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by NAAC

BANGALORE UNIVERSITY

V& VI Semester Chemistry Syllabus
for

B.Sc. / B.Sc. Honours Courses

Framed According to the National Educational Policy (NEP 2020)

(To be implemented from the academic year 2023-24)

DEPARTMENT OF CHEMISTRY

Bangalore
University
Jnanabharathi
Bangalore-560056

AUGUST-2023

Preamble

The Board of studies in UG Chemistry headed by **Prof G Krishnamurthy**, the Chairman, Department of Studies in Chemistry, Jnanabharathi Campus, Bangalore University had the thorough discussions on the syllabus of V and VI semester Chemistry for BSc/ BSc Honors courses using the syllabus provided by the NEP Chemistry syllabus drafting Committee. This syllabus has to be accepted for the academic year 2023-24.

The Core committee consisting of the faculty members of different branches of Chemistry namely Analytical, Physical, Inorganic and Organic Chemistry which comprising the BOS and also additional faculty members from different UG Colleges of Bangalore University have made effective joint brainstorming discussions and arrived at a Syllabus in Chemistry for **V and VI** semesters on **28.08.2023** and **29.08.2023**.

The final syllabus incorporating all the suggestions was finally approved by the members of the Board of Studies in Chemistry (UG) on **29.08.2023**. The following Faculty Members of the Core Committee were involved in the preparation of the Chemistry Syllabus.

Physical Chemistry Section

1. G. Krishnamurthy
2. K. Ramakrishna Reddy
3. P. Nagegowda

Inorganic and Biological Chemistry

4. Dr. Lakshmi Devi
5. Dr. Muddukrishna K R
6. M. Shubha
7. Nebula Murukesh
8. B. M. Sreenivas
9. Dr. Shalini K. S.
10. Dr. Shashikumar N. D.

Organic Chemistry Section

11. Dr. Vasudeva Reddy K
12. Dr. Sumaiya Tabassum

Sd/-

PROF. G. KRISHNAMURTHY

CHAIRMAN

BOS in Chemistry (UG)

Bangalore University

Bangalore -560056

PROGRAMME STRUCTURE

Semester	Title of the Paper	Teaching Hours	Hours / week		Examination Pattern Max. & Min. Marks /Paper						Duration of Exam (hours)		Total Marks / paper	Credits	
					ESE			Practical							
			Theory	Practical	Max.	Min.	IA	Max.	Min.	IA	Theory	Practical		Theory	Practical
V	DSC-5: Organic and Physical Chemistry -III	60	4	-	60	22	40	-	-	-	3	-	100	4	-
	DSC LAB 5: Organic and Physical Chemistry -III	60	-	4	-	-	-	25	9	25	-	3	50	-	2
	DSC-6: Inorganic and Biological Chemistry-III	60	4	-	60	22	40	-	-	-	3	-	100	4	-
	DSC LAB 6 Inorganic and Biological Chemistry- III	60	-	4							-	3	50	-	2
VI	DSC-7: Organic and Physical Chemistry -IV	60	4	-	60	22	40	-	-	-	3	-	100	4	-
	DSC LAB 7: Organic and Physical Chemistry - IV	60	-	4	-	-	-	25	9	25	-	3	50	-	2
	DSC-8: Inorganic and Biological Chemistry- IV	60	4	-	60	22	40	-	-	-	3	-	100	4	-
	DSC LAB 8: Inorganic and Biological Chemistry- IV	60	-	4								3	50		2

Semester	DSC/Title /Name Of the course	Program outcomes that the course addresses	Pre-requisite course(s)	Pedagogy	Assessment
5.	**DSC-5: DSC Lab-5: DSC-6: DSC Lab-6:**		DSC-3 and DSC-4	MOOC, Problem solving	Internal tests, Assignments, Quiz Seminars
6.	**DSC-7: DSC Lab-7: DSC-8: DSC Lab-8:**		DSC-5 and DSC-6	MOOC, Problem solving	Internal tests, Assignments, Quiz Seminars

Proceedings of the BOS meeting held on 28th and 29th August 2023.

The BOS meeting was held on 28th and 29th August 2023 for scrutinizing and approving the syllabus of V and VI Semester of BSc Chemistry for the academic year 2023-24 from 10.30 am in the board room at the department of Chemistry, Bangalore university, Jnana Bharathi, Bangalore-56.

Agenda of the Meeting:

1. Srutinizing the V and VI semester Syllabus of UG chemistry (NEP) for the Academic year 23-24 onwards.
2. Approval of Panel of Examiners in UG Chemistry for the Academic year 2023-24.
3. Approval of BOE Panel in UG Chemistry for the Academic year 2023-24.

The BOS Chairman, Prof G Krishnamurthy, the Charman, Dept of Chemistry Bangalore University, Bangalore Welcomed all the members for the BOS meeting. He briefed the members to scrutinizing the syllabus thoroughly and finalize it.

All the members involved in the active discussions and scrutinized and prepared the final syllabus and unanimously approved the syllabus of V and VI semester UG chemistry (NEP) for the Academic year 23-24 onwards.

All the members unanimously Approved the Approval of Panel of Examiners in UG Chemistry for the Academic year 2023-24.

All the members unanimously Approved the BOE Panel in UG Chemistry for the Academic year 2023-24.

29/08/2023

BOS CHAIRMAN

Prof. G. KRISHNAMURTHY
Chairman
Department of Chemistry
Bangalore University
Jnanabharathi Campus
Bangalore - 560 056.

The members who attended the BOS meeting and their signatures

MEMBERS OF THE BOS (UG) CHEMISTRY

1.	Prof G Krishnamurthy	Chairman	Signature
2.	Prof M Shubha	Member	
3.	Dr Nagegowda P	Member	
4.	Dr Jisha S P	Member	ABSENT
5.	Dr K Ramakrishna Reddy	Member	
6.	Dr K R Muddukrishna	Member	
7.	Prof B M Sreenivas	Member	

MEMBERS RETIRED

4.	Dr Renuka Manjunath	Member(Retired)
5.	Dr B Vijaya Babu	Member(Retired)
6.	Dr Mallesh	Member(Retired)

FACULTY MEMBERS(INVITED)

1. Dr Lakshmi Devi, GFGC, Ramanagara, Karnataka.
2. Dr Vasudevareddy, GFGC, Vijayanagar, Bangalore. ABSENT
3. Dr Prasanna Kumar, M S Ramaiah College, Bangalore.
4. Nebula Murukesh, St Francis de Sales college, Bangalore.
5. Dr. Shalini K S, Maharani' s science College for Women, Bangalore-01.
6. Dr. Sridhar, Maharani' s science College for Women, Bangaluru-56001. ABSENT
7. Dr Sumaiya, Surana College, Bangalore.
8. Dr. Shashi Kumar N D, Christ Academy of Institute for Advanced Studies, B, lore- 83.

G Krishnamurthy 29/08/2023
Chairman, BOS
UG Chemistry, BUB

Prof. G. KRISHNAMURTHY
Chairman
Department of Chemistry
Bangalore University
Jnanabharathi Campus
Bangalore - 560 056.

PROGRAMME OUTCOMES

By the end of the programme the students will:

1. Understand the basic principles of various branches of Chemistry
2. Demonstrate a range of practical skills to conduct and infer experiments independently and in groups
3. Apply the key concepts and standard methodologies to solve problems related to Chemistry
4. Apply methodologies to the solution of unfamiliar types of problems
5. Exhibit skills leading to employability in Chemistry and allied industries
6. Comprehend the fundamental aspects of research in Chemistry
7. Possess the level of proficiency in subject required for post-graduation as well as for pursuing research in Chemistry and related interdisciplinary subjects
8. Design solutions stemming from the application of Chemistry to the local issues

DISCIPLINE CORE COURSE SEMESTER – V (NEP)

DSC-5-Organic chemistry and Physical Chemistry- III

Contact hours- 60 **Credit point-4**

Workload-4 h/week **Each unit: 15h**

COURSE OBJECTIVES

1. Recognize and classify alcohols, thiols, and phenols based on their structural characteristics.
2. Explore the reactivity of alcohols, thiols, and phenols, including their reactions with various reagents and under different conditions**.**
3. Explore the reactivity of aldehydes and ketones, including their reactions with various reagents, such as nucleophiles and oxidizing agents.
4. Explore the reactivity of aldehydes and ketones, including their reactions with various reagents, such as nucleophiles and oxidizing agents.
5. Learn methods for the synthesis of carboxylic acids, including laboratory techniques and industrial processes.
6. To impart the concepts of photochemistry and study beer lamberts law
7. To understand the photochemical and photophysical processes and their quantum yield expressions.
8. To acquire knowledge on nuclear reactions and radioactive decay
9. To develop expertise on the fundamental concepts of quantum mechanics and its application in chemistry
10. To know different types of electrochemical cells, types of electrodes and electrode potential

COURSE SPECIFIC OUTCOMES

After the completion of this course, the students would be able to

1. Demonstrate a solid understanding of the properties, structures, and nomenclature of alcohols, thiols, and phenols.
2. Perform laboratory experiments safely and effectively, including the synthesis and analysis of alcohols, thiols, and phenols.
3. Evaluate the suitability of different synthetic methods and reagents for specific applications involving aldehydes and ketones.
4. Understand and appreciate the practical applications of aldehydes and ketones & carboxylic acids in various industries, research, and daily life.
5. Explain the Lambert-Beer’s law, the laws of photochemistry, photochemical and photophysical processes as well as to calculate the quantum yield of photochemical combinations.
6. Develop an understanding on nuclear stability, nuclear reactions, radioactive decay and applications of nuclear and radiochemistry
7. Explain the fundamental concepts of quantum mechanics and its application in chemistry
8. Determine the electrode potential of a half cell, identify different types of electrodes, construct cells and demonstrate its application.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Demonstrate a solid understanding of the properties, structures, and nomenclature of alcohols, thiols, and phenols.	X				**X**			**X**
2. Perform laboratory experiments safely and effectively, including the synthesis and analysis of alcohols, thiols, and phenols.	X	**X**				**X**		
3. Evaluate the suitability of different synthetic methods and reagents for specific applications involving aldehydes and ketones.	X							
4. Understand and appreciate the practical applications of aldehydes and ketones & carboxylic acids in various industries, research, and daily life.	X	**X**	**X**		**X**			**X**
5. Explain the Lambert-Beer's law, the laws of photochemistry, photochemical and photophysical processes as well as to calculate the quantum yield of photochemical combinations.	X		**X**			**X**		
6. Develop an understanding on nuclear stability, nuclear reactions, radioactive decay and applications of nuclear and radiochemistry	X		**X**		**X**		**X**	
7. Explain the fundamental concepts of quantum mechanics and its application in chemistry	X	**X**		**X**				
8. Determine the electrode potential of a half cell, identify different types of electrodes, construct cells and demonstrate its application.	X				**X**		**X**	

ORGANIC CHEMISTRY III:

UNIT-I

Alcohols,Thiols and Phenols **10h**

Alcohols: Introduction and classification. Methods of preparation-(i) From carbonyl compounds-reduction of aldehydes and ketones (by Meerwein-Pondorff- Verley reaction);(ii) from acids and esters (by reduction with LiAlH4); (iii) From alkenes (by hydroboration oxidation with alkaline peroxide); (iv)hydration of alkenes.

Reactions of alcohols: Acidic nature, esterification, oxidation of alcohols with KMnO4. Comparison of the reactivity of 1°,2°and 3°alcohols- Lucas test, oxidation with $K_2Cr_2O_7$.

Glycols: Preparation from alkenes using OsO_4, $KMnO_4$ and from epoxides.Oxidation of glycols by periodic acid and lead tetraacetate with mechanism. Pinacol- pinacolone rearrangement.

Glycerol:Preparation from propene and from oils/fats. Uses. Reactions of glycerol: (i) nitration, (ii) action of concentrated H_2SO_4 and (iii) oxidation by periodic acid.

Thiols: Nomenclature. Methods of formation and chemical reactions (with sodium,NaOH,metal oxides, formation of thioesters and oxidation with mild and strong oxidizing agents). Uses of dithianes. Introduction of umpolung character (reversal of polarity) in carbonyl compounds.

Phenols

Classification. Acidic nature - Comparison of acidic strength of phenol with alcohols and monocarboxylic acids.Effect of electron withdrawing $–NO_2$ group and electron donating $–CH_3$ group on acidity of phenols at o-, m-, p- positions. Pechmann reaction, Mechanism of Reimer-Tiemann and Kolbe-Schmidt reactions. Industrial applications of phenols: Conversion of phenol to (i) aspirin, (ii)methyl salicylate, (iii) salol, (iv)salicylsalicylic acid.

Aldehydes and Ketones **5h**

Nomenclature. Preparation of aldehydes: (i)from acid chlorides (Rosenmund reaction), (ii) Gattermann- Koch aldehyde synthesis. Preparation of Ketones: (i) From nitriles,from carboxylic acids with alkyl lithium, (ii) from acid chlorides with metal alkyls.

Mechanisms of Cannizzaro reaction, Benzoin condensation, Reformatsky Reaction and Knoevenagel condensation.General mechanism of condensation with ammonia and its derivatives (NH2−R;R=−NH2,−OH,−NH−CO−NH2).

Reduction:Reduction by $LiAlH_4$ and $NaBH_4$.Mannich reaction.Mechanisms of Clemmensen and Wolff-Kishner reductions.

UNIT -II

Carboxylic acids and their derivatives **10h**

Carboxylic acids:Nomenclature,Classification-mono,di,tricarboxylic acids,hydroxy acids- lactic acid, tartaric acid and citric acid. Mono carboxylic acids: preparation- acid hydrolysis of nitriles with mechanism. Acidic strength- pKa values.

Effect of substituents on the strength of aliphatic and aromatic carboxylic acids. Comparison of acid strength of formic and acetic acid, acetic acid and mono-chloro, dichloro, trichloroacetic acids, benzoic and p-nitrobenzoic acid, p-aminobenzoic acid, explanation.

Reactions: Formation of esters, acid chlorides, amides and anhydrides. Hell-Volhard- Zelinsky reaction, decarboxylation and reduction using LiAlH4.

Di and tri carboxylic acids: Action of heat on dicarboxylic acids -oxalic acid, malonic acid, succinic acid, glutaric acid and adipic acid. Reactions of tartaric acid and citric acid- action of heat and reduction with HI.

Acid derivatives: Acid chlorides- hydrolysis, reaction with alcohol, ammonia and lithium dialkyl cuprates. Acid anhydrides –acetic anhydride- hydrolysis, reaction with alcohol and ammonia.

Amides-hydrolysis,reduction,Hoffmann degradation.

Esters-acid hydrolysis and alkaline hydrolysis, ammonolysis and alcoholysis.

Amines **5h**

Classification. Preparation of alkyl and aryl amines- reductive amination of carbonyl compounds, Gabriel phthalimide synthesis. Basicity of amines in aqueous solution: Inductive, resonance, steric and solvation effects on the basicity of amines. Reaction of amines as nucleophiles– Methylation, quaternary salts, Hofmann elimination with mechanism. Distinguishing reactions of primary, secondary and tertiary amines.

Diazotization and synthetic applications of diazonium salts. Sandmeyer's reaction. (Conversion to chlorobenzene, bromo benzene and benzonitrile), hydrolysis, reduction (to phenyl hydrazine and aniline), coupling reactions to give azo dyes (p-hydroxy azo benzene and 1- phenyl azo-2-naphthol).

PHYSICAL CHEMISTRY III:

UNIT-III

Photochemistry **6h**

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients.

Laws of photochemistry. Grotthus-Draper law, Stark-Einstein law – Statements, differences between photophysical and photochemical processes-any four differences with examples.

Comparison of photochemical and thermal reactions with an example each. Quantum yield definition, Magnitude of Quantum yield of photochemical combination of (i) H_2 and Cl_2 (ii) H_2 and Br_2 (iii) dissociation of HI (iv) dimerisation of anthracene: reason for low, high and medium quantum yields.

Photosensitization-definition with example, photostationary equilibrium – definition and example. Singlet and triplet states – definitions. Fluorescence, phosphorescence, luminescence, bioluminescence and chemical sensors definitions of all these with suitable examples.

Nuclear and Radiochemistry. **9h**

Nucleus: Structure and stability, binding energy calculations. Instability of the nuclei, radioactive decay law, half life: numerical problems. Radioactive equilibrium, radioactive series. Artificial radioactivity: Nuclear reactions induced by γ-radiation, α, n, p,and d particles. Nuclear fission and fusion. Nuclear reactors, Breeder reactors, atomic energy programme in India. Isotopes- use of radio isotopes in tracer technique, agriculture, medicine, food preservation and Carbon dating-Numerical problems.

UNIT-IV

Quantum Mechanics **8h**

Concepts of Operators: Laplacian, Hamiltonian, Linear and Hermitian operators. Angular Momentum operators and their properties. Commutation of operators. Solutions of Schrödinger wave equation for a free particle, particle in a three-dimensional box. Quantum mechanical degeneracy, tunneling (no derivation). Application of Schrödinger equation to harmonic oscillator, rigid rotator.

Application of Schrödinger wave equation to hydrogen atom. Schrödinger equation to hydrogen atom in spherical polar coordinates. Separation of variables.

List of wave functions for few initial states of hydrogen like atoms. The Stern-Gerlach experiment and the concept of electron spin, spin orbitals (elementary idea only) and Pauli's exclusion principle.

Approximate methods: Need for approximate methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

Electrochemistry II **7h**

Galvanic cell: conventions of representing galvanic cells-reversible and irreversible cells, derivation of Nernst equation for single electrode potential (free energy concept).

Weston-cadmium cell: Determination of Emf of a cell by compensation method. Determination of E of Zn/Zn^{2+} and Cu/Cu^{2+}electrodes.

Liquid junction potentials, elimination of liquid junction potential.

Types of electrodes: Metal and gas electrodes (chlorine), metal/metal insoluble salt electrodes, redox electrodes. Reference electrodes-standard hydrogen electrode, calomel electrode, quinhydrone electrode and glass electrode. Determination of pH using these electrodes. Numerical problems.

Concentration cells: (i) Emf of concentration cells (ii) determination of solubility of sparingly soluble salts and numerical problems. Redox electrodes, Emf of redox electrodes. Potentiometric titration involving only redox systems

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3. Organic Natural products. Gurudeep and Chatwal.
4. Chemistry of Natural products 1 &2. OP Agarwal
5. Organic Chemistry, R T Morrison and R N Boyd, Prence-Hall, (1998).
6. Organic reactions and their mechanisms. Kalsi. P.S
7. A textbook of Organic Chemistry. OP Agarwal
8. Reactions and Reagents in Organic Chemistry. OP Agarwal
9. Spectroscopy of Organic compounds. Kalsi. P.S.
10. Spectroscopic identification of organic compounds. Silverstien& Weber.
11. Physical Chemistry, P. W. Atkins, Julio de Paula, ELBS, 7th ediBon, (2002).

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15. Introduction to Quantum Chemistry, A. K. Chandra, Tata McGraw Hill, (1988).
16. Quantum Chemistry, Ira. N. Levine, PrenBce Hall, New Jersey, (1991).
17. Quantum Chemistry, R. K. Prasad, New Age InternaBonal, 2nd ediBon, (2000).
18. Quantum Chemistry through problems and solutions, R. K. Prasad, New Age InternaBonal (1997).
19. Chemical Kinetics- K. J. Laidler, McGraw Hill. Inc. New York (1988).
20. Principles of Chemical KineBcs - House J. E. Wm C Brown Publisher, Boston, (1997).
21. Kinetics and Mechanism - A. A. Frost and R. G. Pearson, John-Wiley, New York, (1961).
22. Chemical Kinetic Methods - C. Kalidas, New Age InternaBonal Publisher, New Delhi (1995)

DSC LAB 5: ORGANIC AND PHYSICAL CHEMISTRY-III PRACTICALS

ORGANIC CHEMISTRY PRACTICALS

Preparations(onestage)

1. Cannizzaro Reaction:Benzaldehyde.
2. Fries Rearrangement:Phenylacetate.
3. Sandmeyer Reaction: 4-Chlorotoluene From 4-toluidine.
4. Pechmann Reaction:Resorcinolandethylacetoacetate.
5. Oxidation of Cyclohexanol.
6. Preparation of S-Benzylthiuronium chloride.
7. Synthesis of P-iodonitrobenzene
8. Synthesis of Phenyl-2,4-dinitroaniline.
9. Synthesis of 2,4,6-tribromoaniline.

PHYSICAL CHEMISTRY PRACTICALS

1. Verification of Beer's Law for Cu^{2+} ions
2. Verification of Beer's Law for Fe^{2+} ions
3. Estimation of Fe^{2+} ions concentration in the given solution by titration of FAS versus $KMnO_4$ through colorimetric method.
4. Estimation of Fe^{2+} ions concentration using EDTA through colorimetric method.
5. Study the hydrolysis of methyl acetate in presence of two different concentrations of HCl and report the relative strength.
6. Study the hydrolysis of methyl acetate in the presence of HCl at different temperatures and report the energy of activation
7. Evaluation of Arrehenius parameter for the reaction between $K_2S_2O_8$ versus KI (first order).

REFERENCES FOR PRACTICALS

1. Findlays practical physical chemistry revised by P. B. Levi. Z, Longman's London (1966).
2. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill InternatIonal. (1966)
3. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut (1988)
4. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987)
5. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
6. Practical Physical Chemistry by A.M James and P. E. Pritchard, Longman's Group Ltd (1968)
7. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983)
8. Physical Chemistry Laboratory Principles and Experiments by H. W. Salberg J. I. Morrow, S. R. Cohen an Green Macmillan publishing Co.,.New York (1994).
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10. Textbook of Quantitative Organic Analysis- A. I. Vogel, (1996).

DISCIPLINE CORE COURSE SEMESTER – V (NEP)

DSC-6-Inorganic chemistry and Biological Chemistry- III

Contact hours- 60 **Credit point-4**

Workload-4 h/week **Each unit: 15h**

COURSE OBJECTIVES

1. To teach students the concept of nomenclature of coordination compounds, geometries (e.g., octahedral, tetrahedral, square planar), and the factors that influence the geometry of coordination complexes by taking various examples.
2. To understand how coordination chemistry interfaces with other branches of chemistry and related fields, such as bioinorganic chemistry and organometallic chemistry.
3. To develop a solid understanding of the different materials used in industry, including their properties, applications, and manufacturing processes.
4. The requisite background knowledge in the field of Biochemistry.
5. A thorough knowledge about the structure, chemistry and functions of biomolecules like carbohydrates, lipids and proteins.
6. A knowledge about the salient features of nucleic acids.
7. The principle and the applications of Blotting and Electrophoretic techniques.
8. The basic characteristics of enzyme and its classification, mechanism enzyme action, enzyme kinetics, enzyme inhibition and co-enzymes.

COURSE SPECIFIC OUTCOMES

After the completion of this course, the students would be able to

1. Define and explain what coordination compounds are, including their structure, bonding, and properties.
2. Understand the practical applications of coordination compounds in various fields, such as catalysis, medicinal chemistry, and materials science.
3. Gain knowledge of the manufacturing and processing methods for various industrial materials, including the techniques used to shape, heat treat, and finish them.
4. Exposed to a strong theoretical and practical background in fundamental concepts.
5. To get insights of multiple important technical areas of Biochemistry.
6. Able to correlate structure and function of biomolecules like carbohydrates, lipids and proteins.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

1. Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
2. Define and explain what coordination compounds are, including their structure, bonding, and properties.	X		**X**		**X**	**X**		**X**
3. Understand the practical applications of coordination compounds in various fields, such as catalysis, medicinal chemistry, and materials science.	X	**X**			**X**		**X**	
4. Gain knowledge of the manufacturing and processing methods for various industrial materials, including the techniques used to shape, heat treat,and finish them.	X		**X**		**X**			**X**
5. Exposed to strong theoretical and practical background in fundamental concepts.	X	**X**	**X**					
6. To get insights of multiple important technical areas of Biochemistry.	X		**X**	**X**			**X**	**X**
7. Able to correlate structure and function of biomolecules like carbohydrates, lipids and proteins.	X		**X**	**X**			**X**	**X**
8. The principle and the applications of Blotting and Electrophoretic techniques	**X**	**X**	**X**			**X**	**X**	
9. The basic characteristics of enzyme and its classification, mechanism enzyme action, enzyme kinetics, enzyme inhibition and co-enzymes.	**X**		**X**	**X**			**X**	**x**

INORGANIC CHEMISTRY III:

UNIT-I

Coordination and Organometallic compounds **15h**

Coordination compounds, ligands and their classification (mono, bi, tri, tetra, penta and hexa dentate ligands) and ambidentate ligands, coordination number, nomenclature of coordination compounds in detail. Theories of structure and bonding (Explanation for the formation of complexes by Werner's Theory in detail and its limitations). EAN rule, Valence bond theory- postulates, low spin and high spin complexes with examples, limitations of VBT. Crystal field theory (octahedral, tetrahedral and square planar complexes). Crystal field splitting and crystal field stabilization energies, limitations of CFT. Magnetic properties of $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$, $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$. Spectral properties of $[Ti(H_2O)_6]^{3+}$, $[Co(H_2O)_6]^{3+}$,

$[CoCl_4]^{2-}$. Isomerism-Structural: ionization, linkage, hydrate and coordination isomerism with examples. Stereoisomerism-geometrical and optical isomerism with examples. Organometallic compounds – ligands, classification (hapticity). Synthesis and structure of $K[PtCl_3(\eta 2\text{-}C_2H_4)]$ and $[Fe(\eta 5 - C_5H_5)_2]$.

Metal carbonyls – $Cr(CO)_6$, $Co_2(CO)_8$, $Mn_2(CO)_{10}$; eighteen electron rule and its deviations with examples.

Applications of coordination/organometallic compounds:cis-platin in cancer therapy, Na_2Ca EDTA in the treatment of heavy metals (Pb, Hg) poisoning, Wilkinson's Catalyst in alkene hydrogenation, Monsanto acetic acid process.

UNIT-II

Industrial Materials **15h**

Refractories: Properties, classification, determination of PCE values.

Abrasives – definition and classification with examples, applications, hardness, manufacture and importance of carborundum and tungsten carbide.

Glass: Properties, types, manufacture of soda glass. Composition and applications of borosilicate, metallic glass, optical glasses and polycarbonate glasses, safety glass, fire and bullet proof glasses.

Ceramics: Raw materials and their roles, varieties of clay, production of ceramic ware, glazing, ceramic insulators.

Cement: Raw materials grades, manufacture of Portland cement (by wet process), setting of cement.

Paints and Varnishes: Constituents of oil and emulsion paints and their role, constituents of varnishes.

Fuels: Characteristics, Calorific value and its determination using bomb calorimeter, Coal- Varieties, Gaseous fuels-advantages, constituents and their significance, production of Coal gas and composition of LPG. Octane number.

Explosives: Classification, preparation of dynamite and TNT.

Propellants: Characteristics, classification, and their applications.

BIOLOGICAL CHEMISTRY:

UNIT-III

Essential biological concepts 4h

Contributions of Lavosier, Wohler, Emil Fischer, Louis Pasteur, Embden, Meyerhof, Parnas. Hans Kreb, Michaelis and Menton, Watson and Crick, Chargaff, H.G. Khorana, Knoop, Pauling, Hopkins and Miescher. Elemental and biochemical composition of living organisms. Role of water in biochemical systems (mention the properties of water which makes water a solvent of life). Importance of water in biological system with special reference to the maintenance of the native structure of biological molecules. Types of bonding in biological molecules.Biological relevance of pH and pKa of functional groups in biopolymers, proteins and nucleic acids. Buffers, pH value of various bio-entities, buffer action, buffer capacity and their importance in biological systems.

Carbohydrates 4h

Structure and biological importance of derivatives of monosaccharides. Amino sugars: β-D-glucosamine, galactosamine and their N-acetylated forms: Nacetylmuramic acid (NAMA); N-acetylneuraminic acid (NANA) Sugar acids–structure and biological importance of D- gluconic acid, D-glucuronic acid and D-glucaric acid. Sugar phosphates–structure and biological importance of Glucose-6-P, Fructose-6-P, Fructose1, 6-di-P, β-D-ribose-5-P and β- D-deoxyribose-5-P. Structure and biological importance of oligosaccharides – isomaltose, cellobiose, trehalose. Polysaccharides - source, comparative account of partial structure and biological function of starch, glycogen, cellulose, chitin and insulin.

Lipids 4h

Introduction, Classification. Fatty acids–definition, classification as saturated and unsaturated with examples and structure (lauric, myristic, palmitic, stearic, oleic, linoleic, linolenic and arachidonic acids). Triglycerides–Structure of simple and mixed glycerides, properties of triglycerides- acid and alkali hydrolysis, saponification number and its significance, iodine number andits significance.I odine number of different oilsrancidity (oxidative and hydrolytic).

Nucleic acids 3h

Types–Components of nucleic acids, bases, nucleosides and nucleotides with structures. Partial structure of polynucleotide. Structure of DNA (Watson - Crick Model) and RNA. Biological roles of DNA and RNAs. Protein-nucleic acid interaction- chromatin and viral nuclear capsid

UNIT-IV

Proteins 5h

α-amino acids: Introduction, structure, classification on the basis of polarity of R-groups, essential and non-essential amino acids, ionic properties and reactions of amino acids with alcohol, nitrous acid and Ninhydrin. Peptide bond, nomenclature and classification of peptides, Levels of organizations of Protein: Primary structure, Secondary structure (α-helix, triple helix eg., Collagen and β-pleated sheet) forces stabilizing secondary structure, tertiary structure and forces stabilizing it, quaternary structure. Importance of primary structure by taking sickle cell anaemia as example.

Hormones 2h

Definition. Classification - a) amino acid derivatives (epinephrine and thyroxine); b) peptide (oxytocin and vasopressin) and polypeptide hormones (insulin and glucagon); c) Steroid hormones (progesterone, testosterone) with functions. Role of insulin and glucagon in glucose homeostasis. Mediators of hormone action – Ca^{2+}, cyclic AMP.

Enzymes **6h**

Introduction, Holo enzyme (apo enzyme and coenzyme). Active site, specificity. Classification of enzymes (EC code number not required). Enzyme substrate interaction- Fischer and Koshland models. Enzyme kinetics–factors affecting rate of enzymatic reactions – enzyme concentration, substrate concentration, pH and temperature (mention M. M. equation). Allosteric enzymes–definition and example Enzyme Inhibitions- Competitive, non-competitive and uncompetitive inhibition with one example for each. Co- enzymes and cofactors and their role in biological reactions.

Biochemical techniques **2h**

Principle and applications Electrophoresis–cellulose acetate membrane electrophoresis and PAGE. Blotting techniques- Basic principle, types and application.

REFERENCES :

1. Advanced Inorganic Chemistry, 6th Edition F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann-John Wiley & Sons, 1999.
2. Concise Inorganic Chemistry, 5th Edition J. D. Lee, Blackwell Science, 2001.
3. Inorganic Chemistry, 4th Edition J. E. Huhee, E. A. Keiter and R. I. Keiter, Pearson Education Asia, 2000
4. Inorganic Chemistry, ELBS 2nd Edition D. F. Shriver, P. W. Atkins and C. H. Langford, Oxford Univ. Press 2002.
5. Modern Inorganic Chemistry W. L. Jolly, McGraw Hill Co.
6. Principles of Inorganic Chemistry B. R. Puri and L. R. Sharma, Jauhar S. P-S. N. Chand & Co., 1998
7. Inorganic Chemistry, 3rd Edition (ISE) A G Sharpe, Addison Wesley, 1989.
8. Basic Inorganic Chemistry, 3rd Edition F. A. Cotton, G. Wilkinson, P. L. Gaus-John Wiley & Sons, 1995.
9. Essential Chemistry, International Edition R. Chang, McGraw Hill Co, 1996.
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12. Chemistry, 3rd Edition P. Atkins & L.Jones, W. H. Freeman & Company, 1997.
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14. Concise TextBook of Biochemistry T. N. Pattabhiraman, All India Publishers, 2000.
15. Biochemistry A. L. Lehninger et. al., CBS, 2000.
16. A TextBook of Biochemistry A. V. S. S. Rama Rao, UBSPD, 1998.
17. Biochemistry P. C. Champe and R. A. Harvey, J. B. Lippincott & Co, 1982.
18. Fundamentals of Biochemistry J. L. Jain, S. Chand & Co., 1983.
19. Biochemistry COSIP -ULP, Bangalore University, 1981.

DSC LAB 6: INORGANIC AND BIOLOGICAL CHEMISTRY-III PRACTICALS

INORGANIC CHEMISTRY PRACTICALS

VOLUMETRIC ANALYSIS

1. Estimation of Zinc using EDTA.
2. Estimation of Nickel using EDTA and standard zinc sulphate.
3. Determination of Total Hardness of Water using EDTA
4. Estimation of Copper in Brass.
5. Estimation of Percentage of Iron in Haematite ore using barium diphenylamine sulphonate as an internal indicator.

BIOLOGICAL CHEMISTRY PRACTICALS

1. Preparation of buffers and determination of their pH values using pH meter.
2. Estimation of reducing sugars by Hegdorn-Jensen method.
3. Estimation of lactose in milk by Nelson-Somogi's method.
4. Estimation of creatinine by Jaffe's method.
5. Estimation of inorganic phosphate by Fiske-Subbarow method.
6. Estimation of total reducing sugars by DNS (dinitrosalicylic acid) method.
7. Isolation of lactose and casein from milk and estimation of lactose by colorimetric method.

REFERENCES:

1. Vogel's Textbook of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
2. Vogel's textbook of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
3. Inorganic Semimicro Qualitative Analysis, V. V. Ramanujam; The National Pub. Co. (1974).
4. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).

DISCIPLINE CORE COURSE SEMESTER – VI (NEP)

DSC-7-Organic chemistry and Physical Chemistry IV

Contact hours- 60 **Credit point-4**

Workload-4 h/week **Each unit: 15h**

COURSE OBJECTIVES

1. Recognize and classify heterocyclic compounds based on their ring structures and heteroatoms.
2. Understand the principles and strategies involved in the total synthesis of complex natural products.
3. To keep students informed about current market trends, emerging technologies, and the role of innovation in the organic chemical industry.
4. To introduce students to various spectroscopic techniques, including UV-Vis, IR, NMR, and their applications in organic compound analysis.
5. To acquire and consolidate the fundamental concepts of chemical dynamics
6. To learn the basics of Voltammetry as an electroanalytical technique
7. To develop a good understanding of the electromagnetic spectrum and describe the principles of Vibrational, Raman, Electronic and Electronic spectroscopy
8. Introduce the NMR and ESR spectroscopy and discuss the applications of spectroscopy

COURSE SPECIFIC OUTCOMES

After the completion of this course, the students would be able to

1. Apply knowledge to solve problems related to the synthesis and reactions of heterocyclic compounds.
2. Recognize the importance of natural products in drug discovery, agriculture, and other applied fields.
3. Demonstrate a strong awareness of chemical safety protocols and hazard mitigation in industrial settings.
4. Use spectroscopic data to deduce the structure and connectivity of organic compounds.
5. Explain the theories of chemical kinetics, thermodynamical formulation of reaction rates and conceptualize steady state kinetics, kinetics of Chain reactions, homogeneous, enzyme catalysis.
6. Gain expertise to explain the different methods to study the of kinetics of fast reactions.
7. Demonstrate skills to explain the principles of DME and experimental set up for cyclic voltammetry.
8. Predict the spectroscopic technique and understand its role in the structure elucidation based on its interaction with electromagnetic radiation.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1.Apply knowledge to solve problems related to the synthesis and reactions of heterocyclic compounds.	X		**X**		**X**			
2. Recognize the importance of natural products in drug discovery, agriculture, and other applied fields.	X			**X**	**X**		**X**	**X**
3. Demonstrate a strong awareness of chemical safety protocols and hazard mitigation in industrial settings.	X	**X**				**X**		
4. Use spectroscopic data to deduce the structure and connectivity of organic compounds.	X			**X**			**X**	**X**
5. Explain the theories of chemical kinetics, thermodynamical formulation of reaction rates and conceptualize steady state kinetics, kinetics of Chain reactions, homogeneous, enzyme catalysis.	X		**X**		**X**			**X**
6. Gain expertise to explain the different methods to study the of kinetics of fast reactions.	X		**X**	**X**				
7. Demonstrate skills to explain the principles of DME and experimental set up for cyclic voltammetry.	X	**X**	**X**					**x**
8.Predict the spectroscopic technique and understand its role in the structure elucidation based on its interaction with electromagnetic radiation.	X	**X**		**X**		**X**	**X**	

ORGANIC CHEMISTRY IV:

UNIT: I

Heterocyclic Compounds 5h

Introduction, classification, structures, resonance and aromatic character of furan, pyrrole, thiophene and pyridine. Methods of preparation and reactions of pyrrole, furan, thiophene, pyridine.

Mechanism of electrophilic substitution reactions. Comparison of basicity of pyrrole, pyridine and piperidine. Preparation and reactions of indole, quinoline and isoquinoline.

Chemistry of Natural Products 10h

Carbohydrates: Introduction and classification.

Mono saccharides: Aldoses, structures of all the D-aldohexoses. Elucidation of open chain structure of D-glucose. Mechanism of mutarotation and anomeric effect. Elucidation of ring structure of D-glucose in detail. Ketoses:Fructose,inter-conversion of glucose and fructose.

Disaccharides: Glycosidic bond. Structures of maltose, lactose and sucrose- Haworth and conformational structures.

Terpenes and terpenoids: Occurrence,classification and isoprene rule. Elucidation of structure and synthesis of citral and zingiberene. Structures of limonene, menthol, α- terpineol, camphor, β-carotene, Vitamins-A and their uses.

Alkaloids: Introduction, classification and general characteristics. Structural elucidation and synthesis of nicotine. Structures and uses of ephedrine, caffeine, cocaine, atropine, quinine and morphine.

UNIT-II

Industrial Organic Chemistry 5h

Synthetic dyes: Introduction and classification. Colour and constitution. Synthesis of Congo red, malachite green, alizarin and indigo.

Drugs: Chemotherapy, classification of drugs. Synthesis and uses of paracetamol, diclofenac, ranitidine, sulphanilamide and chloramphenicol.

Introduction to Green Chemistry: Principles of Green chemistry and its application to the synthesis of paracetamol.

Spectroscopy of Organic compounds 10h

UV-Visible spectroscopy: Introduction. Chromophores and auxochromes; blue shift and red shift. Graphical representation of spectra of 1,3-butadiene, benzene and lycopene. Influence of conjugation on UVabsorption- Comparison of UV spectra of acetone and methyl vinyl ketone. IR spectroscopy: Introduction. Stretching frequencies of−OH (free and H-bonded), alkyl −C−H, C -C, C=C, C−C, C=O and C−O groups (by taking suitable examples). Graphical representation of IR spectra of benzoic acid and methyl benzoate.

NMR spectroscopy: Basic principles of proton magnetic resonance: Nuclear magnetic spin quantum number I, influence of the magnetic field on the spin of nuclei, spin population, saturation

using radio frequency. Nuclear magnetic resonance. Chemical shift (δvalues), uses of TMS as reference. Nuclear shielding and deshielding effects. Equivalent and non-equivalent protons. Effect of electronegativity of adjacent atoms on chemical shift values. Spin-spin splitting and spin-spin coupling (qualitative treatment only).

Applications of NMR spectroscopy including identification of simple organic molecules. Examples: Shielding and deshielding effects for(i) methane (ii) CH_3−Cl (iii) CH_2Cl_2(iv) $CHCl_3$. Spin-spin coupling in (i)Cl_2CHCHO (ii)1,1,2- trichloroethane (iii) CH_3CH_2Cl.

PHYSICAL CHEMISTRY IV:

UNIT-III

Chemical Dynamics **11h**

Macroscopic and Microscopic kinetics, Review of theories of reaction rate- Collision theory and Transition State theory. Comparison of transition state theory with collision theory. Arrhenious equation- characteristics, Significance of energy of activation, Temperature coefficient and its evaluation, Thermodynamical formulation of reaction rates (Wyne-jones and Eyring treatment), Reaction between ions in solutions - Influence of ionic strength on reaction rates (primary and secondary salt effects).

Concept of Steady state kinetics, Chain reactions - chain length and chain inhibition, comparison of photochemical and thermal reactions, Mechanisms of thermal and photochemical reactions between hydrogen-bromine and hydrogen-chlorine. Comparative study of thermal and photochemical hydrogen-halogen reactions. Pyrolysis of acetaldehyde, Decomposition of ethane.

Kinetics of fast reactions- Introduction, Study of reactions by relaxation method (Temperature and pressure jump), flow method (Plug flow method and Stopped flow method), Flash photolysis and Shock tube method.

Kinetics of homogeneous catalysis-kinetics of auto catalytic reactions, Comparison of enzyme catalysed and chemical catalysed reactions, Mechanism (Lock and Key theory), Kinetics of enzyme catalysed reactions - Henri-Michaelis- Menten mechanism, Significance of Michaelis-Menten constant, Lineweaver-Burk plot. Effects of enzyme concentration, pH, Temperature, Activators and Inhibitors on enzyme activity.

Electroanalytical Methods **4h**

Voltammetry at a dropping mercury electrodes (DME)-Types of current obtained at DME. Ilkovic equation and its applications. Current –potential relation for a cathodic process – half wave potential. Cyclic Voltammetry-Principles-Experimental set up-Quantitative analysis, determination of diffusion coefficients.

UNIT-IV

Spectroscopy **15h**

Polarisation and orientation of dipoles in an electric field. Dipole moment. Induced dipole moment (experimental determination of dipole moment not included). Clausius-Mossotti equation (only statement). Dipole moment and structure of molecules (planar and non-planar).

The interaction of radiation with matter. Regions of electromagnetic spectrum and associated spectroscopic techniques. Origin of molecular spectra: Born-Oppenheimer approximation. Rotational spectra of diatomic molecules: Relationship between internuclear distance and moment of inertia. Expression for rotational energy. Numerical problems. Criterion for absorption of radiation-selection rule.

Vibrational spectroscopy: Hooke's law- Expression for the frequency of SHO-force constant and its significance. Expression for vibrational energy levels of SHO. Zero-point energy., numerical problems. Degree of freedom of polyatomic molecules– modes of vibration for CO2 and H2O molecules.

Raman spectroscopy: Concept of polarizability. Pure rotation, vibration, qualitative study. Stokes and anti-Stoke's lines-selection rules. Advantages of Raman spectroscopy over IR spectroscopy.

Electronic spectroscopy: Potential energy curves for bonding and antibonding molecular orbitals. Electronic transitions –qualitative description of non-bonding orbitals and transitions between them. Selection rules and Franck-Condon principle.

Introduction to Nuclear Magnetic Resonance Spectroscopy and Electron Spin Resonance Spectroscopy and applications of spectroscopy.

REFERENCES

1. Advanced Organic Chemistry. Arun Bahl and B.S Bahl.
2. Organic Chemistry, Volumes I and II, I L Finar, Longman, (1999).
3. Organic Natural products. Gurudeep and Chatwal.
4. Chemistry of Natural products 1 &2. OP Agarwal
5. Organic Chemistry, R T Morrison and R N Boyd, Prence-Hall, (1998).
6. Organic reactions and their mechanisms. Kalsi. P.S
7. A textbook of Organic Chemistry. OP Agarwal
8. Reactions and Reagents in Organic Chemistry. OP Agarwal
9. Spectroscopy of Organic compounds. Kalsi. P.S.
10. Spectroscopic identification of organic compounds. Silverstien& Weber.
11. Physical Chemistry, P. W. Atkins, Julio de Paula, ELBS, 7th ediBon, (2002).
12. Physical Chemistry: A Molecular Approach, McQuarie and Simon, Viva, New Delhi, (2001).
13. Physical Chemistry- P. Atkins and J. D. Paula, 9th Edn., Oxford University Press (2010).
14. Principles of Physical Chemistry, 4th Edition B. R. Puri and L. R. Sharma and M. S. Pathania, S. L. N. Chand & Co., 1987
15. Introduction to Quantum Chemistry, A. K. Chandra, Tata McGraw Hill, (1988).
16. Quantum Chemistry, Ira. N. Levine, Prentice Hall, New Jersey, (1991).
17. Quantum Chemistry, R. K. Prasad, New Age International, 2nd edition, (2000).
18. Quantum Chemistry through problems and solutions, R. K. Prasad, New Age International (1997).
19. Chemical Kinetics- K. J. Laidler, McGraw Hill. Inc. New York (1988).
20. Principles of Chemical Kinetics - House J. E. Wm C Brown Publisher, Boston, (1997).
21. Kinetics and Mechanism - A. A. Frost and R. G. Pearson, John-Wiley, New York, (1961).
22. Chemical Kinetic Methods - C. Kalidas, New Age International Publisher, New Delhi (1995)

DSC LAB 7: ORGANIC AND PHYSICAL CHEMISTRY-III PRACTICALS

ORGANIC CHEMISTRY PRACTICALS

Qualitative analysis: Systematic analysis and identification of organic compounds.

PHYSICAL CHEMISTRY PRACTICALS

1. Conductometric titration of weak acid versus weak base.
2. Determination of Critical Micellar Concentration (CMC) by conductivity method
3. Potentiometric titration of potassium dichromate with ferrous ammonium sulphate.
4. Determination of single electrode potential of Cu2+/Cu and estimate the given unknown concentration using potentiometric titration.
5. Determination of single electrode potential of Zn2+/Zn and estimate the given unknown concentration using potentiometric titration.
6. Titration of weak acid against a strong base using quinhydrone electrode and calculation of pKa and Ka of the weak acid.
7. Determination of Oxidation and Reduction potential of K4Fe(CN)6/K3Fe(CN)6 system by cyclic voltammeter

REFERENCES FOR PRACTICALS

1. Findlays practical physical chemistry revised by P. B. Levi. Z, Longman's London (1966).
2. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill InternationalEdn. (1966)
3. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut (1988)
4. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987)
5. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
6. Practical Physical Chemistry by A.M James and P. E. Pritchard, Longman's Group Ltd (1968)
7. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983)
8. Physical Chemistry Laboratory Principles and Experiments by H. W. Salberg J. I. Morrow, S. R. Cohen Green Macmillan publishing Co.,.New York (1998).
9. Textbook of Practical Organic Chemistry- A. I. Vogel, (1996).
10. Textbook of Quantitative Organic Analysis- A. I. Vogel, (1996).

DISCIPLINE CORE COURSE SEMESTER – VI (NEP)

DSC-8-Inorganic chemistry and Biological Chemistry IV

Contact hours- 60 **Credit point-4**

Workload-4 h/week **Each unit: 15h**

COURSE OBJECTIVES

1. To encourage research and innovation in materials science, exploring new materials, applications, and sustainable practices.
2. To develop the ability to select appropriate materials for specific engineering applications based on their properties, performance requirements, and cost considerations.
3. To understand the principles of heat treatment, including annealing, quenching, and tempering, and their effects on the structure and mechanical properties of metals.
4. To understand the role of transition metals as catalysts in various chemical reactions.
5. To identify practical applications of conducting polymers in electronics, sensors, and energy storage devices.
6. The Concepts of thermodynamics and the mechanism of energy transfer in ETC
7. The knowledge of mechanism of DNA Replication, Transcription, Genetic code and Translation Process
8. Greater ideas about Vitamins and the knowledge in the quantitative and qualitative estimation of biomolecules

COURSE SPECIFIC OUTCOMES

After the completion of this course, the students would be able to

1. Grasp the role of fuels in energy production, such as in power generation and transportation, and the importance of energy efficiency and renewable energy sources.
2. Apply metallurgical principles to the production, processing, and selection of materials in various industries.
3. Understand the fundamentals of powder metallurgy and its advantages in producing complex-shaped parts with controlled properties.
4. Recognize the importance of transition metals in various chemical processes and industries.
5. Apply knowledge of doping and processing to tailor the performance of conducting polymers.
6. To make them able to express ideas persuasively in written and oral form to develop their leadership qualities.
7. To demonstrate professional and ethical attitude with enormous responsibility to serve the society.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Grasp the role of fuels in energy production, such as in power generation and transportation, and the importance of energy efficiency and renewable energy sources	X	**X**			**X**		**X**	**X**
2. Apply metallurgical principles to the production, processing, and selection of materials in various industries.	X	**X**			**X**		**X**	
3. Understand the fundamentals of powder metallurgy and its advantages in producing complex-shaped parts with controlled properties.	X	**X**		**X**	**X**		**X**	**X**
4. Recognize the importance of transition metals in various chemical processes and industries.	X		**X**	**X**	**X**		**X**	
5. Apply knowledge of doping and processing to tailor the performance of conducting polymers.	X	**X**	**X**			**X**	**X**	
6. To make them able to express ideas persuasively in written and oral form to develop their leadership qualities.	X		**X**	**X**	**X**			
7. To demonstrate professional and ethical attitude with enormous responsibility to serve the society	X			**X**	**X**	**X**		
8. Knowledge about Vitamins and the methods to do quantitative and qualitative estimation of biomolecules	X	**X**				**X**	**X**	**X**

INORGANIC CHEMISTRY IV:

UNIT-I

Bioinorganic Chemistry 2h

Essential and trace elements in biological systems with reference to Na^+, K^+, Ca^{2+}, Fe^{2+}, P, Cu, V and Ni. Metallo-porphyrins with special reference to haemoglobin, myoglobin and chlorophyll. Role of cobalamin (vitamin-B12 coenzyme) in living systems.

Metallurgy 5h

Ellingham's diagrams: Salient features. Selection of reducing agents using Ellingham's diagrams. Extraction of the following metals.

i) Nickel from sulphide ore

ii) Thorium from Monazite sand

iii) Uranium from Pitch blende

iv) Plutonium from Nuclear waste

Powder metallurgy 2h

Advantages of powder metallurgy and its applications. Methods of production of metal powders. production of Tungsten powder from Wulframite.

Steel and Alloys 6h

Steel: Iron-Carbon Phase diagram, Austenite, Ferrite, Cementite and Pearlite phases.

Alloy steels: Influence of Si, Mn, Cr, Ni, Ti and W on the properties of Steel.

Ferro alloys: Production of ferro chrome, ferro manganese, and ferro silicon and their applications. Carbon steel: classification. Heat treatment: hardening, case hardening, carbiding, nitriding, tempering and annealing.

UNIT-II

General study of d and f block elements 6h

Transition elements: electronic configuration, atomic and ionic radii, ionization energy, oxidation states, redox potentials, spectral and magnetic properties, catalytic activity, interstitial compound formation.

Lanthanides and Actinides: Electronic configuration, atomic and ionic sizes, lanthanide contraction and its consequences. Oxidation states, spectral and magnetic properties, comparison of oxidation states, complex formation and magnetic properties of d and f block elements. Ion exchange method for separation of Lanthanides.

Chemistry of Newer materials 5h

Conducting polymers: Introduction, definition, and examples-polyaniline, polyacetylene. Mechanism of conduction. Qualitative treatment of doping, Properties: elasticity with high electrical conductivities, Engineering, and biological applications.

Nanomaterials: Introduction, definition, and electronic structure. Different methods of production: Sol gel synthesis, inert gas condensation, mechanical alloying (ball milling), plasma synthesis, electrodeposition, and general applications.

Water Technology **4 h**

Types of impurities present in water. Causes for the hardness of water. Permissible levels of ions present in water. Treatment of water for domestic and Industrial purposes by the following methods.

i) Demineralization of water by Ion exchange method.

ii) By reverse Osmosis method.

BIOLOGICAL CHEMISTRY IV

UNIT III

Biological oxidation **7h**

Bioenergetics- Introduction-stages of energy transformation. Exergonic and endergonic reactions. Relationship between G and Keq. High energy phosphates–definition, examples, structural features of ATP that makes ATP a high energy phosphate (electro static repulsion, opposing resonance, solvation of ATP). Examples of high energy phosphates other than ATP. Energy coupling in biological reactions (explain the concept with suitable examples). Biological oxidation – comparison of oxidation with combustion using glucose as an example. Redox potentials of some biological important half reactions. Calculation of energy yield from biological redox reaction (oxidation of NADH by oxygen, reduction of acetaldehyde by NADH). Mitochondrial electron transport chain, oxidative phosphorylation. Substrate level phosphorylation.

Metabolism **8h**

Catabolism and anabolism (explanation with an example) – Carbohydrate metabolism, glycolysis, fate of pyruvate. TCA cycle, energetic. Gluconeogenesis–definition, synthesis of glucose from lactate. Fatty acid metabolism–activation of fatty acids, role of carnitine, β- oxidation pathway, energetics. Protein metabolism–general aspects of amino acid degradation– transamination, deamination and decarboxylation. Urea cycle.

UNIT IV

Molecular biology **7h**

Central dogma of molecular biology–semi conservative replication and mechanism of DNA replication, transcription, translation. DNA finger printing – Definition and its applications.

Vitamins **8h**

Classification and Nomenclature of vitamins. Fat soluble vitamins and water-soluble vitamins Sources, deficiency diseases, Vitamin B complex and Vitamins of E group. Structure of Vitamin A1andA2, mechanism of vision, structures of Vitamin B1, Vitamin C, Vitamin D, Vitamin E & Vitamin K1.

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1. Advanced Inorganic Chemistry, 6th Edition F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann-John Wiley & Sons, 1999.
2. Concise Inorganic Chemistry, 5th Edition J. D. Lee, Blackwell Science, 2001.
3. Inorganic Chemistry, 4th Edition J. E. Huhee, E. A. Keiter and R. I. Keiter, Pearson Education Asia, 2000
4. Inorganic Chemistry, ELBS 2nd Edition D. F. Shriver, P. W. Atkins and C. H. Langford, Oxford Univ. Press 2002.
5. Modern Inorganic Chemistry W. L. Jolly, McGraw Hill Co.
6. Principles of Inorganic Chemistry B. R. Puri and L. R. Sharma, Jauhar S. P-S. N. Chand &

Co., 1998
7. Inorganic Chemistry, 3rd Edition (ISE) A G Sharpe, Addison Wesley, 1989.
8. Basic Inorganic Chemistry, 3rd Edition F. A. Cotton, G. Wilkinson, P. L. Gaus-John Wiley & Sons, 1995.
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10. University Chemistry, 4th Edition (ISE) B. H. Mahan & R. J. Myers, Addison Wesley, 1989.
11. Essential Trends in Inorganic Chemistry C. M. P. Mingos, Oxford Univ Press, 1998
12. Chemistry, 3rd Edition P. Atkins & L.Jones, W. H. Freeman & Company, 1997.
13. Modern Chemistry, 4th Edition D. W. Oxicby, H. P. Gills & N. H. Nachtrieb, Saunders College Publishing, 1998.
14. Concise Textbook of Biochemistry T. N. Pattabhiraman, All India Publishers, 2000.
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17. Biochemistry P. C. Champe and R. A. Harvey, J. B. Lipincott& Co, 1982.
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DSC LAB 8:INORGANIC AND BIOLOGICAL CHEMISTRY PRACTICALS

INORGANIC CHEMISTRY PRACTICALS

1. Preparation of cis and trans-potassiumdioxalatodiaquachromium (III) complex
2. Preparation of cuprammoniumsulphate.
3. Preparation of tri-oxalato ferrate(III).
4. Preparation of hexamminecobalt(III) chloride.
5. Preparation of pentaamminecobalt(III) chloride.

BIOLOGICAL CHEMISTRY PRACTICALS

1. Estimation of α-amino acids using ninhydrin by colorimetric method.
2. Determination of blood group.
3. Separation of α-amino acids by paper chromatography.
4. Isolation of DNA from onions.
5. Estimation of cholesterol by colorimetric method.
6. Determination of pKa of amino acid (glycine).
7. Qualitative analysis of carbohydrates.

REFERENCES

1. Vogel's Textbook of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
2. Vogel's textbook of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
3. Inorganic Semimicro Qualitative Analysis, V. V. Ramanujam; The National Pub. Co. (1974).
4. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).

ASSESSMENT: WEIGHTAGE FOR ASSESSMENT

Common for both V and VI semesters

TYPE OF ASSESSMENT	SUMMATIVE (MARKS)	FORMATIVE (MARKS)
THEORY	60	40
PRACTICAL	25	25

SCHEME OF INTERNAL ASSESSMENT MARKS: THEORY PAPERS

Common for both V and VI semesters

Sl N	PARTICULARS	MARKS
1	Attendance	10
2	Assignments/ Seminars	10
3	Internal Tests (Average of two tests)	20
TOTAL		40

PRACTICALS

Common for both V and VI semesters

SL NO	PARTICULARS	MARKS
1	Attendance	05
2	Record writing	05
3	Internal Tests (Average of two tests)	15
TOTAL		25

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