St. FRANCIS COLLEGE FOR WOMEN, BEGUMPET HYDERABAD-500016
(An Autonomous College Affiliated to Osmania University)
DEPARTMENT OF CHEMISTRY

DISCIPLINE SPECIFIC CORE II **CHEMISTRY II** **B.Sc. I - SEMESTER- II 60 h**
Module 1: Inorganic Chemistry Chemistry of d-Block elements Chemistry of f-Block elements
Module 2: Organic Chemistry Halogen Compounds Hydroxy Compounds and Ethers Carbonyl Compounds
Module 3: Physical Chemistry Electrochemistry
Module 4: General Chemistry Chemical Bonding Stereoisomerism Colligative Properties

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SEMESTER - II
CHEMISTRY - II

1. Course Description

Programme: B.Sc.
Course Code: U26/CHE/DSC/201
Course type: DSC - 2
No. of credits: 4

Max. Hours: 60
Max. Marks: 100
Hours per week: 4

2. Course Objectives

- To enable students to critically understand the electronic structure, periodic trends, magnetic and spectral properties, complex formation, and applications of d- and f-block elements.
- To develop a clear understanding of the structure, reactivity, preparation methods, and reaction mechanisms of halogen compounds, alcohols, ethers, and carbonyl compounds.
- To provide a comprehensive understanding of electrochemical principles, including electrode potentials, electrochemical cells, and their practical applications.
- To impart fundamental knowledge of chemical bonding theories, stereochemical concepts, and colligative properties to explain the structure and behavior of chemical substances.

3. Course Outcomes

On completion of the course the student will be able to

- Explain and predict the chemical behavior of d- and f-block elements based on electronic structure and bonding principles.
- Analyze reactions and predict products of halogen, alcohol, ether, and carbonyl compounds.
- Calculate electrode potentials, analyze electrochemical cells, and apply electrochemical concepts to practical systems such as batteries and corrosion.
- Students will be able to apply bonding theories, distinguish stereoisomers, and solve numerical problems related to colligative properties.

4. Course Content

MODULE I: INORGANIC CHEMISTRY **15 h (1h/week)**

Chemistry of d-block elements **7h**

Characteristics of d-block elements with special reference to electronic configuration, variable oxidation states, color properties, d-d spectral transitions, ability to form complexes, magnetic properties, calculation of magnetic moment-spin only formula & catalytic properties. Comparative treatment of second and third transition series with their 3d analogues.

Chemistry of f-block elements **8h**

Chemistry of Lanthanides: Position in periodic table, electronic structure, oxidation state, ionic and atomic radii/ionic radii- lanthanide contraction- cause and consequences, anomalous behavior of post lanthanides-complexation-type of donor ligands preferred. Magnetic properties- paramagnetism, color and spectra, f-f transitions-occurrence and separation-ion exchange method, solvent extraction.

Chemistry of actinides: General features-electronic configuration, oxidation state, actinide contraction, color and complex formation. Comparison with lanthanides.

IKS: Case studies on The Iron Pillar of Delhi – Metallurgical Excellence and Monazite Sands of Kerala – Source of Rare Earths and Thorium.

MODULE II: ORGANIC CHEMISTRY **15 h (1h/week)**

Halogen compounds **4 h**

Classification: alkyl (primary, secondary, tertiary), aryl, aralkyl,. Chemical reactivity - reduction, formation of RMgX, Nucleophilic substitution reactions – classification into S_N1 and S_N2. Mechanism and energy profile diagrams of S_N1 and S_N2 reactions. Stereochemistry of S_N2 (Walden Inversion) 2-bromobutane, S_N1 (Racemization) 1-bromo-1-phenylpropane.

Hydroxy compounds and ethers **5 h**

Alcohols: Preparation: 1°, 2° and 3° alcohols using Grignard reagent, Reduction of Carbonyl compounds, carboxylic acids and esters. Physical properties: H-bonding, Boiling point and Solubility. Reactions with Sodium, $HX/ZnCl_2$ (Lucas reagent), oxidation with conc. HNO_3 and Oppenauer oxidation (Mechanism).

Phenols: Preparation: (i) from diazonium salts of anilines and (ii) from benzene sulphonic acids. Properties: Acidic nature, formation of phenoxide and reaction with R-X, electrophilic substitution; halogenations, Riemer Tiemann reaction (Mechanism), Gattermann-Koch reaction, Schotten Baumann reaction.

Ethers: Nomenclature, preparation by Williamson synthesis. Chemical properties – inert nature, action of conc. H_2SO_4.

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Carbonyl compounds 6h

Preparation of aldehydes & ketones from acid chlorides, nitriles and carboxylic acids. Special methods of preparing aromatic aldehydes and ketones by Oxidation of arenes. Physical properties – absence of Hydrogen bonding. Reactivity of the carbonyl groups in aldehydes and ketones. Chemical reactivity: Addition of (a) $NaHSO_3$ (b) HCN (c) RMgX (d) 2,4-DNP (Schiff base). Addition of H_2O to form hydrate, addition of alcohols - hemi acetal and acetal formation. Cannizzaro reaction. Oxidation reactions – $KMnO_4$ oxidation, reduction – catalytic hydrogenation, mechanism of Clemmensen reduction, Meerwein-Ponndorf-Verley reduction.

MODULE III: PHYSICAL CHEMISTRY 15 h (1h/week)

Electrochemistry 15h

Revision of conductance, specific conductance, equivalent conductance and factors influencing conductance of electrolytes. Ionic mobility, definition and significance of transport number. Kohlrausch's law – its applications: determination of degree of dissociation and acid dissociation constant (K_a) of weak acids, solubility product determination and conductometric titrations. Ostwald's dilution law - its uses and limitations. Debye- Hückel -Onsager's equation for strong electrolytes (elementary treatment only).

Types of electrodes with examples - Types of reversible electrodes - the gas electrode, metal metal ion, metal-insoluble salt, redox electrodes and ion-selective electrode. Reversible and irreversible cells; Nernst equation – EMF of a cell; representation of a cell-problems; electrode potentials-electrochemical series and its significance. Determination of pH – using quinhydrone and glass electrodes. Potentiometric titrations.

MODULE IV: GENERAL CHEMISTRY 15 h (1h/week)

Chemical Bonding 5h

Molecular orbital theory: Shapes and sign convention of atomic orbitals. Modes of bonds. Criteria for orbital overlap. LCAO concept. π and σ overlapping. Concept of Types of molecular orbitals: bonding, antibonding and non-bonding. MOED of homonuclear diatomic molecules - H_2, N_2, O_2, O_2^-, O_2^{2-}, F_2 (unhybridized diagrams only) and heteronuclear diatomics - CO,. CN^-, NO, NO^+ and HF, their bond order, stability and magnetic properties.

Stereoisomerism 5h

Optical activity: Definition, wave nature of light, plane polarized light, optical rotation and specific rotation, chiral centers. Chiral molecules: definition and criteria - absence of plane, center and Sn axis of symmetry – asymmetric and dissymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and dissymmetric molecules (trans- 1,2-Dichlorocyclopropane). Molecules with constitutionally symmetrical chiral carbons (Tartaric acid) Molecules with constitutionally unsymmetrical chiral carbons (2,3-Dibromopentane). D, L configuration – examples. R, S – configuration: Cahn-Ingold-Prelog (CIP) rules.

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Colligative Properties 5h

Definition of colligative properties- relative lowering of vapour pressure-Raoult's law; Osmotic pressure; elevation of boiling point and depression of freezing point; thermodynamic relation between molecular weight and colligative property (derivations not required) -Problems.

5. Reference Books

General reference: B.Sc. I Year Chemistry : Semester II, Telugu Academy publication, Hyd.

Module- I

1. Puri, B. R., Sharma, L. R., & Kalia, M. S. (1996). Principles of inorganic chemistry. Vishal Publications.
2. Lee, J. D. (1981). Concise inorganic chemistry (3rd ed.). Oxford University Press.
3. Cotton, F. A., Wilkinson, G., & Gaus, P. L. (2001). Basic inorganic chemistry (3rd ed.). Wiley.
4. Greenwood, N. N., & Earnshaw, A. (1989). Chemistry of the elements. Pergamon Press.
5. Shriver, D. F., & Atkins, P. W. (1999). Inorganic chemistry (3rd ed.). Oxford University Press.
6. Huheey, J. E., Keiter, E. A., & Keiter, R. L. (1993). Inorganic chemistry: Principles of structure and reactivity (4th ed.). Harper Collins College Publishers.
7. Gopalan, R. (2009). Textbook of inorganic chemistry. University's Press.

Module- II

1. Morrison, R. T., & Boyd, R. N. (2011). Organic chemistry. Pearson Education (Prentice Hall).
2. Solomons, T. W. G., & Fryhle, C. B. (2016). Organic chemistry. Wiley (John Wiley & Sons).
3. Bruice, P. Y. (2017). Organic chemistry. Pearson Education.
4. Wade, L. G., Jr. (2013). Organic chemistry. Pearson Education.
5. Jones, M., Jr. (2010). Organic chemistry. W. W. Norton & Company.
6. McMurry, J. (2015). Organic chemistry. Cengage Learning (Brooks/Cole).
7. Soni, P. L., & Soni, H. M. (2012). Organic chemistry. Sultan Chand & Sons.
8. Ghosh, S. K. (2009). General organic chemistry. Bharati Bhawan Publishers.
9. Pillai, C. N. (2008). Organic chemistry. Universities Press (India) Pvt. Ltd.

Module-III

1. Glasstone, S., & Lewis, D. (1966). Elements of physical chemistry. Macmillan.
2. Maron, S. H., & Lando, J. B. (1966). Fundamentals of physical chemistry. Macmillan Limited.
3. Puri, B. R., Sharma, L. R., & Pathania, M. S. (2013). Principles of physical chemistry (46th ed.). Vishal Publishing Company.
4. Atkins, P. W. (2001). Physical chemistry (7th ed.). Oxford University Press.

b. Components on Skill Development/Entrepreneurship Development/Employability

SD/ED /EMP	Syllabus Content	Description of Activity
SD	Module I	Encourage them to compare and discuss trends in reactivity and chemical behaviour.
EMP	Module II	Design and present a synthetic pathway for an industry-relevant product using halogen, hydroxy, ether, and carbonyl compounds, including mechanism and yield.
ED (NSQF level 3 or 4)	Module III	Enables students to identify opportunities and develop innovative, cost-effective solutions in energy storage, corrosion control, electroplating, and other electrochemical industries.
EMP	Module IV	Solve and present a set of application-based problems on chemical bonding, stereochemistry, and colligative properties, explaining reasoning and calculations.

c. IKS component:

IKS	Syllabus Content	Module
	Introduced Case studies on The Iron Pillar of Delhi – Metallurgical Excellence and Monazite Sands of Kerala – Source of Rare Earths and Thorium.	**I**

7. Pedagogy

S. No.	Student Centric Methods Adopted	Type / Description of Activity
1	Experiential learning	Field trips
2	Participative Learning	Presentations/Peer-teaching
3	Problem solving	Case studies/ Data interpretation

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8. Course Assessment Plan

a) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA - 40%	End Semester Examination-60%
CO1	**CIA-1:** Written Exam	Written Exam
CO2	**CIA-2:** Quiz/Assignment/3D model making	
CO3	**CIA-1:** Written Exam	
CO4	**CIA-2:** Assignment (Crossword/Word search/ Problem solving)	

b) Model Question Paper - End Semester exam Theory

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(An Autonomous College Affiliated to Osmania University)
Faculty of Science – Department of Chemistry
MODEL PAPER
B.Sc. I YEAR SEMESTER -II
CHEMISTRY - II

Time: 2 hrs **Course Code: U26/DSC/CHE/201**

Max. Marks: 60

SECTION –A (Essay Questions)

I. Answer the following **4x 10=40 Marks**

1. What are Transition elements? Explain the general properties with reference to Complex formation, magnetic properties and variable oxidation states. 10M

OR

2. a. What is lanthanide contraction and explain its consequences. 5M

   b. How are lanthanides separated by ion exchange method? 5M

3. a. Explain the mechanism and stereochemistry of S_N1 reaction. 5M

   b. How are 1°, 2° and 3° alcohols prepared from carbonyl compounds using Grignard reagent? 5M

OR

4. Formulate the steps involved in the mechanism of (i) Reimer -Teimann reaction and (ii) Cannizaro reaction. 10M

5. a. Explain standard hydrogen electrode (SHE). 5M
   b. State Ostwald's dilution law. Discuss its uses and limitations. 5M

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OR

6. a. State Kohlrausch law and mention its applications. 5M
   b. Describe Hittorf method for the determination of Transport number. 5M
7. Write the postulates of MOT and explain the MOED of O_2. 10M

   OR

8. a. State and explain Raoult's law. 5M
   b. What are enantiomers? Explain the optical isomers of Tartaric acid. 5M

SECTION –B (Short Answer Questions)

II. Answer any four. **4x5=20 Marks**

9. Compare the properties of lanthanides with actinides.
10. How do you differentiate 1°, 2° and 3° alcohols based on the Lucas test?
11. Give equations for Williamson's ether synthesis and Clemmensen's reduction..
12. Write short notes on conductometric titrations.
13. What is an electrochemical series? What is its significance?
14. Discuss the R,S configuration of L-Alanine and D-Glyceraldehyde based on CIP rules.

Question Paper Format - Blooms Taxonomy Level

SECTION A - INTERNAL CHOICE				4 X 10 = 40 M
Question Number	**Module**	**Question**	**CO**	**BTL**
1	I	What are Transition elements? Explain the general properties with reference to Complex formation, magnetic properties and variable oxidation states. 10M OR	CO1	Level 1 & 2
2	I	a. What is lanthanide contraction and explain its consequences. 5M b. How are lanthanides separated by ion exchange method? 5M	CO1	Level 1 & 3
3	II	a. Explain the mechanism and stereochemistry of S_N1 reaction. 5M b. How are 1°, 2° and 3° alcohols prepared from carbonyl compounds using Grignard reagent? 5M OR	CO2	Level 3

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4	II	Formulate the steps involved in the mechanism of (i) Reimer -Teimann reaction and (ii) Cannizaro reaction. 10M	CO2	Level 4
5	III	a. Explain standard hydrogen electrode (SHE). 5M b. State Ostwald's dilution law. Discuss its uses and limitations. 5M OR	CO3	Level 2
6	III	a. State Kohlrausch law and mention its applications. 5M b. Describe Hittorf method for the determination of Transport number. 5M	CO3	Level 2 & 3
7	IV	Write the postulates of MOT and explain the MOED of O_2. 10M OR	CO4	Level 2 & 3
8	IV	a. State and explain Raoult's law. 5M b. What are enantiomers? Explain the optical isomers of Tartaric acid. 5M	CO4	Level 2 & 3
SECTION B - Short answer questions **ANSWER ANY 4 OUT OF 6**				**4 x 5 = 20M**
9	I	Compare the properties of lanthanides with actinides.	CO1	Level 4
10	II	How do you differentiate 1°, 2° and 3° alcohols based on the Lucas test?	CO2	Level 4
11	II	Give equations for Williamson's ether synthesis and Clemmensen's reduction..	CO2	Level 2
12	III	Write short notes on conductometric titrations.	CO3	Level 2
13	III	What is an electrochemical series? What is its significance?	CO3	Level 2
14	IV	Discuss the R,S configuration of L-Alanine and D-Glyceraldehyde based on CIP rules.	CO4	Level 5

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c) Question Paper Blueprint

Modules	Hours Allotted in the Syllabus	COs Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15	CO1	2	10	6 (By taking at least one question from each module)	5
2	15	CO2	2	10		10
3	15	CO3	2	10		10
4	15	CO4	2	10		5

9. CO-PO Mapping

CO	PO	Cognitive Level	Classroom sessions (h)
1	1,3	Understand	15
2	1,2	Analyse	15
3	1,2	Apply	15
4	1,7	Remember	15

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(An Autonomous College Affiliated To Osmania University)
FACULTY OF SCIENCE- DEPARTMENT OF CHEMISTRY
SEMESTER -II
LABORATORY COURSE-II - QUALITATIVE ANALYSIS

1. Course Description

Program: B.Sc. **Max. Hours: 20**
Course Code: U26/CHE/DSC/201/ P **Max. Marks: 50**
Course type: DSC-2 **Hours per week: 2**
No. of Credits: 1

2. Course Objective

- To enable students to systematically identify and analyze anions and cations in salt mixtures using semi-micro qualitative analysis techniques.

3. Course outcomes

CO 1: Students will be able to systematically identify anions and cations in salt mixtures, interpret experimental observations, and write balanced equations for the reactions involved.

CO 2: Students will be able to apply the principles of common ion effect and solubility product to explain and justify the systematic separation and identification of both anions and cations in semi-micro qualitative analysis.

4. Course Content

QUALITATIVE ANALYSIS - Semi micro analysis of mixtures

Analysis of two anions (one simple, one interfering) and two cations in the given mixture.
Anions: CO_3^{2-} , SO_3^{2-} , S^{2-}, Cl^- , Br^-, I^-, CH_3COO^-, NO_3^-, PO_4^{3-}, BO_3^{3-}, SO_4^{2-}

Cations: Hg_2^{2+}, Ag^+, Pb^{2+}
Hg^{2+}, Bi^{3+}, Cd^{2+}, Cu^{2+}, As^{3+} / As^{5+} , Sb^{3+} / Sb^{5+}, Sn^{2+} / Sn^{4+}
Al^{3+}, Cr^{3+}, Fe^{3+}
Mn^{2+}, Co^{2+}, Ni^{2+}, Zn^{2+}
Ca^{2+}, Ba^{2+}, Sr^{2+}
Mg^{2+}, NH_4^+

Reference Books

1. Svehla, G. (1996). Vogel's qualitative inorganic analysis (7th ed.). Prentice Hall.
2. Gopalan, R., Subramanian, P. S., & Raghavan, K. (2004). Elements of analytical chemistry. Sultan Chand & Sons.
3. Ahluwalia, V. K., and Sunita Dhingra, (2005). A Laboratory Manual of Organic and Inorganic Chemistry, 1st Edition, University Press, Hyderabad, ISBN: 9788173715623

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4. Giri, A. N. (2010). A textbook of practical chemistry. Himalaya Publishing House.
5. Sharma, R. K. (2013). Experiments and techniques in inorganic chemistry. Krishna Prakashan Media.
6. O.P. Pandey, D.N. Bajpai, & S. Giri. (2020). Practical chemistry. 10th Revised Edition, S. Chand Publishing. ISBN: 9789352535859.
7. Gopalan, R., Venkappayya, D., and Nagarajan, S. (2012). Textbook of Inorganic Chemistry (Lab Manual), 3rd Edition, University's Press, Hyderabad, ISBN: 9788173718204
8. Vogel, A. I. and Svehla, G.Vogel's Textbook of Macro and Semi-Micro Qualitative Inorganic Analysis, 5th Edition, Longman Group Ltd., 1979. ISBN: 9780582446939

6. Model Question Paper - End Semester Exam Practical

St. FRANCIS COLLEGE FOR WOMEN, BEGUMPET, HYDERABAD-500016
(An Autonomous College Affiliated to Osmania University)
Faculty of Science – Department of Chemistry
MODEL PAPER
B.Sc. I YEAR SEMESTER -II
LABORATORY COURSE-II - QUALITATIVE ANALYSIS

Program: B.Sc. **Course Code: U26/DSC/CHE/201/P**
Type of course: DSC-2 **Time: 2 hrs**
No. of credits: 1 **Max. Marks: 50**

1. Using systematic procedure, identify and report two anions and two cations present in the given an unknown salt mixture. 30M

2. Record + Attendance 10M
3. Viva voce 10 M

Prepared by	Checked & Verified by	Approved by
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PANEL OF EXAMINERS							
FACULTY OF SCIENCES - DEPARTMENT OF CHEMISTRY							
CBCS-2026							
S. No	Course Title	Examiner	Name & Designation	Place of Work	Yrs of Experience	Contact No.	Email Id.
1	Semester I	Dr. Aliya Begum	Dr. Aliya Begum Assistant Professor of Organic Chemistry	Head, Dept of Chemistry, Veeranari Chakali Ilamma Women's University	Above 20	9849170130	aliyads@yahoo.com
		Dr. S. Sreekanth	Dr. S. Sreekanth Assistant Professor of Organic Chemistry	Dept of Chemistry Veeranari Chakali Ilamma Women's University	22	8465945408	Sivan.sreekanth@gmail.com
		Dr. Radhika. M	Dr. Radhika. M Assistant Prof. of Inorganic Chemistry	Head, Dept of Chemistry, Nizam college,Hyderabad	20	9032841181	radhikamone@yahoo.com
2	Semester II	Dr. Mary Nygi. K	Dr. Mary Nygi. K Assistant Professor of Organic Chemistry	Head,Dept of Chemistry Bhavan's Vivekananda Degree and PG College	20	9963123387	knygi@yahoo.com
		Ms. M. Sujatha	Ms. M. Sujatha Assistant Professor of Organic Chemistry	Dept of Chemistry St.Ann's college for women	15	9866049923	sujatha.stanns09@gmail.com
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SEMESTER II

Core Course 2

CHEMISTRY OF NUCLECI ACIDS & BIOCHEMICAL TECHNIQUES

Code : U26/BIC/DSC/201

Credits : 4

Total hours : 60

Hours/week : 4

Module I : COMPOSITION OF NUCLEIC ACIDS

Module II : STRUCTURE OF NUCLEIC ACIDS

Module III : SPECTROPHOTOMETRIC & CENTRIFUGATION TECHNIQUES

Module IV : CHROMOTOGRAPHY &ELECTROPHORETIC TECHNIQUES

Semester -II

CHEMISTRY OF NUCLEIC ACIDS & BIOCHEMICAL TECHNIQUES

1. Course Description

Programme : B.Sc.
Course Code : U26/BIC/DSC/201
Type of course : DSC 2
No. of credits : 4

Max. Hours: 60
Hours per week: 4
Max. Marks: 100

2. Course Objectives

1. To understand the structure, composition, and organization of nucleic acids, including DNA and RNA, and their components such as nucleotides and phosphodiester linkages.
2. To learn various important techniques of separation like chromatography, electrophoresis, centrifugation, and spectroscopy.

3. Course Outcomes

After the successful completion of the course, the student will be able to:

CO1: Describe the organization, composition, and chemical structure of nucleic acids (L2)

CO2: Explain the structure of DNA based on the Watson–Crick model and describe DNA denaturation, reassociation kinetics, and the types and functions of RNA. (L2)

CO3: Illustrate the separation techniques like colorimetry, spectrophotometry and centrifugation. (L3)

CO4: Analyze the principle and applications of Chromatography and electrophoresis(L4).

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4. Course Content

Module I: COMPOSITION OF NUCLEIC ACIDS — 15 Hours

Organization of DNA in the cell, including its arrangement in mitochondria and chloroplasts; the composition of nucleic acids such as DNA and RNA; the structure of purines and pyrimidines; nucleosides and nucleotides; the formation and stability of phosphodiester linkages; the effects of acids, alkalis, nucleases, and phosphodiester linkages on nucleic acids; and the photochemical and spectral characteristics of nucleic acids.

Module II: STRUCTURE OF NUCLEIC ACIDS — 15 Hours

Watson and Crick model of the DNA double helix; an introduction to circular DNA, supercoiling, and the helix-to-random coil transition; denaturation of nucleic acids and the hyperchromic effect; melting temperature (Tm) values and their significance; reassociation kinetics including Cot curves and their significance; and the different types of RNA, micro RNA along with their biological functions.

Module III: SPECTROPHOTOMETRIC & CENTRIFUGATION TECHNIQUES — 15 Hours

Concept of absorbance and the electromagnetic spectrum, Beer–Lambert's law along with its limitations, and the principles of colorimetry and spectrophotometry. It also covers UV and visible spectra, the molar extinction coefficient, the principle and applications of fluorimetry, the principle of centrifugation and sedimentation coefficient, and the different types of centrifugations along with their applications.

Module IV: CHROMOTOGRAPHY &ELECTROPHORETIC TECHNIQUES — 15 Hours

Introduction to chromatography and the principles of chromatographic techniques, including including paper chromatography and its applications, thin layer chromatography and its applications, gel filtration (molecular sieve) chromatography, ion exchange chromatography, and affinity chromatography. It also includes electrophoresis, with emphasis on its principle and applications, including native electrophoresis, SDS-PAGE, and agarose gel electrophoresis.

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5. Reference Books

1. Lehninger: Principles of Biochemistry (2013) 6thed.,Nelson, D.L. and Cox, M.M.W.H. Freeman and Company (New York).
2. Trevor Palmer: Enzymes (Biochemistry, Biotechnology, Clinical Chemistry), (2001) Horwood Publishing, ISBN 1-898563-78-0.
3. Wilson & Walker : Principles & Biochemical Techniques of Practical Biochemistry,(2000) Cambridge University Press. (Fifth Edition)
4. Upadhyaya &Upadhyaya. Biophysical Chemistry (2009) Himalayan Publishers.
5. Mathews: Biochemistry –3rd edition. Pearson Education Limited. (2003). ISBN: 81-297-0215-0.

6. Syllabus Focus

a) Relevance to Local, Regional, National and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
Global Development needs	Analytical techniques play a crucial role in various fields and industries, providing valuable insights and information

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b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
SD/EMP	Chromatography	Practicals
SD/EMP	Centrifugation	Practicals
SD/EMP	Electrophoresis	Practicals

7. Pedagogy

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Science experiments	Experiential Learning
2.	Field trip	Experiential Learning
3.	Presentations/Assignments	Participative Learning

8. Course Assessment Plan

a) **Weightage of Marks in Continuous Internal Assessments and End Semester Examination**

COs	Continuous Internal Assessments – CIA (40%)	End Semester Examination (60%)
CO1	CIA-1	End Semester examination
CO2	CIA-1	
CO3	CIA-2 – Objective	
CO4	CIA-2 - Assignment/ model making/ PPT	

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b) **Model Question Paper-End semester exam Theory**

CHEMISTRY OF NUCLEIC ACIDS & BIOCHEMICAL TECHNIQUES

Course Code: U26/BIC/DSC/201 **Max Time: 2 Hrs**
Credits: 4 **Max. Marks: 60**

I. Answer the following questions **(4x10=40M)**

1. Explain the composition of Nucleic acids in DNA

OR

2. Describe the effects of acids, alkalies, nucleases and phospho diester linkages on nucleic acids

3. Illustrate Watson and Crick model of DNA double Helix.

OR

4. Explain denaturation of Nucleic acids and define the hyperchromic effect, melting temperature values.

5. Distinguish Colorimetry & Spectrophotometry

OR

6. Explain the Principle and applications of Fluorimetry

7. Demonstrate the principle & applications of Ion exchange chromatography.

OR

8. Define Electrophoresis and describe the agarose gel electrophoresis with principle and applications.

II. Write Short notes on any 4 questions **(4x5=20M)**

9. Structure of Purines & Pyrimidines
10. Types of RNA
11. Principle of paper chromatography
12. Sedimentation Coefficient
13. Molar extinction coefficient
14. SDS PAGE

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Question Paper format – Blooms Taxonomy Level

SECTION A - INTERNAL CHOICE				**4Q X 10 M = 40 M**
Question Number	**Module Covered**	**Question**	**CO**	**BTL (Blooms Taxonomy Level)**
1	Module 1	Explain the composition of Nucleic acids in DNA	CO 1	Level II
2	Module 1	Describe the effects of acids, alkalies, nucleases and phosphodiester linkages on nucleic acids	CO 1	Level II
3	Module 2	Illustrate Watson and Crick model of DNA double Helix	CO 2	Level II
4	Module 2	Explain denaturation of Nucleic acids and define the hyperchromic effect, melting temperature values.	CO 2	Level II
5	Module 3	Distinguish Colorimetry & Spectrophotometry	CO 3	Level III
6	Module 3	Explain the Principle and applications of Fluorimetry	CO 3	Level III
7	Module 4	Demonstrate the principle & applications of Ion exchange chromatography.	CO 4	Level IV
8	Module 4	Define Electrophoresis and describe the agarose gel electrophoresis with principle and applications	CO 4	Level IV
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have ONE question from each module)				**4Q X 5 M = 20 M**
9	Module 1	Structure of Purines & Pyrimidines	CO 1	Level II
10	Module 2	Types of RNA	CO 2	Level II
11	Module 3	Molar extinction coefficient	CO 3	Level III
12	Module 3	Sedimentation Coefficient	CO 3	Level III
13	Module 4	Principle of paper chromatography	CO 4	Level IV
14	Module 4	SDS PAGE	CO 4	Level IV

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c) **Question Paper Blueprint**

Modules	Hours Allotted in the Syllabus	COs Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15	CO-1	2	4X10=40M	6 (Open Choice) Atleast 1 Question from each Module	4X5=20M
2	15	CO-2	2			
3	15	CO-3	2			
4	15	CO-4	2			

9. CO-PO Mapping:

CO	PO	Cognitive Level	Class room sessions(hrs)
1	1	Understand/ Remember	15
2	2	Application	15
3	2	Application	15
4	1,2	Analysing	15

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ESTIMATION OF NUCLEIC ACIDS & BIOCHEMICAL TECHNIQUES

PRACTICAL

1. Course Description:

Max. Hours: 30
Course Code: U26/BIC/DSC/201/P
Type of course: DSC

Hours per week: 2
No. of credits: 1
Max. Marks: 50

2. Course objective:

- Acquire skills of important separation techniques.

3. Course Outcomes:

CO1: Demonstrate their skills in qualitative identification of amino acids.

CO2: Apply the knowledge of separation techniques of biomolecules.

4. Course Content

PRACTICAL SESSIONS

1. Qualitative analysis of Amino acids (4 sessions)
2. Verification of Beer Lamberts law
3. Absorption Maxima
4. Estimation of DNA
5. Estimation of RNA
6. Separation of Amino Acids by Paper Chromatography
7. Separation of Lipids by TLC
8. Gel Filtration Chromatography
9. Paper Electrophoresis

5. Reference Books

1. Experimental Biochemistry-A student companion -Beedu Sashidhar Rao & Vijay Deshpande
2. Laboratory Manual in Biochemistry-Jayaraman, J. Wiley Eastern

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Model Question Paper – End Semester Exam Practical

CHEMISTRY OF NUCLEIC ACIDS & BIOCHEMICAL TECHNIQUES

Course Code: U26/BIC/DSC/201/P
Credits: 1

Max Time: 2 Hrs
Max. Marks: 50

Answer the following: -

1. Write the schematic representation (flowchart) for the qualitative analysis of
   a. Amino acids
   b. Principle involved in Gel filtration chromatography (10 M)
2. Identify the given amino acid present in the given solutions **A** and **B** (10 + 10 M)
3. Perform Paper chromatography of amino acids & calculate the Rf value of the mixture. (10 M)
4. Viva (5M)
5. Record (5M)

Prepared by	Checked & verified	Approved by
Dr. S. Parijatham Kanchana **Teaching faculty**	**Dr.G. Sony** **HoD**	**Prof. Uma Joseph** **Principal**

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Panel of Examiners

Semester/ Course Title	Examiner	Designation Place of Work	Years of Experience	Contact No.	Email Id.
Semester I Molecules of Life	**Ms. S.Vanitha**	Assistant Professor, Bhavan's Vivekananda college, Sainikpuri.	19	9985549428	vanitha.biochem@bhavansvc.ac.in
	Dr.S.Ravi kiran	Assistant Professor, RBVRR College-Naryanguda, Hyderabad	20	9948043292	srksuripeddi@gmail.com
Semester II Chemistry of Nucleic acids & Biochemical techniques	Ms. Shailaja	Assistant Professor, St. Ann's College for Women, Mehdipatnam Hyderabad	18	9849174742	sylaja.mekala@gmail.com
	Ms. C. Vanisree	HOD, St. Pious College, Nacharam, Hyderabad.	18	9703599392	vanisree.ch@stpiouscollege.org

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SEMESTER II

MICROBIOLOGY & IMMUNOLOGY

1. Course Description

Programme: B.Sc. **Max. Hours: 60**
Course Code: U26/BIT/DSC/201 **Hours per week: 4**
Course Type: DSC-2 **Max. Marks: 100**
No. of credits: 4

2. Course Objectives

- To learn about the principles of microbiology and acquire an understanding of fundamental microbiological concepts as well as several ways for isolating pure cultures
- To understand an overview of different types of immunity, cells & organs involved in the immune system and comprehend the immunoglobulins and autoimmune disorders

3. Course Outcomes

On completion of the course the student will be able to:

CO1: Recognize and summarize the contributions of scientists in the field of Microbiology, gain an insight into characterization of microorganisms and apply skills in handling microscopes. **((REMEMBER, UNDERSTAND, APPLY) L I, II & III**

CO2: Outline, apply and evaluate microbiological practices like Sterilization techniques, isolation, and culturing of microorganisms to study the microbial cells. **(UNDERSTAND, APPLY, EVALUATE) L II, III & V**

CO3: Remember, interpret, and use the basic concepts to have a comprehensive understanding of antigen-antibody interactions and their relevance in immunology **(REMEMBER, UNDERSTAND) L I & II**

CO4: Define, summarize, use, and analyze the knowledge, skills, and competencies to understand immunoassays effectively in various scientific and biomedical sciences **(UNDERSTAND, ANALYZE) L II & IV**

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4. Course Content

MODULE I: FUNDAMENTALS OF MICROBIOLOGY **(15HRS)**

1.1 Historical development of Microbiology and Contributors of Microbiology
1.2 Basic Microscopy: Bright field microscopy, Dark field microscopy, Phase contrast microscopy
1.3 Advanced Microscopy: Fluorescent microscopy, Scanning and Transmission Electron microscopy
1.4 Introduction to Microorganisms (Archaea, Bacteria, Algae, Fungi, Mycoplasma and Viruses)
1.5 General characteristics of bacteria and virus, disease-causing pathogens, and symptoms (*Mycobacterium*, Hepatitis)
1.6 General characteristics and applications of micro-algae and fungi

MODULE II: CULTURE AND IDENTIFICATION OF MICROORGANISMS (15HRS)

2.1 Methods of sterilization - physical and chemical methods
2.2 Bacterial nutrition - nutritional types of bacteria, essential macro, micronutrients and growth factors.
2.3 Bacterial growth curve - batch and continuous cultures, synchronous cultures, measurement of bacterial growth-measurement of cell number and cell mass
2.4 Factors affecting bacterial growth
2.5 Culturing of anaerobic bacteria and viruses
2.6 Pure culture and its characteristics

MODULE III: BASICS OF IMMUNOLOGY **(15HRS)**

3.1 Types of Immunity - innate and adaptive Immunity
3.2 Cells of the immune system: T-cells (helper and cytotoxic cells), B-cells, Natural killer cells, Macrophages, Basophils and Dendritic cells
3.3 Primary organs of immune system - Thymus and Bone marrow
3.4 Secondary organs of immune system - Spleen and Lymph nodes
3.5 Antigens-immunogenicity vs antigenicity, factors affecting antigenicity, Epitopes,
3.6 Haptens & types of adjuvants

MODULE IV: HUMORAL AND CELL MEDIATED IMMUNITY **(15HRS)**

4.1 Structure of immunoglobulin - types and functions of immunoglobulins
4.2 Major Histocompatibility Complex (MHC) & Human Leukocyte Antigen (HLA)- role in organ transplantation
4.3 Cell mediated immunity- T-cell receptor (TCR), Antigen Presenting Cells (APCs), ternary complex (TCR, peptide & MHC); cytokines
4.4 Hypersensitivity- types I, II, III & IV
4.5 Autoimmunity- Mechanisms of autoimmunity; Autoimmune diseases - Systemic lupus erythematosus, Rheumatoid arthritis
4.6 Monoclonal antibody (MAbs) production and its applications, Vaccines

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5. Reference books

1. Biology of Microorganisms by: Brock, T.D. and Madigan, M.T.
2. Microbiology by: Prescott, L.M., Harley, J.P. Klein, D.A.
3. Microbiology by: Pelczar, M.J, Chan, E.C.S., Ereig, N.R.
4. Microbiological applications by: Benson
5. Essential Immunology. Publ: Blackwell by: Roitt I.
6. Immunology. Publ: Blackwell by: Reever G. & Todd I.
7. Cellular and Molecular Immunology. Saunders Publication, Philadelphia by: Abbas A.K. Lichtman A.H., Pillai S.
8. Kuby's Immunology. W.H. Freeman and Company by: Golds R.A., Kindt T.J., Osborne

6. Syllabus Focus

a. Relevance to Local, Regional, National and Global Development Needs

Local/Regional/National /Global Development Needs	Relevance
National Development (Module 1, 2 & 3)	Addressing Health, Agriculture, Environment, and industry challenges through Research Innovation with an interdisciplinary collaboration of Microbiology and immunology.
Global development (Module 4)	The course addresses global imperatives by fostering interdisciplinary scholarship, innovation, and sustainable solutions for pressing societal challenges.

b. Components on Skill Development/Entrepreneurship/Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
Skill Development	(Module 1 & 2)	Seminar presentations, Art projects, group discussions to understand and evaluate the basics of Microbiology and Immunology.

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Employability	(Module 2, 3 & 4)	Hands on training on different media preparations, pure culture procedures, handling of varied microscopes and Immunoassays are useful in enhancing employability across a range of diagnostic and research labs.

7. Pedagogy

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Participative Learning	Seminar
2.	Experiential Learning	Quiz
3.	Participative Learning	Group Discussion
4.	Participative Learning	Presentation
5.	Experiential Learning	Art projects
6.	Problem Solving	Research projects
7.	Experiential Learning	Science experiments
8.	Experiential Learning	Internship opportunities

8. Course Assessment Planp

A) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments - CIA (40%)	End Semester Examination - (60%)
CO1	CIA-1 Written Exam	Written Exam
CO2	CIA-2 Quiz/ Assignment/Seminar Presentation	
CO3	CIA-1 Written Exam	
CO4	CIA-2Presentation/ Art projects/ Science experiments/ Case studies	

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b. Model Question Paper- End Semester Exam

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Faculty of Science – Department of Biotechnology

MODEL QUESTION PAPER

END SEMESTER EXAM

MICROBIOLOGY & IMMUNOLOGY

TIME: 2hrs **Course Code: U26/BIT/DSC/201**

MAX.MARKS: 60

SECTION – A

I.Answer the following **4 x 10 = 40 M**

1. How would you summarize the principle and working of Transmission Electron Microscopy

OR

2. Illustrate the salient features of bacterial cell structure with well labelled diagrams

3. Explain about Batch culture. Add a detailed note on bacterial growth curve

OR

4. Define sterilization. Assess the different physical sterilization methods.

5. Contrast between Innate and adaptive immunity.

OR

6. Explain in detail Secondary organs of immune system

7. Analyze Major Histocompatibility Complex (MHC) & Human Leukocyte Antigen (HLA)- and its role in organ transplantation

OR

8.Summarize autoimmune response with suitable examples

SECTION – B

II. Answer any <u>FOUR</u> of the following **4 x 5 = 20 M**

9. List the contributions of Louis Pasteur.

10. Demonstrate the factors affecting bacterial growth

11. Compare the isolation of different pure culture techniques

12. Describe Haptens

13. Analyse the role of APC in cell mediated immune response

14. Explain Monoclonal antibodies

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SEMESTER-END MODEL QUESTION PAPER

SECTION A - INTERNAL CHOICE 4 Q X 10 M = 40 M				
Question Number	**Question**	**Question**	**CO**	BTL (Blooms Taxonomy Level)
1	Module 1	How would you summarize the principle and working of Transmission Electron Microscopy	CO 1	II
2	Module 1	Illustrate the salient features of bacterial cell structure with well labelled diagrams	CO 1	III
3	Module 2	Explain about Batch culture. Add a detailed note on bacterial growth curve	CO 2	II
4	Module 2	Define sterilization. Assess the different physical sterilization methods.	CO 2	V
5	Module 3	Contrast between Innate and adaptive immunity	CO 3	II
6	Module 3	Explain in detail Secondary organs of immune system	CO 3	II
7	Module 4	Analyze Major Histocompatibility Complex (MHC) & Human Leukocyte Antigen (HLA)- and its role in organ transplantation	CO 4	IV
8	Module 4	Summarize autoimmune response with suitable examples	CO 4	II

SECTION B - ANSWER ANY 4 OUT OF 6 4 Q X 5 M = 20 M (To compulsorily have **ONE** question from **each** module)				
9	Module 1	List the contributions of Louis Pasteur.	CO 1	I
10	Module 2	Demonstrate the factors affecting bacterial growth	CO 2	III
11	Module 3	Compare the isolation of different pure culture techniques	CO 2	IV
12	Module 4	Describe Haptens	CO 3	II
13	Any Module	Analyse the role of APC in cell mediated immune response	CO 4	IV
14	Any Module	Explain Monoclonal antibodies	CO 4	II

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c. Question Paper Blueprint

Modules	Hours Allotted in the Syllabus	COs Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15	CO-1	2	10	6 questions with at least 1 from each module	5
2	15	CO-2	2	10		5
3	15	CO-3	2	10		5
4	15	CO-4	2	10		5

9. CO PO Mapping

CO	PO	Cognitive Level	Class room sessions (hrs)
1	1, 3, 7	Remember, understand, and apply	15
2	1, 2, 6, 7	Understand, apply and evaluate	15
3	1,2,7	Remember and understand	15
4	1,2,7	Understand and analyse	15

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SEMESTER-II
MICROBIOLOGY & IMMUNOLOGY - PRACTICAL

1. Course description

Programme: B.Sc.
Course Code: U26/BIT/DSC/201/P
Course Type: DSC-2
No. of credits: 1

Max. Hour: 30
Hours per week: 2
Max. Marks: 50

2. Course objective:

- To aid students gain hands on experience in basic Microbiological techniques including aseptic handling, staining and culture methods and apply this knowledge in research or clinical findings.
- To provide hands-on training in fundamental immunological techniques and diagnostic procedures, enabling students to understand antigen–antibody interactions and immune response mechanisms.

3. Course Outcomes:

On completion of the course the student will be able to

CO-1: apply skills to prepare and sterilize media for isolation and culturing of microorganisms. **(APPLY & ANALYSE) L III & IV**

CO-2: Demonstrate and assess basic immunological techniques such as antigen–antibody reactions, blood grouping, and immunoassays. **(APPLY, EVALUATE) L III & V**

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PRACTICAL SESSIONS

1. Sterilization methods – Autoclave, Hot Air Oven, Filtration
2. Preparation of microbiological media (bacterial, algal & fungal)
3. Isolation of bacteria by streak, spread and pour plate methods
4. Isolation of bacteria from soil
5. Simple staining and differential staining (Gram's staining)
6. Bacterial growth curve
7. Blood grouping
8. Single radial immunodiffusion
9. ELISA
10. Viability test of cells/bacteria (Evans blue test or tryphan blue test)

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SEMESTER-II

MICROBIOLOGY & IMMUNOLOGY -PRACTICAL

Course Code: U26/BIT/DSC/201/P **Max. Marks: 50**

Credits: 1 **Time: 2Hrs**

I. MAJOR: **(20M)**

Perform Gram's staining using the given sample and report the results. Write the principle and procedure for the same

II. MINOR: **(10M)**

Perform and report your blood group using the given sample. Write the principle and procedure for the same

III. IDENTIFY THE GIVEN SPOTTERS: **(10M)**

IV. VIVA **(5M)**

V. RECORD **(5M)**

Prepared by	Checked & verified by	Approved by
Dr. Deepa Switha Teaching faculty	Ms. Shouni Niveditha HoD	Prof. Uma Joseph Principal

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PANEL OF EXAMINERS

FACULTY OF SCIENCE-DEPARTMENT OF BIOTECHNOLOGY

CBCS-2026

S.No.	B.Sc-Course Title	Examiner	Designation Place of Work	Years of Experience	Contact No.	Email Id.
1.	Semester I	Ms. D. Metilda Roselin	Asst. Prof., Dept of Genetics & Biotechnology, BVC	12	9160612832	metilda2324@gmail.com
		Dr.K.Madhuri	Associate Prof, Dept of Biotechnology, Mahatma Gandhi University	14	9000595973	madhuriphd09@yahoo.com
		Dr. Sushma Patkar	Asst. Prof, Dept of Genetics & Biotechnology, BVC	18	8790265800	Sushma.biotech @bhavansvc.ac. in
2.	Semester II	Dr.K.Madhuri	Associate Prof, Dept of Biotechnology, Mahatma Gandhi University	14	9000595973	madhuriphd09@yahoo.com
		Dr.T. Siva Ram	Asst. Prof, Dept of Biotechnology,	12	9032694559	tsram@outlook. com
		Dr.Madhuri	Loyola Degree & PG College, Alwal	21	9849442334	

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SEMESTER II

Core Course 2

CHEMISTRY OF NUCLECI ACIDS & BIOCHEMICAL TECHNIQUES

Code : U26/BIC/DSC/201

Credits : 4

Total hours : 60

Hours/week : 4

Module I : COMPOSITION OF NUCLEIC ACIDS

Module II : STRUCTURE OF NUCLEIC ACIDS

Module III : SPECTROPHOTOMETRIC & CENTRIFUGATION TECHNIQUES

Module IV : CHROMOTOGRAPHY &ELECTROPHORETIC TECHNIQUES

Semester -II

CHEMISTRY OF NUCLEIC ACIDS & BIOCHEMICAL TECHNIQUES

1. Course Description

Programme : B.Sc.
Course Code : U26/BIC/DSC/201
Type of course : DSC 2
No. of credits : 4

Max. Hours: 60
Hours per week: 4
Max. Marks: 100

2. Course Objectives

1. To understand the structure, composition, and organization of nucleic acids, including DNA and RNA, and their components such as nucleotides and phosphodiester linkages.
2. To learn various important techniques of separation like chromatography, electrophoresis, centrifugation, and spectroscopy.

3. Course Outcomes

After the successful completion of the course, the student will be able to:

CO1: Describe the organization, composition, and chemical structure of nucleic acids (L2)

CO2: Explain the structure of DNA based on the Watson–Crick model and describe DNA denaturation, reassociation kinetics, and the types and functions of RNA. (L2)

CO3: Illustrate the separation techniques like colorimetry, spectrophotometry and centrifugation. (L3)

CO4: Analyze the principle and applications of Chromatography and electrophoresis(L4).

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4. Course Content

Module I: COMPOSITION OF NUCLEIC ACIDS — 15 Hours

Organization of DNA in the cell, including its arrangement in mitochondria and chloroplasts; the composition of nucleic acids such as DNA and RNA; the structure of purines and pyrimidines; nucleosides and nucleotides; the formation and stability of phosphodiester linkages; the effects of acids, alkalis, nucleases, and phosphodiester linkages on nucleic acids; and the photochemical and spectral characteristics of nucleic acids.

Module II: STRUCTURE OF NUCLEIC ACIDS — 15 Hours

Watson and Crick model of the DNA double helix; an introduction to circular DNA, supercoiling, and the helix-to-random coil transition; denaturation of nucleic acids and the hyperchromic effect; melting temperature (Tm) values and their significance; reassociation kinetics including Cot curves and their significance; and the different types of RNA, micro RNA along with their biological functions.

Module III: SPECTROPHOTOMETRIC & CENTRIFUGATION TECHNIQUES — 15 Hours

Concept of absorbance and the electromagnetic spectrum, Beer–Lambert's law along with its limitations, and the principles of colorimetry and spectrophotometry. It also covers UV and visible spectra, the molar extinction coefficient, the principle and applications of fluorimetry, the principle of centrifugation and sedimentation coefficient, and the different types of centrifugations along with their applications.

Module IV: CHROMOTOGRAPHY &ELECTROPHORETIC TECHNIQUES — 15 Hours

Introduction to chromatography and the principles of chromatographic techniques, including including paper chromatography and its applications, thin layer chromatography and its applications, gel filtration (molecular sieve) chromatography, ion exchange chromatography, and affinity chromatography. It also includes electrophoresis, with emphasis on its principle and applications, including native electrophoresis, SDS-PAGE, and agarose gel electrophoresis.

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5. Reference Books

1. Lehninger: Principles of Biochemistry (2013) 6thed.,Nelson, D.L. and Cox, M.M.W.H. Freeman and Company (New York).
2. Trevor Palmer: Enzymes (Biochemistry, Biotechnology, Clinical Chemistry), (2001) Horwood Publishing, ISBN 1-898563-78-0.
3. Wilson & Walker : Principles & Biochemical Techniques of Practical Biochemistry,(2000) Cambridge University Press. (Fifth Edition)
4. Upadhyaya &Upadhyaya. Biophysical Chemistry (2009) Himalayan Publishers.
5. Mathews: Biochemistry –3rd edition. Pearson Education Limited. (2003). ISBN: 81-297-0215-0.

6. Syllabus Focus

a) Relevance to Local, Regional, National and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
Global Development needs	Analytical techniques play a crucial role in various fields and industries, providing valuable insights and information

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b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
SD/EMP	Chromatography	Practicals
SD/EMP	Centrifugation	Practicals
SD/EMP	Electrophoresis	Practicals

7. Pedagogy

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Science experiments	Experiential Learning
2.	Field trip	Experiential Learning
3.	Presentations/Assignments	Participative Learning

8. Course Assessment Plan

a) **Weightage of Marks in Continuous Internal Assessments and End Semester Examination**

COs	Continuous Internal Assessments – CIA (40%)	End Semester Examination (60%)
CO1	CIA-1	End Semester examination
CO2	CIA-1	
CO3	CIA-2 – Objective	
CO4	CIA-2 - Assignment/ model making/ PPT	

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b) **Model Question Paper-End semester exam Theory**

CHEMISTRY OF NUCLEIC ACIDS & BIOCHEMICAL TECHNIQUES

Course Code: U26/BIC/DSC/201 **Max Time: 2 Hrs**
Credits: 4 **Max. Marks: 60**

I. Answer the following questions **(4x10=40M)**

1. Explain the composition of Nucleic acids in DNA

OR

2. Describe the effects of acids, alkalies, nucleases and phospho diester linkages on nucleic acids

3. Illustrate Watson and Crick model of DNA double Helix.

OR

4. Explain denaturation of Nucleic acids and define the hyperchromic effect, melting temperature values.

5. Distinguish Colorimetry & Spectrophotometry

OR

6. Explain the Principle and applications of Fluorimetry

7. Demonstrate the principle & applications of Ion exchange chromatography.

OR

8. Define Electrophoresis and describe the agarose gel electrophoresis with principle and applications.

II. Write Short notes on any 4 questions **(4x5=20M)**

9. Structure of Purines & Pyrimidines
10. Types of RNA
11. Principle of paper chromatography
12. Sedimentation Coefficient
13. Molar extinction coefficient
14. SDS PAGE

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Question Paper format – Blooms Taxonomy Level

SECTION A - INTERNAL CHOICE				**4Q X 10 M = 40 M**
Question Number	**Module Covered**	**Question**	**CO**	**BTL (Blooms Taxonomy Level)**
1	Module 1	Explain the composition of Nucleic acids in DNA	CO 1	Level II
2	Module 1	Describe the effects of acids, alkalies, nucleases and phosphodiester linkages on nucleic acids	CO 1	Level II
3	Module 2	Illustrate Watson and Crick model of DNA double Helix	CO 2	Level II
4	Module 2	Explain denaturation of Nucleic acids and define the hyperchromic effect, melting temperature values.	CO 2	Level II
5	Module 3	Distinguish Colorimetry & Spectrophotometry	CO 3	Level III
6	Module 3	Explain the Principle and applications of Fluorimetry	CO 3	Level III
7	Module 4	Demonstrate the principle & applications of Ion exchange chromatography.	CO 4	Level IV
8	Module 4	Define Electrophoresis and describe the agarose gel electrophoresis with principle and applications	CO 4	Level IV
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have ONE question from each module)				**4Q X 5 M = 20 M**
9	Module 1	Structure of Purines & Pyrimidines	CO 1	Level II
10	Module 2	Types of RNA	CO 2	Level II
11	Module 3	Molar extinction coefficient	CO 3	Level III
12	Module 3	Sedimentation Coefficient	CO 3	Level III
13	Module 4	Principle of paper chromatography	CO 4	Level IV
14	Module 4	SDS PAGE	CO 4	Level IV

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c) **Question Paper Blueprint**

Modules	Hours Allotted in the Syllabus	COs Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15	CO-1	2	4X10=40M	6 (Open Choice) Atleast 1 Question from each Module	4X5=20M
2	15	CO-2	2			
3	15	CO-3	2			
4	15	CO-4	2			

9. CO-PO Mapping:

CO	PO	Cognitive Level	Class room sessions(hrs)
1	1	Understand/ Remember	15
2	2	Application	15
3	2	Application	15
4	1,2	Analysing	15

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ESTIMATION OF NUCLEIC ACIDS & BIOCHEMICAL TECHNIQUES

PRACTICAL

1. Course Description:

Max. Hours: 30
Course Code: U26/BIC/DSC/201/P
Type of course: DSC

Hours per week: 2
No. of credits: 1
Max. Marks: 50

2. Course objective:

- Acquire skills of important separation techniques.

3. Course Outcomes:

CO1: Demonstrate their skills in qualitative identification of amino acids.

CO2: Apply the knowledge of separation techniques of biomolecules.

4. Course Content

PRACTICAL SESSIONS

1. Qualitative analysis of Amino acids (4 sessions)
2. Verification of Beer Lamberts law
3. Absorption Maxima
4. Estimation of DNA
5. Estimation of RNA
6. Separation of Amino Acids by Paper Chromatography
7. Separation of Lipids by TLC
8. Gel Filtration Chromatography
9. Paper Electrophoresis

5. Reference Books

1. Experimental Biochemistry-A student companion -Beedu Sashidhar Rao & Vijay Deshpande
2. Laboratory Manual in Biochemistry-Jayaraman, J. Wiley Eastern

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Model Question Paper – End Semester Exam Practical

CHEMISTRY OF NUCLEIC ACIDS & BIOCHEMICAL TECHNIQUES

Course Code: U26/BIC/DSC/201/P
Credits: 1

Max Time: 2 Hrs
Max. Marks: 50

Answer the following: -

1. Write the schematic representation (flowchart) for the qualitative analysis of
   a. Amino acids
   b. Principle involved in Gel filtration chromatography (10 M)
2. Identify the given amino acid present in the given solutions **A** and **B** (10 + 10 M)
3. Perform Paper chromatography of amino acids & calculate the Rf value of the mixture. (10 M)
4. Viva (5M)
5. Record (5M)

Prepared by	Checked & verified	Approved by
Dr. S. Parijatham Kanchana **Teaching faculty**	**Dr.G. Sony** **HoD**	**Prof. Uma Joseph** **Principal**

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Panel of Examiners

Semester/ Course Title	Examiner	Designation Place of Work	Years of Experience	Contact No.	Email Id.
Semester I Molecules of Life	**Ms. S.Vanitha**	Assistant Professor, Bhavan's Vivekananda college, Sainikpuri.	19	9985549428	vanitha.biochem@bhavansvc.ac.in
	Dr.S.Ravi kiran	Assistant Professor, RBVRR College-Naryanguda, Hyderabad	20	9948043292	srksuripeddi@gmail.com
Semester II Chemistry of Nucleic acids & Biochemical techniques	Ms. Shailaja	Assistant Professor, St. Ann's College for Women, Mehdipatnam Hyderabad	18	9849174742	sylaja.mekala@gmail.com
	Ms. C. Vanisree	HOD, St. Pious College, Nacharam, Hyderabad.	18	9703599392	vanisree.ch@stpiouscollege.org

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DEPARTMENT OF CHEMISTRY

DISCIPLINE SPECIFIC CORE II **CHEMISTRY II** **B.Sc. I - SEMESTER- II 60 h**
Module 1: Inorganic Chemistry Chemistry of d-Block elements Chemistry of f-Block elements
Module 2: Organic Chemistry Halogen Compounds Hydroxy Compounds and Ethers Carbonyl Compounds
Module 3: Physical Chemistry Electrochemistry
Module 4: General Chemistry Chemical Bonding Stereoisomerism Colligative Properties

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SEMESTER - II
CHEMISTRY - II

1. Course Description

Programme: B.Sc.
Course Code: U26/CHE/DSC/201
Course type: DSC - 2
No. of credits: 4

Max. Hours: 60
Max. Marks: 100
Hours per week: 4

2. Course Objectives

- To enable students to critically understand the electronic structure, periodic trends, magnetic and spectral properties, complex formation, and applications of d- and f-block elements.
- To develop a clear understanding of the structure, reactivity, preparation methods, and reaction mechanisms of halogen compounds, alcohols, ethers, and carbonyl compounds.
- To provide a comprehensive understanding of electrochemical principles, including electrode potentials, electrochemical cells, and their practical applications.
- To impart fundamental knowledge of chemical bonding theories, stereochemical concepts, and colligative properties to explain the structure and behavior of chemical substances.

3. Course Outcomes

On completion of the course the student will be able to

- Explain and predict the chemical behavior of d- and f-block elements based on electronic structure and bonding principles.
- Analyze reactions and predict products of halogen, alcohol, ether, and carbonyl compounds.
- Calculate electrode potentials, analyze electrochemical cells, and apply electrochemical concepts to practical systems such as batteries and corrosion.
- Students will be able to apply bonding theories, distinguish stereoisomers, and solve numerical problems related to colligative properties.

4. Course Content

MODULE I: INORGANIC CHEMISTRY **15 h (1h/week)**

Chemistry of d-block elements **7h**

Characteristics of d-block elements with special reference to electronic configuration, variable oxidation states, color properties, d-d spectral transitions, ability to form complexes, magnetic properties, calculation of magnetic moment-spin only formula & catalytic properties. Comparative treatment of second and third transition series with their 3d analogues.

Chemistry of f-block elements **8h**

Chemistry of Lanthanides: Position in periodic table, electronic structure, oxidation state, ionic and atomic radii/ionic radii- lanthanide contraction- cause and consequences, anomalous behavior of post lanthanides-complexation-type of donor ligands preferred. Magnetic properties- paramagnetism, color and spectra, f-f transitions-occurrence and separation-ion exchange method, solvent extraction.

Chemistry of actinides: General features-electronic configuration, oxidation state, actinide contraction, color and complex formation. Comparison with lanthanides.

IKS: Case studies on The Iron Pillar of Delhi – Metallurgical Excellence and Monazite Sands of Kerala – Source of Rare Earths and Thorium.

MODULE II: ORGANIC CHEMISTRY **15 h (1h/week)**

Halogen compounds **4 h**

Classification: alkyl (primary, secondary, tertiary), aryl, aralkyl,. Chemical reactivity - reduction, formation of RMgX, Nucleophilic substitution reactions – classification into S_N1 and S_N2. Mechanism and energy profile diagrams of S_N1 and S_N2 reactions. Stereochemistry of S_N2 (Walden Inversion) 2-bromobutane, S_N1 (Racemization) 1-bromo-1-phenylpropane.

Hydroxy compounds and ethers **5 h**

Alcohols: Preparation: 1°, 2° and 3° alcohols using Grignard reagent, Reduction of Carbonyl compounds, carboxylic acids and esters. Physical properties: H-bonding, Boiling point and Solubility. Reactions with Sodium, $HX/ZnCl_2$ (Lucas reagent), oxidation with conc. HNO_3 and Oppenauer oxidation (Mechanism).

Phenols: Preparation: (i) from diazonium salts of anilines and (ii) from benzene sulphonic acids. Properties: Acidic nature, formation of phenoxide and reaction with R-X, electrophilic substitution; halogenations, Riemer Tiemann reaction (Mechanism), Gattermann-Koch reaction, Schotten Baumann reaction.

Ethers: Nomenclature, preparation by Williamson synthesis. Chemical properties – inert nature, action of conc. H_2SO_4.

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Carbonyl compounds 6h

Preparation of aldehydes & ketones from acid chlorides, nitriles and carboxylic acids. Special methods of preparing aromatic aldehydes and ketones by Oxidation of arenes. Physical properties – absence of Hydrogen bonding. Reactivity of the carbonyl groups in aldehydes and ketones. Chemical reactivity: Addition of (a) $NaHSO_3$ (b) HCN (c) RMgX (d) 2,4-DNP (Schiff base). Addition of H_2O to form hydrate, addition of alcohols - hemi acetal and acetal formation. Cannizzaro reaction. Oxidation reactions – $KMnO_4$ oxidation, reduction – catalytic hydrogenation, mechanism of Clemmensen reduction, Meerwein-Ponndorf-Verley reduction.

MODULE III: PHYSICAL CHEMISTRY 15 h (1h/week)

Electrochemistry 15h

Revision of conductance, specific conductance, equivalent conductance and factors influencing conductance of electrolytes. Ionic mobility, definition and significance of transport number. Kohlrausch's law – its applications: determination of degree of dissociation and acid dissociation constant (K_a) of weak acids, solubility product determination and conductometric titrations. Ostwald's dilution law - its uses and limitations. Debye- Hückel -Onsager's equation for strong electrolytes (elementary treatment only).

Types of electrodes with examples - Types of reversible electrodes - the gas electrode, metal metal ion, metal-insoluble salt, redox electrodes and ion-selective electrode. Reversible and irreversible cells; Nernst equation – EMF of a cell; representation of a cell-problems; electrode potentials-electrochemical series and its significance. Determination of pH – using quinhydrone and glass electrodes. Potentiometric titrations.

MODULE IV: GENERAL CHEMISTRY 15 h (1h/week)

Chemical Bonding 5h

Molecular orbital theory: Shapes and sign convention of atomic orbitals. Modes of bonds. Criteria for orbital overlap. LCAO concept. π and σ overlapping. Concept of Types of molecular orbitals: bonding, antibonding and non-bonding. MOED of homonuclear diatomic molecules - H_2, N_2, O_2, O_2^-, O_2^{2-}, F_2 (unhybridized diagrams only) and heteronuclear diatomics - CO,. CN^-, NO, NO^+ and HF, their bond order, stability and magnetic properties.

Stereoisomerism 5h

Optical activity: Definition, wave nature of light, plane polarized light, optical rotation and specific rotation, chiral centers. Chiral molecules: definition and criteria - absence of plane, center and Sn axis of symmetry – asymmetric and dissymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and dissymmetric molecules (trans- 1,2-Dichlorocyclopropane). Molecules with constitutionally symmetrical chiral carbons (Tartaric acid) Molecules with constitutionally unsymmetrical chiral carbons (2,3-Dibromopentane). D, L configuration – examples. R, S – configuration: Cahn-Ingold-Prelog (CIP) rules.

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Colligative Properties 5h

Definition of colligative properties- relative lowering of vapour pressure-Raoult's law; Osmotic pressure; elevation of boiling point and depression of freezing point; thermodynamic relation between molecular weight and colligative property (derivations not required) -Problems.

5. Reference Books

General reference: B.Sc. I Year Chemistry : Semester II, Telugu Academy publication, Hyd.

Module- I

1. Puri, B. R., Sharma, L. R., & Kalia, M. S. (1996). Principles of inorganic chemistry. Vishal Publications.
2. Lee, J. D. (1981). Concise inorganic chemistry (3rd ed.). Oxford University Press.
3. Cotton, F. A., Wilkinson, G., & Gaus, P. L. (2001). Basic inorganic chemistry (3rd ed.). Wiley.
4. Greenwood, N. N., & Earnshaw, A. (1989). Chemistry of the elements. Pergamon Press.
5. Shriver, D. F., & Atkins, P. W. (1999). Inorganic chemistry (3rd ed.). Oxford University Press.
6. Huheey, J. E., Keiter, E. A., & Keiter, R. L. (1993). Inorganic chemistry: Principles of structure and reactivity (4th ed.). Harper Collins College Publishers.
7. Gopalan, R. (2009). Textbook of inorganic chemistry. University's Press.

Module- II

1. Morrison, R. T., & Boyd, R. N. (2011). Organic chemistry. Pearson Education (Prentice Hall).
2. Solomons, T. W. G., & Fryhle, C. B. (2016). Organic chemistry. Wiley (John Wiley & Sons).
3. Bruice, P. Y. (2017). Organic chemistry. Pearson Education.
4. Wade, L. G., Jr. (2013). Organic chemistry. Pearson Education.
5. Jones, M., Jr. (2010). Organic chemistry. W. W. Norton & Company.
6. McMurry, J. (2015). Organic chemistry. Cengage Learning (Brooks/Cole).
7. Soni, P. L., & Soni, H. M. (2012). Organic chemistry. Sultan Chand & Sons.
8. Ghosh, S. K. (2009). General organic chemistry. Bharati Bhawan Publishers.
9. Pillai, C. N. (2008). Organic chemistry. Universities Press (India) Pvt. Ltd.

Module-III

1. Glasstone, S., & Lewis, D. (1966). Elements of physical chemistry. Macmillan.
2. Maron, S. H., & Lando, J. B. (1966). Fundamentals of physical chemistry. Macmillan Limited.
3. Puri, B. R., Sharma, L. R., & Pathania, M. S. (2013). Principles of physical chemistry (46th ed.). Vishal Publishing Company.
4. Atkins, P. W. (2001). Physical chemistry (7th ed.). Oxford University Press.

b. Components on Skill Development/Entrepreneurship Development/Employability

SD/ED /EMP	Syllabus Content	Description of Activity
SD	Module I	Encourage them to compare and discuss trends in reactivity and chemical behaviour.
EMP	Module II	Design and present a synthetic pathway for an industry-relevant product using halogen, hydroxy, ether, and carbonyl compounds, including mechanism and yield.
ED (NSQF level 3 or 4)	Module III	Enables students to identify opportunities and develop innovative, cost-effective solutions in energy storage, corrosion control, electroplating, and other electrochemical industries.
EMP	Module IV	Solve and present a set of application-based problems on chemical bonding, stereochemistry, and colligative properties, explaining reasoning and calculations.

c. IKS component:

IKS	Syllabus Content	Module
	Introduced Case studies on The Iron Pillar of Delhi – Metallurgical Excellence and Monazite Sands of Kerala – Source of Rare Earths and Thorium.	**I**

7. Pedagogy

S. No.	Student Centric Methods Adopted	Type / Description of Activity
1	Experiential learning	Field trips
2	Participative Learning	Presentations/Peer-teaching
3	Problem solving	Case studies/ Data interpretation

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8. Course Assessment Plan

a) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA - 40%	End Semester Examination-60%
CO1	**CIA-1:** Written Exam	Written Exam
CO2	**CIA-2:** Quiz/Assignment/3D model making	
CO3	**CIA-1:** Written Exam	
CO4	**CIA-2:** Assignment (Crossword/Word search/ Problem solving)	

b) Model Question Paper - End Semester exam Theory

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Faculty of Science – Department of Chemistry
MODEL PAPER
B.Sc. I YEAR SEMESTER -II
CHEMISTRY - II

Time: 2 hrs **Course Code: U26/DSC/CHE/201**

Max. Marks: 60

SECTION –A (Essay Questions)

I. Answer the following **4x 10=40 Marks**

1. What are Transition elements? Explain the general properties with reference to Complex formation, magnetic properties and variable oxidation states. 10M

OR

2. a. What is lanthanide contraction and explain its consequences. 5M

   b. How are lanthanides separated by ion exchange method? 5M

3. a. Explain the mechanism and stereochemistry of S_N1 reaction. 5M

   b. How are 1°, 2° and 3° alcohols prepared from carbonyl compounds using Grignard reagent? 5M

OR

4. Formulate the steps involved in the mechanism of (i) Reimer -Teimann reaction and (ii) Cannizaro reaction. 10M

5. a. Explain standard hydrogen electrode (SHE). 5M
   b. State Ostwald's dilution law. Discuss its uses and limitations. 5M

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OR

6. a. State Kohlrausch law and mention its applications. 5M
   b. Describe Hittorf method for the determination of Transport number. 5M
7. Write the postulates of MOT and explain the MOED of O_2. 10M

   OR

8. a. State and explain Raoult's law. 5M
   b. What are enantiomers? Explain the optical isomers of Tartaric acid. 5M

SECTION –B (Short Answer Questions)

II. Answer any four. **4x5=20 Marks**

9. Compare the properties of lanthanides with actinides.
10. How do you differentiate 1°, 2° and 3° alcohols based on the Lucas test?
11. Give equations for Williamson's ether synthesis and Clemmensen's reduction..
12. Write short notes on conductometric titrations.
13. What is an electrochemical series? What is its significance?
14. Discuss the R,S configuration of L-Alanine and D-Glyceraldehyde based on CIP rules.

Question Paper Format - Blooms Taxonomy Level

SECTION A - INTERNAL CHOICE				4 X 10 = 40 M
Question Number	**Module**	**Question**	**CO**	**BTL**
1	I	What are Transition elements? Explain the general properties with reference to Complex formation, magnetic properties and variable oxidation states. 10M OR	CO1	Level 1 & 2
2	I	a. What is lanthanide contraction and explain its consequences. 5M b. How are lanthanides separated by ion exchange method? 5M	CO1	Level 1 & 3
3	II	a. Explain the mechanism and stereochemistry of S_N1 reaction. 5M b. How are 1°, 2° and 3° alcohols prepared from carbonyl compounds using Grignard reagent? 5M OR	CO2	Level 3

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4	II	Formulate the steps involved in the mechanism of (i) Reimer -Teimann reaction and (ii) Cannizaro reaction. 10M	CO2	Level 4
5	III	a. Explain standard hydrogen electrode (SHE). 5M b. State Ostwald's dilution law. Discuss its uses and limitations. 5M OR	CO3	Level 2
6	III	a. State Kohlrausch law and mention its applications. 5M b. Describe Hittorf method for the determination of Transport number. 5M	CO3	Level 2 & 3
7	IV	Write the postulates of MOT and explain the MOED of O_2. 10M OR	CO4	Level 2 & 3
8	IV	a. State and explain Raoult's law. 5M b. What are enantiomers? Explain the optical isomers of Tartaric acid. 5M	CO4	Level 2 & 3
SECTION B - Short answer questions **ANSWER ANY 4 OUT OF 6**				**4 x 5 = 20M**
9	I	Compare the properties of lanthanides with actinides.	CO1	Level 4
10	II	How do you differentiate 1°, 2° and 3° alcohols based on the Lucas test?	CO2	Level 4
11	II	Give equations for Williamson's ether synthesis and Clemmensen's reduction..	CO2	Level 2
12	III	Write short notes on conductometric titrations.	CO3	Level 2
13	III	What is an electrochemical series? What is its significance?	CO3	Level 2
14	IV	Discuss the R,S configuration of L-Alanine and D-Glyceraldehyde based on CIP rules.	CO4	Level 5

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c) Question Paper Blueprint

Modules	Hours Allotted in the Syllabus	COs Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15	CO1	2	10	6 (By taking at least one question from each module)	5
2	15	CO2	2	10		10
3	15	CO3	2	10		10
4	15	CO4	2	10		5

9. CO-PO Mapping

CO	PO	Cognitive Level	Classroom sessions (h)
1	1,3	Understand	15
2	1,2	Analyse	15
3	1,2	Apply	15
4	1,7	Remember	15

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FACULTY OF SCIENCE- DEPARTMENT OF CHEMISTRY
SEMESTER -II
LABORATORY COURSE-II - QUALITATIVE ANALYSIS

1. Course Description

Program: B.Sc. **Max. Hours: 20**
Course Code: U26/CHE/DSC/201/ P **Max. Marks: 50**
Course type: DSC-2 **Hours per week: 2**
No. of Credits: 1

2. Course Objective

- To enable students to systematically identify and analyze anions and cations in salt mixtures using semi-micro qualitative analysis techniques.

3. Course outcomes

CO 1: Students will be able to systematically identify anions and cations in salt mixtures, interpret experimental observations, and write balanced equations for the reactions involved.

CO 2: Students will be able to apply the principles of common ion effect and solubility product to explain and justify the systematic separation and identification of both anions and cations in semi-micro qualitative analysis.

4. Course Content

QUALITATIVE ANALYSIS - Semi micro analysis of mixtures

Analysis of two anions (one simple, one interfering) and two cations in the given mixture.
Anions: CO_3^{2-} , SO_3^{2-} , S^{2-}, Cl^- , Br^-, I^-, CH_3COO^-, NO_3^-, PO_4^{3-}, BO_3^{3-}, SO_4^{2-}

Cations: Hg_2^{2+}, Ag^+, Pb^{2+}
Hg^{2+}, Bi^{3+}, Cd^{2+}, Cu^{2+}, As^{3+} / As^{5+} , Sb^{3+} / Sb^{5+}, Sn^{2+} / Sn^{4+}
Al^{3+}, Cr^{3+}, Fe^{3+}
Mn^{2+}, Co^{2+}, Ni^{2+}, Zn^{2+}
Ca^{2+}, Ba^{2+}, Sr^{2+}
Mg^{2+}, NH_4^+

Reference Books

1. Svehla, G. (1996). Vogel's qualitative inorganic analysis (7th ed.). Prentice Hall.
2. Gopalan, R., Subramanian, P. S., & Raghavan, K. (2004). Elements of analytical chemistry. Sultan Chand & Sons.
3. Ahluwalia, V. K., and Sunita Dhingra, (2005). A Laboratory Manual of Organic and Inorganic Chemistry, 1st Edition, University Press, Hyderabad, ISBN: 9788173715623

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4. Giri, A. N. (2010). A textbook of practical chemistry. Himalaya Publishing House.
5. Sharma, R. K. (2013). Experiments and techniques in inorganic chemistry. Krishna Prakashan Media.
6. O.P. Pandey, D.N. Bajpai, & S. Giri. (2020). Practical chemistry. 10th Revised Edition, S. Chand Publishing. ISBN: 9789352535859.
7. Gopalan, R., Venkappayya, D., and Nagarajan, S. (2012). Textbook of Inorganic Chemistry (Lab Manual), 3rd Edition, University's Press, Hyderabad, ISBN: 9788173718204
8. Vogel, A. I. and Svehla, G.Vogel's Textbook of Macro and Semi-Micro Qualitative Inorganic Analysis, 5th Edition, Longman Group Ltd., 1979. ISBN: 9780582446939

6. Model Question Paper - End Semester Exam Practical

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(An Autonomous College Affiliated to Osmania University)
Faculty of Science – Department of Chemistry
MODEL PAPER
B.Sc. I YEAR SEMESTER -II
LABORATORY COURSE-II - QUALITATIVE ANALYSIS

Program: B.Sc. **Course Code: U26/DSC/CHE/201/P**
Type of course: DSC-2 **Time: 2 hrs**
No. of credits: 1 **Max. Marks: 50**

1. Using systematic procedure, identify and report two anions and two cations present in the given an unknown salt mixture. 30M

2. Record + Attendance 10M
3. Viva voce 10 M

Prepared by	Checked & Verified by	Approved by
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PANEL OF EXAMINERS							
FACULTY OF SCIENCES - DEPARTMENT OF CHEMISTRY							
CBCS-2026							
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