumentation and applications.

UNIT-V: RADIOCHEMICAL METHODS

Hot atom chemistry – the Szilard – chalmers process, chemistry of recoil atoms, chemical effects on radioactive decay, solvated electron. Uses of radiations in the study of matter, neutron activation analysis, dilution analysis, dosimetry, synthesis of organic and inorganic compounds by irradiation. Radiometric analysis and radiography.

TEXT BOOKS:

- 1. R. Wiesendanger, *Scanning Probe Microscopy and Spectroscopy*, Cambridge University Press, 1994.
- 2. Frank A. Settle, Handbook of instrumental techniques for analytical chemistry, Prince Hall, New Jersey, 1997.
- 3. K. W. Kolasinski, Surface science: Foundations of catalysis and nanoscience, John Wiley and Sons, West Susses, 2002.
- 4. D. A. Skoog, D. M. West, F. J. Holler and S. R. Couch, Fundamentals of analytical chemistry. Brooks/ColeCengage learning, New Delhi, 2004.
- 5. P. Atkins and J. de Paula, Atkins' physical chemistry, 8th Ed., Oxford University Press, New Delhi, 2008.
- 6. T. Pradeep, Nano: The essentials, McGraw-Hill Education, New Delhi, 2010.
- 7. F. Scholz, Electroanalytical Methods, Springer, 2nd Ed., 2010.
- 8. Allen J. Bard and Larry R. Faulkner, Electrochemical Methods: Fundamentals and Applications, 2nd edition 2001, John Wiley & Sons
- 9. Allen J. Bard (Ed), Electroanalytical Chemistry, Vol.13, Plenum Press 1983
- 10. Joseph Wang, Analytical Electrochemistry, 3rd edition 2006, John Wiley & Sons
- 11. D.A. Skoog, 1985, Principles of Instrumental Methods of analysis, III Edition, Saunders College Publ.
- 12. Willard Merrit, Dean and Settle, 1986, Instrumental methods of analysis, VI Edition, CBS Publ.
- 13. D.A. Skoog and D.M. West, 1982, Fundamentals of Analytical Chemistry, IV Edition, old Reinhord & Winston, Publication

SUGGESTED REFERENCE BOOKS:

- 1. G.D.Christian & J.E.O. Reily, 1986, Instrumental Analysis, II Edition, Allegn Recon.
- 2. H.A. Strobel, 1976, Chemical Instrumentation, Addition- Wesely Publ Co.
- 3. Kolthoff and Elwing (All Series) Treatise on Analytical Chemistry.

- 4. Willson Series Comprehensive Analytical Chemistry.
- 5. Willard, Merit, Dean and Settle, Instrumental Methods of Analysis, CBS Publishers and Distributors, IV Edn. 1986
- 6. Schoog, Holler, Nieman, Principles of Instrumental Analysis, Thomson Asia Pte Ltd., Singapore, 2004.

OPEN ELECTIVE PAPER-3 (To choose 1 out of 3)

A.INDUSTRIAL CHEMISTRY-II

OBJECTIVES:

To make the students learn about electrochemical industries To understand the importance of agrochemical industries To learn the importance of petroleum and fuel gases To study about the paints and varnishes To understand the importance of Cement, Ceramic and Glass **OUTCOMES:** The students will be able to Identify the importance of electrochemical industries Acquire knowledge of agrochemical industries Appreciate the importance of petroleum and fuel gases

Acquire knowledge of paints and varnishes

Illustrate the importance of Cement, Ceramic and Glass

UNIT I Electrochemical Industries: Production of materials like chlorine, caustic soda ,sodium chlorate, perchlorates, Batteries – primary and secondary cells, solar cells, fuel cells.

UNIT II Agrochemical industries: Important categories of insecticides, fungicides, herbicides, rodenticide, Mode of action and synthesis of common pesticides like gammexane, DDT, aldrin, Parathion, Malathion, Baygon,

UNIT III Petroleum : Origin, refining, Cracking, reforming ,knocking and octane number, LPG, synthetic gas, synthetic petrol. **Fuel Gases:** Large scale production, storage, hazards and uses of coal gas, water gas, producer gas, and oil gas.

UNIT IV Paints & Varnishes: Primary constituents of paints, Dispersion medium (solvent), binder Pigments, formulation of paints and varnishes. Requirements of a good paint. **Cleansing Agents:** Preparation of toilet and washing soaps, synthetic detergents-alkyl aryl sulphonates, ethanolamines, nonionic detergents, builders, additives, corrosion inhibitors. 124

UNIT V Cement : Manufacture – Wet Process and Dry process, types, analysis of major constituents, setting of cement, reinforced concrete. Cement industries in India. **Ceramics:** Important clays and feldspar, glazing and vitrification. **Glass:** Composition and manufacture of glass .Types of glasses- optical glass, coloured glasses and lead glass.

Reference : 1. B.N.Chakrabarty, Industrial Chemistry, Oxford & IBH Publishing Co, New Delhi, 1981.

2. B.K. Sharma, Industrial Chemistry, Goel Publishing House, Meerut.

3. P.P.Singh, T.M.Joesph, R.G.Dhavale, College Industrial

Chemistry, Himalaya Publishing House, Bombay, 4th Ed., 1983 125

OPEN ELECTIVE PAPER-3

B. SCIENCE OF PHOTOGRAPHY

OBJECTIVES:

To make the student understand the principles of photography.

To make the student understand concepts of image formation. To make the student understand the concept motion image and film. To allow the student to have a deep knowledge of photography and photographic systems.

OUTCOMES:

The students will be able to

Learning the basic concepts of photography

Explaining the types and characterstics of Lens and filters

Acquiring the knowledge of functions of films and SD cards

Gaining the knowledge of aesthetic photography and lightings.

UNIT I: BASICS OF PHOTOGRAPHY

Photography- Definition and concept-Nature and Functions of Photography- Historical development of Photography- Camera-Introduction to camera- Human Eye and Camera - Concept of Visual Perception-Basics of Camera: Different types of Camera- Box - TLR- SLR and Digital; Parts and Functions of Camera- Aperture- Shutter- Lens and Film-Camera Accessories.

UNIT II: LENS

Lens- Definition and Concept- Nature and Characteristics of Lens- Types of Lens- Wide angle-Normal and Tele- Special Lens- Zoom- Fish eye and Macro Lens- Focus- Definition and Concept-Types of Focus- Split Image and Macro Image Focusing- Focal Length- Types of Focal Length-Short- Long and Variable Focal Length- Exposure- Depth of Field Aperture Priority and Shutter Priority- Filter- Definition and concept- Characteristics of Filters- Types of Filters- UV- Polarizing Filter- Grey Grad Color Balancing Filter- Neutral Density Filter and Soft Focus Filter.

UNIT III: PHOTOGRAPHIC FILM

Film- Definition and Concept- Function and Characteristics of Film- Cross Section of Film- Types of Film- Film Speed Definition- Functions of Film Speed- Types of Film Speed- Fast Speed and Slow Speed- Film Speed Numbers- ASA- ISO and DIN- Digital Storage- Digital Storage process-Types of Digital Storage- Compact Flash (CF)- Secure Digital Card(SD)- Mini SD Card- Micro SD and etc.- Film Developing Process- Developing- Fixing- Washing and Drying- Film Printing Process- Digital Printing Process.

UNIT IV: LIGHTING

Lighting- Definition and concept- Nature of Light- Characteristics of Light- Understanding Light-Indoor and Outdoor-Types of Light- Natural and Artificial- Three Point Lighting- Key- Fill and Back Light- Types of Lighting Equipments Pro-lit- Soft Box and etc- Different accessories of Lighting- Umbrella- andetc- Flash- Functions of Flash- Light MeterDefinition and concept-Functions of Light Meter.

UNIT V: AESTHETICS OF PHOTOGRAPHY

Aesthetics of Photography- Framing- Characteristics of Framing- Composition- Characteristics of Compositions- Types of Composition- Rule of Third- Frame within Frame and Etc.- Scope of Photography- Types of Photography- Photo Journalism-Ad Photography- Natural Photography-Wild life Photography- Fashion Photography and Industrial Photography.

TEXT BOOKS

1. James Curran, The Photography Handbook, 2nd Edition, Routledge, 2013.

2. Ben Long, Complete Digital Photography, 6th Edition, PTR, 2010.

REFERENCES

1. Linda Good, Teaching and Learning with Digital Photography, Sage Publications, 2009.

2. Ian Jeffrey, The Photography Book, Focal Press, 2nd Edition, 2000.

3. Michael Langford, Basic Photography, Focal Press, 6th Edition, 2000.

OPEN ELECTIVE PAPER-3

C.ENERGY RESOURCES

OBJECTIVES:

To make the students to understand about energy resources To understand the importance of solar energy To learn the importance of energy from the ocean To study about the wind energy and hydrogen energy To understand the importance of energy management **OUTCOMES:** The students will be able to Identify the importance of energy resources Appreciate the importance of solar energy

Appreciate the importance of solar energy Analyze the importance of energy from the ocean Acquire knowledge of wind energy and hydrogen energy Identify the importance of energy management

UNIT I: INTRODUCTION TO ENERGY SOURCES

Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development - strategy for meeting the future energy requirements Global and National scenarios-Prospects of renewable energy sources.

UNIT II: SOLAR ENERGY

Solar radiation - beam and diffuse radiation, solar constant, earth sun angles- attenuation and measurement of solar radiation-solar cooker, solar heating and cooling of buildings- photo voltaics - solar cells and its applications.

UNIT III: ENERGY FROM THE OCEAN

Ocean Thermal Electric Conversion (OTEC) systems like open cycle-closed cycle- Hybrid cycleprospects of OTEC in India. Energy from tides- basic principle of tidal power- single basin and double basin tidal power plants- advantages- limitation and scope of tidal energy.

UNIT IV: WIND ENERGY AND HYDROGEN ENERGY

Principle of wind energy conversion-Basic components of wind energy conversion systems-wind mill components-various types and their constructional features Hydrogen Energy-Introduction-Hydrogen Production methods-Hydrogen storage-hydrogen transportation-utilization of hydrogen gas-hydrogen as alternative fuel for vehicles.

UNIT V: ENERGY MANAGEMENT

Energy economics-energy conservation-energy audit-general concept of total energy system-scope of alternative energy system in India.

TEXTBOOKS

- 1. Rai. G.D., Non-conventional energy sources, 4th Edition, Khanna Publishers, 2009.
- 2. Garg H.P. & Jai, Solar Energy: Fundamentals and Applications by Prakash, Tata McGraw Hill, 1977.
- 3. Singhal B.L., Alternative Energy Sources, 2nd Edition Tech Max Publication, 2007.

REFERENCES

- 1. Duffic.J.A and Beckman W.A ,Solar Engineering of Thermal Processes , 3rd Edition ,John Wiley & sons, New York, 1975.
 - 2. Giri.N.K, Alternate energy sources and application, 2nd Edition, Khanna Publication, 2004.
 3. Sukhatme S,P, Solar Energy: Principles of Thermal Collection and Storage, 3rd Edition ,Tata McGraw Hill, 2008.

SEMESTER IV

PAPER - 10 ORGANIC CHEMISTRY IV

OBJECTIVE:

To know the methods of synthetic strategies and applications. To apply the knowledge of chemical reactions in organic synthesis. To learn the chemistry of terpenes and alkaloids and their importance. To understand the techniques involved in the rearrangements and their synthetic utility. To understand the different chromatographic techniques and their applications. To know the separation and purification methods.

OUTCOMES:

The student will be able to

- Develop problem solving skills requiring application of chemical reaction.
- Acquire knowledge of terpenes and alkaloids.
- Elucidate the structure of proteins and nucleic acids.
- Solve problems related to molecular rearrangements
- Attain skills on separation and purification of organic compounds.

UNIT-I: MODERN SYNTHETIC METHODS, REACTIONS AND REAGENTS

Synthesis of simple organic molecules using acetylation and alkylation of enamines, Grignard reactions, Diels - Alder reaction, phosphorus and sulphur ylides, Robinson annulation. Retrosynthetic Analysis: Basic principles and terminology of retrosynthesis, one group and two group C-X disconnections, one group C-C and two group C-C disconnections, amine and alkene synthesis. Protection and deprotection of functional groups

(R-OH, R-CHO, RCO-R, R-NH2 and R-COOH). Uses of the following reagents: DCC, Trimethylsilyliodide, 1,3-Dithiane (Umpolung), and diisobutylaluminiumhydride (DIBAL).

UNIT-II: TERPENES AND ALKALOIDS

Introduction - classification - isoprene rule - structural determination of terpenoids - Citral, geraniol - linalool - farnesol - α -pinene and camphor.

Introduction - isolation of alkaloids - total synthesis of quinine - morphine and reserpine.

UNIT-III PROTEINS AND NUCLEIC ACIDS

Proteins - peptides and their synthesis - synthesis of tripeptide - Merrifield synthesis - determination of tertiary structure of protein - biosynthesis of proteins - nucleic acids - types - DNA & RNA polynucleotide chain - components - biological functions - structure and role of (genetic code) DNA and RNA (nucleotides only) - Biosynthesis of Cholesterol

UNIT-IV: MOLECULAR REARRANGEMENTS

A detailed study with suitable examples of the mechanism of the following rearrangements: Wagner - Meerwein, Pinacol - Pinacolone, Demjanov, Dienone - phenol, Favorskii, Baeyer - Villiger, Wolff, Hofmann- Lofler-Freytag – Sommlet- Hauser-Stevens and Von Richter rearrangements.

UNIT-V: SEPARATION AND PURIFICATION TECHNIQUES

Thin layer chromatography, Gas Chromatography, HPLC, Ion-exchange chromatography-Basic principles and applications.

Distillation: fractional, steam, azeotropic and vacuum distillations. Recrystallization of organic compounds.

Recommended Books:

1. Eric E.Conn, Paul. R. Stumpf, George Bruening and Roy H. Dole,

Outlines of Biochemistry, V Edition, John Wiley and Sons.

2. Stuart Warren, Work book for organic synthesis, The Disconnection Approach, John Wiley & Sons (Asia) Pvt. Ltd.

3. I. L. Finar, Organic Chemistry, Vol. II, VEdition ELBS publication.

4. J.March, Advanced organic reaction mechanism and structure, Tata McGraw Hill.

 L.Smith, Robert L.Hill I. Robert Lehman, Robert J.Let Rowitz, Philip Handlar and Abraham white, Principles of Biochemistry General Aspects, VII EditionMcGraw Hill Int.,
 Lubert Stryer, Biochemistry, Freeman and Co., New York.

7. O.P. Agarwal, Chemistry of organic Natural Products, Goel Publishing House, Meerut. 8. Parmer and Chawla, Organic reaction mechanisms, S. Chand and Co.,

9. Paul de Mayo, Molecular Rearrangements, Vol. I and II.

10.Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th Edition, 2005, Saunders College Publishing, New York.

11. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.

12. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, 1993, prentice Hall, Inc. New Delhi.

13.Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Inidan Reprint.2003 Pearson Education Pvt. Ltd., New Delhi.

14. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.

15. Introduction to Chromatography Theory and practice, V.K.Srivastava, K.K.Srivastava, Chand &.Company Ltd , New Delhi

16. S. M. Mukherji and S.P. Singh, Organic Reaction Mechanism, MacMillan India Ltd., Chennai (1990).

PAPER-11

PHYSICAL CHEMISTRY-IV

OBJECTIVE

To study the principles of photochemical reactions. To study the Experimental methods and kinetics studies of photochemical reactions. Study of electrode - electrolytic interface. To study the fundamental principles of quantum chemistry and its application to chemical bonding. Schrödinger wave equation and its applications. To study statistical thermodynamics, quantum statistics and irreversible thermodynamics.

OUTCOMES:

The student will be able to

- *Explain photophysical processes with the help of Jablonski diagram and analyze sternvolmer equation.*
- Describe photovoltaic, galvanic cell and solar energy conversion.
- Illustrate Schrodinger equation and its applications.
- Explain Huckel theory of conjugate molecules and compare LCAO and MO theory for diatomic molecules.
- Illustrate Einstein and Debye heat capacity models and Derive Sackur tetrode equation.

UNIT- I: PHOTOCHEMISTRY - I

Absorption and emission of radiation - Franck - Condon Principle - decay of electronically excited states - Jablonski diagram - radiative and non-radiative processes - fluorescence and phosphorescence - spin forbidden radiative transition - Internal conversion and intersystem crossing - energy transfer process - kinetics of unimolecular and bimolecular photophysical processes - excimers and exciplexes - static and dynamic quenching - Stern-Volmer analysis.

UNIT- II: PHOTOCHEMISTRY - II

Experimental methods - quantum yield and life time measurements - steady state principle - quantum yield and chemical actinometry.

Kinetics of photochemical reactions: hydrogen and halogen reactions,

Brief study about photoredox, photosubstitution, photoisomerization and photosensitized reactions - photovoltaic and photogalvanic cells, photo electrochemical cells, photo-assisted electrolysis of water, aspects of solar energy conversion.

UNIT- III: QUANTUM CHEMISTRY - I

Failure of classical mechanics - Compton effect - wave particle duality - uncertainty principle - waves - wave equation for electrons - quantum mechanical postulates - The concept of operators - Hermitian property. Schrodinger wave equation - application of Schrodinger's equation - the particle in a box (one, and three dimensional cases) - particle in a ring, solution to rigid rotor and harmonic oscillator. Schrodinger equation for hydrogen atom (no derivation is required) and the solutions.

UNIT- IV: QUANTUM CHEMISTRY - II

Approximation methods - Perturbation and Variation methods - application to hydrogen molecule and helium atoms. Born - Oppenheimer approximation - valence bond theory for hydrogen molecule - LCAO - MO theory for diatomic molecules. Concept of hybridization - Huckel theory for conjugated molecules (Ethylene, butadiene and benzene).

UNIT- V: STATISTICAL THERMODYNAMICS - II

Thermodynamic functions in terms of partition functions - application of partition function to heat capacity of ideal gases - nuclear partition function - contribution to heat capacity of ortho and para hydrogen. Heat capacity of solids - Einstein and Debye models, Negative Kelvin temperature. Entropy of monoatomic gases - Sackur-Tetrode equation.

Irreversible thermodynamics - forces and fluxes - linear force - flux relation - phenomenological equations.

TEXT BOOKS

N.J.Turro, Modern Molecular Photochemistry, Benjamin, Cumming, Menlo Park, California (1978).

K.K.Rohatgi, Mukherjee, Fundamentals of Photochemistry, Wiley Eastern Ltd., (1978).

R.K. Prasad, Quantum Chemistry, Wiley Eastern, New Delhi (1992).

D.A. Mcquarrie, Quantum Chemistry, University Science Books, Mil Valley, California (1983).

Quantum Chemistry, Allyn and Bacon, Boston (1983).

R.Anantharaman, Fundamentals of Quantum Chemistry, Mac Millan India Limited (2001).

M.W. Hanna, Quantum Mechanics in Chemistry, W.A. Benjamin Inc. London (1965).

M.C.Gupta, Statistical thermodynamics, Wiley Easter, New Delhi (1990).

R.Hasee, Thermodynamics Of Irreversible Process, Addition Wesley, Reading, Mass (1969).

L.K. Nash, Elements of Chemical Thermodynamics, Addision Wesley (1962).

G.M. Barrow, Physical Chemistry, McGraw Hill (1988).

R.L. De Koch and H.B. Gray, Chemical Structure and Bonding, Benjamin- Cumming, Menlo Park, California. S.Glasstone, Text Book of Physical Chemistry.M.Sc. Chemistry: Syllabus (CBCS)

Suggested References

A.K. Chandra, Introductory Quantum Chemistry, Tata Mc Graw Hill.

D.A. Mc Quarrie, Quantum Chemistry, University Science Books, Mill Valley, California (1983).

P.W. Atkins, Molecular Quantum Mechanics, Oxford University Press, Oxford (1983).

J.G.Clavert and J.N.Pitts, Photochemistry, Wiley, London (1966).

R.P.Wayne, Photochemistry, Butterworths, London (1970).

B.J.Mc Clenlland, Statistical Thermodynamics, Chapman and Hall, London (1973).

Cleyde, Physical Chemistry, Schaum Series, Mc Graw Hill (1976).

Dole, Thermodynamics, Prentice Hall, New York (1954).

Prigogine, Introduction to Thermodynamics of Irreversible Process, Interscience, New York (1961).

N.O.Smith, Elementary Statistical Thermodynamics - A Problem Approach, Plenum Press, NewYork (1961).

G.Clavert and J.N.Pitts, Photochemistry, Wiley, London (1966).

R.P.Wayne, Photochemistry, Butterworths, London (1970).

Francis W Sears and Gerhard L Salinger, Thermodynamics, kinetic theory, and statistical thermodynamics.

CORE PRACTICAL PRACTICAL PAPER - 4 ORGANIC CHEMISTRY PRACTICAL - II

I. ANY SIX PREPARATIONS FROM THE FOLLOWING INVOLVING TWO STAGES

- 1. sym-Tribromo benzene from aniline (bromination, diazotization and hydrolysation)
- 2. Benzanilide from benzophenone (addition and Beckmann rearrangement)
- 3. m-Nitro benzoic acid from methyl benzoate (nitration and hydrolysation)
- 4. 2, 4.- Dinitrobenzoic acid from p-nitrotoluene (oxidation and nitration)
- 5. m-Nitro benzoic acid from benzaldehyde (oxidation and nitration)
- 6. Benzil from benzaldehyde (rearrangement)
- 7. Anthraquinone from phthalic anhydride (Fridel Crafts reaction)
- 8. Acetyl salicylic acid from methyl salicylate (hydrolysis and acetylation)
- 9. 2- Phenyl indole from phenyl hydrazine (Fisher indole reaction)
- 10. m-nitroaniline from nitrobenzene (nitration and reduction)

II. ANY TWO EXERCISES IN THE EXTRACTION OF NATURAL PRODUCTS

- 1. Caffeine from tea leaves
- 2. Lactose from milk
- 3. Citric acid from lemon
- 4. Piperine from black pepper

III. CHROMATOGRAPHIC SEPARATIONS

- 1. Column chromatography Separation of anthracene and picric acid from anthracene picrate.
- 2. Thin layer chromatography Separation of green leaf pigments.
- 3. Paper chromatography Identification of amino acid.

IV. ANY FIVE ESTIMATIONS

- 1. Estimation of aniline
- 2. Estimation of phenol
- 3. Estimation of glucose
- 4. Estimation of ethyl methyl ketone
- 5. Estimation of amino group
- 6. Estimation of amide group
- 7. Saponification of fat or an oil
- 8. Iodine value of an oil
- 9. Estimation of sulphur in an organic compound

V.SPECIAL INTERPRETATION OF ORGANIC COMPOUNDS USING UV, IR, PMR AND MASS SPECTRA OF THE FOLLOWING 15 COMPOUNDS

[See ANNEXURE – I]

Recommended Books

Arthur I.Vogel, A text book of Practical Organic Chemistry, ELBS Raj K. Bansal, Laboratory Manual of Organic Chemistry, Wiley Eastern limited.

UNIVERSITY EXAMINATION MARKS

University Examination	Marks
Estimation	25
Preparation	25
Interpretation of spectra	10
Viva Voce	10
Record	05
Total	75

<u>CONTINUOUS INTERNAL ASSESSMENT MARKS (CIA MARK)</u> <u>MAX. MARKS = 25</u>

Evaluation method for practical paper:

Distribution of Marks

Internal assessment	Marks
Two Tests	10
Results accuracy	10
Attendance/ Regularity	5
Total	25

PRACTICAL PAPER - 5 INORGANIC CHEMISTRY PRACTICAL - II

1. ANALYSIS OF ORES

- 1. Determination of percentage of calcium and magnesium in dolomite.
- 2. Determination of percentage of MnO_2 in pyrolusite.
- 3. Determination of percentage of lead in galena.

II. ANALYSIS OF ALLOYS

- 1. Estimation of tin and lead in solder.
- 2. Estimation of copper and zinc in brass.
- 3. Estimation of chromium and nickel in stainless steel.

III. ANALYSIS OF INORGANIC COMPLEX COMPOUNDS

- 1. Preparation of cis and trans potassium bis (oxalato) diaquochromate(III) and analysis of each of these for chromium.
- 2. Preparation of potassium tris (oxalato) ferrate (III) and analysis for iron and oxalate.

IV. QUANTITATIVE ANALYSIS OF THE FOLLOWING MIXTURES (one by volumetric and one by gravimetric method)

- 1. Copper and Nickel
- 2. Copper and Zinc
- 3. Iron and Nickel
- 4. Iron and Magnesium

V. COLORIMETRIC ANALYSIS USING PHOTOELECTRIC METHOD

- 1. Estimation of iron
- 2. Estimation of nickel
- 3. Estimation of manganese
- 4. Estimation of copper

VI. AMPEROMETRIC TITRATIONS (With dead stop endpoint)

- 1. Thiosulpate iodine system
- 2. Iron (II) cerium (IV) systems.

Reference book.

N.N. Greenwood and A. Earnshaw, Chemistry of the Elements, Vol.II, Pergamon Press (1997

VII. SPECTRAL INTERPRETATION OF THE FOLLOWING INORGANIC COMPOUNDS

[See ANNEXURE – II]

UNIVERSITY EXAMINATION MARKS

University Examination	Marks
I. Estimation of mixture	
containing two metal ions	
procedure	5
Volumetric analysis	15
Gravimetric analysis	10
II. Colorimetric estimation (or)	
Amperometric titration	
Estimation	15
Procedure	5
III. Interpretation of spectra	10
Viva Voce	10
Record	05
Total	75

<u>CONTINUOUS INTERNAL ASSESSMENT MARKS (CIA MARK)</u> <u>MAX. MARKS = 25</u>

Evaluation method for practical paper:

Distribution of Marks

Internal assessment	Marks
Two Tests	10
Results accuracy	10
Attendance/ Regularity	5
Total	25

PRACTICAL PAPER - 6 PHYSICAL CHEMISTRY PRACTICAL- II

EXPERIMENTS IN ELECTROCHEMISTRY: CONDUCTOMETRY, POTENTIOMETRY, PH METRY AND SPECTROSCOPY.

I.CONDUCTIVITY MEASUREMENTS

- 1. Determination of equivalent conductance of a strong electrolyte and verification of Debye Huckel Onsager Equation
- 2. Verification of Debye-Huckel limiting law
- 3. Verification of Ostwald's Dilution law for a weak electrolyte.
- 4. Determination of pK_a values of weak acids and weak bases.
- 5. Conductometric titrations between acid (simple and mixture of strong and weak acids) base,
- 6. Precipitation titrations including mixture of halides.

II. E.M.F MEASUREMENTS

- 1. Determination of standard potentials (Copper, Silver & Zinc)
- 2. Determination of thermodynamic quantities from EMF measurements -
- 3. Potentiometric titrations Neutralization reactions
- 4. Determination of pH of buffer solution and calculation of pKa.
- 5. Determination of stability constant of a complex.
- 6. Determination of solubility product of a sparingly soluble salt.
- 7. Potentiometric titrations Redox titrations.
- 8. Potentiometric titrations Precipitation titration of mixture of halides by EMF measurements.

III. SPECTROSCOPY: INTERPRETATION OF SPCTRA [See ANNEXURE – III].

- 1. Experiments given only to familiarize the interpretation of spectra provided.
- 2. Interpretation of UV-Visible spectra of simple molecules for the calculation of molecular data
- 3. Identification of functional groups (5 typical spectra will be provided).
- 4. IR and NMR spectral calculations of force constant and coupling constants respectively
- 5. Identification and interpretation of a spectra (5 each in IR and NMR will be provided)

LIST OF EXPERIMENTS SUGGESTED FOR PHYSICAL CHEMISTRY PRACTICAL II

Typical list of possible experiments are given. Experiments of similar nature and other experiments may also be given. The list given is only a guideline. Any 15 experiments have to be performed in a year.

- 1. Determination of the equivalent conductance of a weak acid at different concentrations and verify Ostwald's dilution law and calculate the dissociation constant of the acid.
- 2. Determination of equivalent conductance of a strong electrolyte at different concentrations and examine the validity of the Onsager's theory as limiting law at high dilutions.
- 3. Determination of the activity co-efficient of Zinc ions in the solution of 0.002M Zinc sulphate using Debye-Huckel limiting law.
- 4. Determination of the solubility product of silver bromate and calculate its solubility in water and in 0.01 M KBrO₃ using Debye-Huckel limiting law.
- 5. Conductometric titrations of a mixture of HCl, CH₃COOH and CuSO₄ and NaOH.
- 6. Determination of the dissociation constant of an acid at different dilution.
- Determination of the solubility of the lead iodide in water , 0.04 M KI and 0.04 M Pb(NO₃)₂ at 298 K
- 8. Determination of the solubility product of leadiodide at 298 K and 308 K and calculate the molar heat of solution of lead iodide.
- 9. Compare the relative strength of acetic acid and mono chloroacetic acid by conductance method.
- 10. Determine the basicity of organic acids (oxalic /benzoic).
- 11. Determine the electrode potentials of Zn and Ag electrodes in 0.1M and 0.001M solutions at 298 K and fine the standard potentials for these electrodes and test the 12.
- 12. Determine the activity co-efficient of an electrolyte at different molalities by EMF measurements.
- 13. Determine the dissociation constant of acetic acid titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
- 14. Study of the electrolytic separation of metals (Ag, Cu, Cd and Zn)
- 15. Determine the strength of a given solution of KCl using differential potentiometric titration technique.

- 16. Determine the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.
- 17. Determine the transport number of Ag ions and nitrate ions by Hittorf's method.
- 18. Determine the transport number of cadmium ions and sulphate ions by measuring emf of concentration cells with and without transference.
- 19. Determine the dissociation constant of monobasic or dibasic acid by all the Alber-Serjeant method.
- 20. Determine the pH of the given solution with the help of indicators using buffer solutions and by colorimetric method.
- 21. Perform acid-base titration in a non aqueous medium.
- 22. Determine the pH of a given solution by EMF method using glass and calomel electrodes and evaluate pKa value of an acid.
- 23. Determine the pH of a given solution by emf methods using hydrogen electrode and quinhydrone electrode.
- 24. Estimate the concentration of cadmium and lead ions by successive reduction in polarography. Verify Illkovic equation.
- 25. Determine lead ion by amperometric titrations with potassium dichromate.
- 26. Determine ferric ion by amperometric titration.
- 27. Determine pH value of an acid-base indicator (methyl red) by colorimetry.
- 28. Determine the composition and instability constant of a complex by mole ratio method.
- 29. By colorimetry determine simultaneously Mn and Cr.
- 30. Study the effect of solvent on the conductivity of AgNO₃/acetic acid and determine the degree of dissociation and equilibrium constant in different degree of dissociation and mixtures (DMSO, DMF, dioxane, acetone, water) and test the validity of Debye-Huckel Onsager's equation.
- 31. Determine the solubility of $Ca(TiO_3)_2$ in deionised water and in dilute solution of KCl at 298 K. Determine the solubility product graphically.
- 32. Determine the equivalent conductivity of a Ca electrolyte and dissociation constant of the electrolyte.
- 33. Determine the equivalent dissociation constant of a polybasic acid.
- 34. Calculate the thermodynamic parameters for the reaction $Zn + H_2SO_4$ gives $ZnSO_4 + H_2$ by emf method.
- 35. Determine the formation constant of silver-ammonia complex and stoichiometry of the complex potentiometrically.
- 36. Determine the stability constant of a complex by polarographic method.
- **37.** Determine the g value from a given ESR spectrum.

CORE ELECTIVE PAPER- 4 (to choose 1 out of 3)

A. INORGANIC CHMISTRY-IV

OBJECTIVE:

To study about the Inorganic Spectroscopy and Nuclear Chemistry.

OUTCOMES:

The students will be able to

- Explain the different types of inorganic spectra and also interpretation.
- Applying and interpreting NMR spectrums of various inorganic compounds.
- Applying and interpreting ESR spectrums of various inorganic compounds.
- Describe Koopman's theorem, structure, chemical shift and correlation with electronic charges of photo electron spectroscopy.
- Illustrate the principle, instrumentation and applications of AAS, AES and AFS.

UNIT-I: INORGANIC SPECTROSCOPY - I

Applications to inorganic systems of the following: ultra violet, visible, infra-red and Raman spectra of metal complexes, organometallic and simple inorganic compounds with special reference to coordination sites and isomerism.

UNIT-II: INORGANIC SPECTROSCOPY - II

Application to Inorganic systems of the followings

NMR, NQR and Mossebauer spectra - NMR of ³¹P, ¹⁹F, NMR shift reagents. NQR - Nitrosyl compounds. Mossebauer spectra of Fe and Sn systems.

UNIT-III: INORGANIC SPECTROSCOPY - III

ESR Introduction - Zeeman equation, g-value, nuclear hyperfine splitting, interpretation of the spectrum, simple carbon centered free radicals. Anisotropy - g-value and hyperfine splitting constant. McConnell's equation, Kramer's theorem.ESR of transition metal complexes of copper, manganese and vanadyl complexes.

Photoelectron spectroscopy (UV and X-ray) - photo electron spectra - Koopman's theorem, fine structure in PES, chemical shift and correlation with electronic charges.

UNIT-IV: INSTRUMENTAL ANALYSIS - I

AAS, AES and AFS – Principle, instrumentation and applications, advantages of AAS, interferences; GLC and HPLC – Principle, instrumentation and working, types of detectors; Inductively coupled plasma spectroscopy (ICP)- introduction, instrumentation, interferences and applications.

UNIT-V INSTRUMENTAL ANALYSIS - II

Laser Raman spectroscopy - principle, interfaces, advantages and applications.

Magnetic susceptibility and its determination - Guoy method, Faraday method and applications.

Polarography and Amperometry - Principle, instrumentation and applications.

TEXT BOOKS

1. A. Earnshaw, Introduction to Magneto Chemistry, Academic Press, London, (1968).

2. C.N.R. Rao, I.R. Ferraro, Spectroscopy in Inorganic Chemistry, Vol. I and Vol. II, Academic Press, (1970).

3. D. A. Skoog and D.M.West, Principles of Instrumental Methods of Analysis, Saunder's College Publ. III Edition, (1985).

4. E. A. V. Ebsworth, D. W. H. Rankin and S. Cradock, Structural Methods in Inorganic Chemistry, II Edition, Blackwell Scientific Publications, Oxford, London (1991).

5. G.D. Christian and J.E.G. Reily, Instrumental Analysis, Allegn Becon, II Edition, (1986).

6. H.A. Strobel, Chemical Instrumentation, Addison - Wesley Pub. Co., (1976).

7. R. S. Drago, Physical Methods for Chemists, Saunders College Publishing, Philadelphia (1992).

8. Willard Merrit, Dean and Settle, Instrumental methods of analysis, CBS Publ. VI edition, (1986).

Suggested References

1. AI Vogel, Text book of Qualitative Analysis - IV Edition (1985).

2. C. N. Banwell and E.M. Mc Cash, Fundamentals of Molecular Spectroscopy, IV edition, Tata McGraw Hill, New Delhi (1994).

3. D.A. Skoog D.M. West, Holt Reinhert and Winston, Fundamental of Analytical Chemistry, Publication, IV Edition (1982).

4. D.N. Sathyanarayana, Electronic Absorption Spectroscopy and Related Techniques, Universities Press (India) Ltd., Hyderabad (2001).

5. FA Cotton and G Wilkinson, Advanced Inorganic Chemistry, John Wiley and Sons, V Edition (1988).

6. G. Aruldhas, Molecular Structure and spectroscopy, Prentice Hall of India Pvt. Ltd., New Delhi (2001).

7. J. Huheey, Inorganic Chemistry, Harper and Collins, NY, IV Edition, (1993).

8. J. M. Hollas, Modern Spectroscopy, IVedition, John Wiley & Sons, Ltd., Chichester (2004).

9. M.C. Shrivers, P.W Atkins, CH. Langford, Inorganic Chemistry, OUP (1999).

10. Nakamoto, Infrared and Raman Spectra of Inorganic and Coordination Compounds, III Edn., John Wiley and Sons, New York, (1986).

11. O. Khan, Molecular Magnetism, New York, VCH (1993).

12. R.L. Carlin, Magneto chemistry, Springer-Verlag, New York, (1986).

13. S.F.A.Kettle, Physical Inorganic Chemistry: A Coordination Chemistry Approach, Oxford University Press, (1998)

CORE ELECTIVE PAPER-4

B. ENVIRONMENTAL CHEMISTRY

OBJECTIVES:

To understand the concept of different types of pollution. To learn the various techniques involved in the analysis of pollutants. To know the methods for the control of pollution

OUTCOMES:

The students will be able to

Understanding of adverse effect of pollution. Knowledge on sampling techniques. Understanding on the adverse effect of air, water, and noise pollution. Awareness on radioactive pollution.

UNIT-I AIR POLLUTION AND WATER POLLUTION

Classification of air pollution according to origin, chemical composition and state of matter - effects of air pollutants on living and nonliving things - ambient air quality standards - problems of air pollution in India - pollutions in industrial area (cement industry and thermal power plant) - Effect and consequences of air pollution: acid rain, green house effect, global warming and ozone depletion - major air pollution disasters - Bhopal Gas Leak - Chernobyl Nuclear Accident and Three Mile Island disaster.

Classification of water pollutants: DOD, BOD and COD - Effects of water pollutant on life and Environment.

UNIT-II SAMPLING AND ANALYSIS OF WATER AND AIR POLLUTANTS

Methods of sampling of gaseous, liquid and solid pollutant - analysis and effect of sulfur oxides, nitrogen oxides and carbon monoxide - biochemical effects and toxicology of Cd, Cr, As, Pb and Cu. Environmental implications of fertilizers, insecticides, pesticide - effect of pesticide residue on life - analytical techniques for pesticides residue analysis (Neutron Activation Analysis, Anodic Stripping Voltammetry and Atomic Absorption Spectroscopy).

UNIT-III METHODS OF CONTROL OF AIR AND WATER POLLUTION

Methods of control of air pollution: Electrostatic precipitations - wet and dry scrubber, filters, gravity and cyclonic separation - adsorption, absorption and condensation of gaseous effluent.

Methods of control of water pollution: Water and waste water treatment - aerobic and anaerobic - aeration of water - principle of coagulation, flocculation, softening, disinfection, demineralization and fluoridation.

UNIT – IV NOISE POLLUTION

The decibel scale - effect: physiological, psychological, acute and chronic - Measurement of noise level (Sound level meter, Magnetic tap recorder, noise limit indicator) - noise control in industries: Administrative, engineering and path control - Protection of the personne (ear plugs, ear muffs. Helmets) - acoustic absorptive materials - noise control methods in industrial plants.

UNIT-IV RADIOACTIVE POLLUTION

Classification: Non-ionizing and ionizing radiation - radioactive pollution and their sources - natural and anthropogenic - biological effect of radiation on the human body - radiation doses -preventive measure from nuclear radiation - regulations from safety measure.

Radioactive wastes: Classification - low level and high level - radioactive waste disposal - geological disposal - ocean dumping - sub-sea bed dumping - subductive waste disposal method - transmutation of high - level radioactive waste - radioactive waste management in India.

TEXT BOOKS

- 1. S.S Dara ," A Text Book of Environmental chemistry and Pollution Control ",S.. Chand & company Ltd, New Delhi
- 2. V. K. Ahluwalia," Environmental chemistry", Ane Books India, Chennai.
- 3. Anu Gopinath and Chandradasan, Environmental Chemistry., Vishal Publishing Co, Delhi.

REFERENCE BOOKS

- 1. A. K. De. "Environmental Pollution", New age intenational publishers, New Delhi
- 2. G. S. Sodhi, "Fundamental Concepts of Environmental Chemistry", Narosa Publishing House, New Delhi.
- 3. S.M. Khopkar, Environmental Pollution Analysis,
- 4. S. P.Mahajan, Pollution control in process industries.

http://www.nios.ac.in/media/documents/313courseE/L36.pdf

http://www.iisc.ernet.in/currsci/dec252001/1534.pdf

http://www.sciencelog.net/2014/12/radioactive-pollution-causes-and-effect.html

http://collegesat.du.ac.in/UG/Envinromental%20Studies_ebook.pd

CORE ELECTIVE PAPER - 4 C. MEDICINAL CHEMISTRY AND DRUG DESIGN

Objectives:

Students should be able to understand concepts of drug design and mechanism of drug action of different drugs. Students will be aware of metabolism and delivery methods of different classes of drugs.

OUTCOMES:

The students will be able to

Have knowledge on principles of drug design and development. Understanding the mechanism of drug action. Acquire Knowledge on various types of medicinal compounds. Gain Knowledge on quantitative analysis of drugs.

UNIT-I: DRUG DESIGN

Development of new drugs, concepts of pro-drugs and soft drugs, Principles of drug design, Quantitative structure activity relationships. History and development of QSAR (Quantitative Structure Activity Relationships) - Concepts of drug parameters. High throughput Screening.

UNIT-II: IMPORTANCE AND MECHANISM OF DRUG ACTION

Antibiotics: Drug action of penicillin, cephalosphorin, tetracycline and macrocyclic antibiotics (no synthesis). Antimalerials: Trimethoprim- NSAIDS: Paracetamol, Meperidine, Aminopyrine-Ibuprofen, Oxyphenylbutazone, Diclophenac sodium, Indomethacin-Antitubercular and antileprotic: Ethambutol, Isoniazide and Daspone - Anaesthetics: Lidocaine, - Antihistamines: Phenobarbital, Diphenylhydramine-Tranquilizers: Diazepham, Trimeprazine, Thiopental - Anti AIDS agents: Acylovir, Ganciclovir.

UNIT-III: PHYSICO-CHEMICAL FACTORS AND BIOLOGICAL ACTIVITIES

Physical properties - Features governing drug action - Structurally specific - nonspecific drugs -Thermodynamic activity - Theories - Cut-off point - Factors governing ability of drugs -Absorption - Distribution - Excretion - Biotransformation - Intramolecular distances -Dissociation constants - Isosterism and Bioisosterism.

UNIT-IV: CLASSIFICATION OF MEDICINAL COMPOUNDS

Central Nervous system acting drugs – (General and Local anaesthetics, Sedatives and Hypnotics, Anticonvulsants, Narcotic and Non-narcotic analgesics, Anti-Parkinsonian

agents, Anti-depressants, Tranquilizers, Psychomimetics) - Pharmacodynamic agents (Anti-arrythmics, Anti-anginals, Vasodialators, Anti-hypertensives, Diuretics, Antihistamines) - Chemotherapeutic Agents (Antibiotics, Antivirals, Antifungals) - Drugs for metabolic and endocrine disorders (Anti-thyroid drugs, Anti-diabatic drugs, biosynthetic insulin) – Therapeutic Index (Definitions with examples).

UNIT-V: DRUG ANALYSIS

Principles of quantitative analysis of the following drugs in formulations: Aspirin - benzyl penicillin - ascorbic acid - isoniazid - codeine - chloramphenical - riboflavin and folic acid.

Reference Books

- 1. Burger's Medicinal Chemistry & Drug discovery, Vol 1-3, 5th Ed, 1995.
- 2. Wilson, Gisvold & Dorque: Text book of Organic Medical and Pharmaceutical Chemistry, 10th Ed, Lippincoh pover publishers, 1998.
- 3. David A Williams, William O. Foye & Thomas L. Lemke, Foye's Principles of medicinal Chemistry, 6th Edition, Lippincott Williams & Wilkins, 2002.

4. Zubay G, Biochemistry, Maxwell Macmillan International Editions, second edition, 1987.

5. R. L. Foster, The Nature of Enzymology, Croom Helm, 1980.

6. D. L. Purich, (Ed), Contemporary Enzyme kinetics and Mechanisms, Academic Press, 1983.

- 7. Dugas H, Bio-organic Chemistry, A chemical approach to enzyme action, Springer 2003.
- 8. Chemistry of drug design and drug action-. R. B. Silverman (2004) Acad. press
- 9. Graham Patrick, An Introduction to Medicinal Chemistry- 2nd Edn. Qxford, 2010
- 10. N. K. Jain, Advances in Controlled and Novel Drug Delivery, CBS, 2001.
- 11. Lednicer, The Organic Chemistry of Drug Synthesis, Vol. 1, 5th Edition, John Wiley & Sons, 2001.
- 12. Foye's Principles of Medicinal Chemistry, Sixth Edition, Wolters Kluwer, 2008
- 13. G.R. Chatwal, Medicinal Chemistry, Himalaya Publishing House.
- 14. V.K. Ahluwalia and M. Chopra, Medicinal Chemistry, Ane Book Pvt. Ltd., 2008.
- 15. J. B. Taylor and P. D. Kenewell., Introductory medicinal chemistry.
- 16. D. C. Garratt., Quantitative analysis of drugs.
- 17. G. L. Patrick., An introduction to medicinal chemistry.
- 18. Beckett and Stenlake., Practical pharmaceutical chemistry. Vol 1 and 2.

OPEN ELECTIVE PAPER-4

(To choose 1 out of 3)

A.POLYMER AND PLASTICS

OBJECTIVES:

- To make the students learn the concept of polymers and plastics.
- *To understand the classification of polymers.*
- *To understand the methods of molecular weight determination.*
- To learn the importance of freons and rubber.
- To appreciate the applications of plastics

OUTCOMES:

The student will be able to

- Classify the different types of polymers.
- Illustrate the importance of stereochemistry of polymers
- Apply the methods for determination of molecular weight
- Acquire knowledge on the various types of rubber
- Differentiate thermoplastic and thermosetting plastic

UNIT-I 1.1. Basic concepts : An introduction to polymers and macro molecules. Natural and synthetic polymers. Classification of Polymers-addition and condensation polymers. 1.2. General methods of preparation of polymers. Polymerization through functional groups, multiple bonds and ring opening. Coordination polymerization.

UNIT-II 2.1. Structure of polymers- linear, branched and cross linked Stereochemistry of polymers-Isotactic ,Sydiotactic and Atactic. 2.2. properties of polymers : The crystalline melting point. The glassy state and glass transition temperature.

UNIT-III 3.1. Copolymerisation – Definitions – homo and copolymers.Block copolymers and Graft copolymers. 3.2.Molecular weight of polymers. Number average molecular weight and weight average molecular weight. Determination of molecular weight by Viscosity and Osmometry methods.

UNIT-IV 4.1. Poly olefins-polythene, PTFE, Freons, PVC, polypropylene and polystyrene. 4.2. Natural and synthetic rubbers.-Constitution of natural rubber. Butyl, Buna, Buna-S, Buna-N, Neoprene, SBR, Thiocol, Polyurethane and silicone rubbers. 138

UNIT-V 5.1. Plastics and Resins Definitions. Thermoplastic and thermosetting resins. Constituents of plastic-fillers, dyes, pigments, plasticizers, Lubricants and catalysts.Uses of thermoplastic resins and thermo setting resins.

REFERENCES: 1.V. R. Gowrikar ,N.V.Viswanathan : Polymer Science- Wiley Eastern Limited ,New Delhi. 1986

2. R.B.Seymour, Introduction to Polymer Chemistry, MC Craw Hill, New York 1971.

3. S.S.Dara, A Text Book in Engineering Chemistry, S.Chand & Company Ltd, New Delhi. Third Edition ,!992.

OPEN ELECTIVE PAPER-4

B.BASICS OF FORENSIC SCIENCE

OBJECTIVES:

To define forensic science or criminalistics, and describe the major contributors to the development of forensic science. To define the physical evidence of a crime scene and explain the difference between the identification and comparison of physical evidence of crimes To demonstrate the ability to identify, collect, and preserve a variety of fingerprint types and will demonstrate the ability to analyze components To explain the various methods for analyzing DNA from a crime scene

OUTCOMES:

Learn the concept and basics of forensic sciences Gaining the knowledge of microanalysis of DNA Describing the forensic engineering and finger print analysis Explaining the legal aspects and trace analysis

UNIT I: CONCEPTS OF FORENSIC SCIENCE

Forensic Science- History and Development of Forensic Science - What Is a Forensic Scientist? - Career Information – Indian and Other Forensic Science Systems - The Organization of Forensic Science Laboratories- The Functions of the Forensic Scientist -Crime Scene Investigation - The Crime Scene as Recent History - Preserving and Recording the Crime Scene - Crime Scene Investigation Process - Recognition of Bloodstain Patterns – other examples.

UNIT II: FORENSIC SCIENCE IN THE LABORATORY

The Forensic Laboratory - Identification and Characterization of Blood and Bloodstains Identification of Biological Fluids and Stains - Techniques of DNA Analysis - Microanalysis and Examination of Trace Evidence – Fingerprints - Forensic Footwear Evidence - Forensic Tire Impression and Tire Track Evidence - Firearm and Tool Mark Examinations - Questioned Documents - Analysis of Controlled Substances.

UNIT III: FORENSIC ENGINEERING AND INVESTIGATION

Forensic Pathology - How to Become a Forensic Pathologist - Investigation of Death: Coroners and Medical Examiners - Death Investigation Process - The Postmortem Interval (PMI)—Time of Death – Exhumations - The Teamwork Approach - The Human Skeleton - Identification of Skeletal Remains - The Significance of Age - The Biological Profile -Individualization of Human Bone - Collection of Bones - Forensic Odontology

UNIT IV: FORENSIC TRACE EVIDENCES

Forensic Analysis of Metals, soils, Plants, Paints – The Chemistry of fire and analysis of flammable residues - Explosions and Explosives - Collection and Analysis of Evidence of Explosives – Fingerprints – History of Fingerprints - Classification of Fingerprints - Automated

Fingerprint Identification Systems- Methods of Detecting Fingerprints - Preservation of Developed Prints- Digital Imaging for Fingerprint Enhancement - Document Examination - The Document Examiner - Handwriting Comparisons-Typescript Comparisons-Alterations, Erasures, and Obliterations

UNIT V: LEGAL ASPECTS OF FORENSIC SCIENCE

Forensic Science and the Law - Admissibility of Evidence - Laboratory Reports - Expert Testimony - Countering Chaos- Logic, Ethics, and the Criminal Justice System - Forensic Science and the Law - Legal Issues in Forensic DNA

TEXTBOOKS

- 1. Jay A. Siegel, Kathy Mirakovits, Forensic Science: The Basics, 2nd Edition, CRC Press, 2010.
- 2. Stuart H. James, Jon J. Nordby, Suzanne Bell, Stuart H. James, Jon J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2002.
- 3. Richard Saferstein, Forensic Science, An Introduction, Pearson Education, Inc. (Pearson Prentice Hall), 2011.

REFERENCE BOOKS

- 1. Robert Milne, Forensic Intelligence, Taylor and Francis Group, 2013.
- 2. Robert Bruce Thompson and Barbara Fritchman Thompson, An Illustrated Guide to Home Forensic Science Experiments-DIY Science-O'Reilly Media Inc., 2012.
- 3. Louis B. Schlesinger, Sexual Murder Catathymic and Compulsive Homicides, CRC Press, 2004.
- 4. Terrence F. Kiely, Forensic Evidence: Science and The Criminal Law, CRC Press LLC, 2001.

OPEN ELECTIVE PAPER-4 C.HEALTH SCIENCE

OBJECTIVES:

To give students a knowledge about role of science in health care To introduce physical principles of instrumentation involved in medical diagnosis To describe the scientific basis for regulating exposures to radiations To lay the foundations for further studies in medical science and radiology

OUTCOMES :

Explaining the fundamentals of health science Gaining knowledge of types of radiations Gaining knowledge of breathing mechanism of cardiovascular system Describing about the environmental effects on health.

UNIT I: HEALTH SCIENCE FUNDAMENTALS

Electromagnetic spectrum and its medical application-Light - Chemistry of light, Intensity of light, limits of Vision and color vision Sound - Physics of sound- Normal sound levels Ultrasound fundamentals- Generation of ultrasound-Ultrasound Transducer – Interaction of Ultrasound with Materials-Reflection and Refraction – Absorption and Scattering.

UNIT II: RADIATION

Radioactivity- Transformation mechanisms- Transformation kinetics- Naturally Occurring Radiation- Interaction of radiation with matter- Alpha rays- Beta rays- Gamma rays- Radiation - external exposure- dosimetry- dose response characteristics- Radiation safety guidelines.

UNIT III: SCIENCE OF CARDIOPULMONARY SYSTEM

The Airways, - blood and lung interaction –pressure air flow volume relationships of lungs – physics of alveoli – the breathing mechanism – Major components of cardiovascular system – O_2 and CO_2 exchange in the capillary system – Physical activity of heart – transmural pressure – Bernolli's principles applied to cardiovascular system - Blood flow – laminar and turbulentzz.

UNIT IV: HEALTH SCIENCE INSTRUMETATION

Radiation detectors- Particle counting instruments- types of counters- resolving time- Nuclear Spectroscopy- Dose measuring instruments- types of dosimeters- neutron measurements-detection reactions- neutron dosimetry- calibration- counting statistics.

UNIT V: ENVIRONMENTAL HEALTH SCIENCE

Naturally occurring radioactive material- Radon- Environmental monitoring programs-Environmental releases- Regulatory guidelines for effluent pathways- Doses from liquid effluent pathways- Doses from gaseous effluent pathways- Pathway selection- Model parameters.

TEXTBOOKS

- 1. Herman Cember, Thomas E. Johnson, Introduction to Health Physics, 4th Edition, 2008.
- 2. Joseph John Bevelacqua, Contemporary Health Physics: Problems and Solutions,1stedition, 1995.

REFERENCES

- 1. Brown B.H, PV Law ford, R H Small wood, D R Hose, D C Barber , Medical Physics and Biomedical Engineering, CRC Press, 1999.
- 2. Gopal B.Saha Physics and Radiobiology of Nuclear Medicine,3rd edition, Springer, 2006.
