

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

B. Saritha

Head

Department of Chemistry
 St. Francis College for Women
 Begumpet, Hyderabad-16.



Professor

Department of Chemistry
 Osmania University
 HYDERABAD - 500 007

**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.

DEPARTMENT OF CHEMISTRY, ST. FRANCIS COLLEGE FOR WOMEN, HYDERABAD.

D. Parvatha
Department of Chemistry
St. Francis College for Women
Begumpet, Hyderabad-16.

[Signature]
Professor
Department of Chemistry
Osmania University

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.

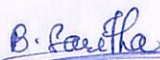
Hydroxy compounds and ethers

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/ZnCl₂ (Lucas reagent), oxidation with conc. HNO₃ 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. H₂SO₄.



Head

Department of Chemistry

St. Francis College for Women
Begumpet, Hyderabad-16, 65H


Professor

Department of Chemistry

Osmania University
HYDERABAD - 500 007

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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) NaHSO₃ (b) HCN (c) RMgX (d) 2,4-DNP (Schiff base). Addition of H₂O to form hydrate, addition of alcohols - hemiacetal and acetal formation. Cannizzaro reaction. Oxidation reactions – KMnO₄ 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 - H₂, N₂, O₂, O₂⁻, O₂²⁻, F₂ (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 S_n 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.

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.

DEPARTMENT OF CHEMISTRY, ST. FRANCIS COLLEGE FOR WOMEN, HYDERABAD.

B. Gautha
Head
Department of Chemistry
St. Francis College for Women
Begumpet, Hyderabad-16.

Jh
Professor
Department of Chemistry
22

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

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) Cannizzaro reaction. 10M
5. a. Explain standard hydrogen electrode (SHE). 5M
b. State Ostwald's dilution law. Discuss its uses and limitations. 5M

DEPARTMENT OF CHEMISTRY, ST. FRANCIS COLLEGE FOR WOMEN, HYDERABAD.
Department of Chemistry
St. Francis College for Women
Begumpet, Hyderabad-16.

Professor
Department of Chemistry
Osmania University

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 O₂. 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 _N 1 reaction. 5M b. How are 1°, 2° and 3° alcohols prepared from carbonyl compounds using Grignard reagent? 5M OR	CO2	Level 3	

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

B. Saritha
Head

Department of Chemistry
St. Francis College for Women
Begumpet, Hyderabad-16.

Dr. [Signature]
Professor
Department of Chemistry
Osmania University
HYDERABAD-50000.

DEPARTMENT OF CHEMISTRY, ST. FRANCIS COLLEGE FOR WOMEN, HYDERABAD.

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

B. Sartha
Head

Department of Chemistry
St. Francis College for Women
Begumpet, Hyderabad-16.

Hh
Professor
Department of Chemistry
Osmania University
HYDERABAD - 500 007

St. FRANCIS COLLEGE FOR WOMEN, BEGUMPET, HYDERABAD-500016
(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.****Course Code: U26/CHE/DSC/201/ P****Course type: DSC-2****No. of Credits: 1****Max. Hours: 20****Max. Marks: 50****Hours per week: 2****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

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

DEPARTMENT OF CHEMISTRY, ST. FRANCIS COLLEGE FOR WOMEN, HYDERABAD.

Department of Chemistry
 St. Francis College for Women
 Begumpet, Hyderabad-16.

Professor
 Department of Chemistry
 Osmania University
 Hyderabad, 500 007

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.

Type of course: DSC-2

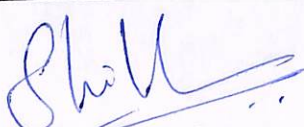


No. of credits: 1

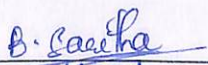
Course Code: U26/DSC/CHE/201/P

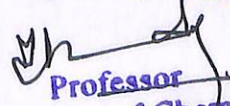
Time: 2 hrs

Max. Marks: 50

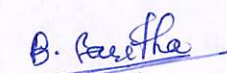
1. Using systematic procedure, identify and report two anions and two cations present in the given an unknown salt mixture. 30M
2. Record + Attendance 10M
3. Viva voce 10 M


Prepared by	Checked & Verified by	Approved by
 Dr Shikha Chander Ms V Prashanthi	 Dr Saritha Aduri HoD	 Prof. Uma Joseph Principal <i>Principal</i> St. Francis College for Women Begumpet, Hyderabad-16.


 B. Saritha
 Head
 DEPARTMENT OF CHEMISTRY, ST. FRANCIS COLLEGE FOR WOMEN, HYDERABAD
 Department of Chemistry
 St. Francis College for Women
 Begumpet, Hyderabad-16.


 Professor
 Department of Chemistry
 Osmania University
 HYDERABAD - 500 007

PANEL OF EXAMINERS							
FACULTY OF SCIENCES - DEPARTMENT OF CHEMISTRY							
CBCS-2026							
S · N o	Course Title	Examiner	Name & Designation	Place of Work	Yrs of Exp er i e n c e	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	Abo ve 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
		Dr. L. Yamini	Dr. L. Yamini Assistant Prof. of Inorganic Chemistry	Dept of Chemistry Veeranari Chakali Ilamma Women's University	Abo ve 20	7702873514	ylingala@gmail.com


B. Sujatha
Head
 Department of Chemistry
 St. Francis College for Women
 Begumpet, Hyderabad-16.


Professor
 Department of Chemistry
 Osmania University
 HYDERABAD - 500 007

SEMESTER II
Core Course 2
CHEMISTRY OF NUCLEIC 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 : CHROMATOGRAPHY & ELECTROPHORETIC
TECHNIQUES**

Semester -II

CHEMISTRY OF NUCLEIC ACIDS & BIOCHEMICAL TECHNIQUES

1. Course Description

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

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:

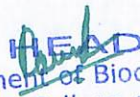
CO1: Describe the organization, composition, and chemical structure of nucleic acids (L2)

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).


HOD Biochemistry
St. Francis College for Women
Begumpet, Hyderabad-16.


Department of Biochemistry
University College of Science
Osmania University
Hyderabad-500 007.

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 (T_m) 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: CHROMATOGRAPHY & 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

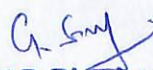
SD/ED/EMP	Syllabus Content	Description of Activity
SD/EMP	Chromatography	Practicals
SD/EMP	Centrifugation	Practicals
SD/EMP	Electrophoresis	Practicals


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 Plana) **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
Credits: 4

Max Time: 2 Hrs
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


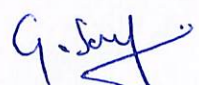
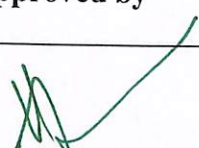
CHEMISTRY OF NUCLEIC ACIDS & BIOCHEMICAL TECHNIQUES

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 R_f 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 HOD Biochemistry	 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 & Biochemic al 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
Core Course 2
BIOMOLECULES AND MICROBIAL PHYSIOLOGY

Code :U26/MIC/DSC/201

Credits : 4

Total hours : 60

Hours/week : 4

Module I : INTRODUCTION TO BIOMOLECULES

Module II : MICROBIAL GROWTH AND METABOLISM

Module III : AEROBIC RESPIRATION & PHOTOTROPHISM

Module IV : ANAEROBIC RESPIRATION & FERMENTATION

SEMESTER –II

BIOMOLECULES AND MICROBIAL PHYSIOLOGY

1. Course Description:

Programme: B.Sc.
Course Code: U26/MIC/DSC/201
Course Type: Discipline Specific Core
No. of credits: 4

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

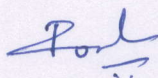
2. Course Objectives:

- This course will help the students gain knowledge about the Microbial physiology and metabolism by understanding microbial nutrition and growth characteristics.
- Differentiating concepts of aerobic and anaerobic respiration and how these are manifested in the form of different metabolic pathways in microorganisms.

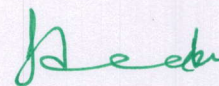
3. Course Outcomes:

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

- CO 1: Gain knowledge in concepts related to biomolecules like carbohydrates, amino acids, and lipids (L II), (L III)
- CO2: Understand central metabolic pathways, energy production and growth characteristics. (LII)
- CO 3: Attain insight about aerobic respiration and Photosynthesis of Green, Purple bacteria and Cyanobacteria. (L IV)
- CO4: Analyse the concepts of anaerobic respiration and fermentation through different metabolic pathways in microorganisms. (L IV)



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Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

4. Course Content:**MODULE I - INTRODUCTION TO BIOMOLECULES****(15 Hrs)**

Carbohydrates: Monosaccharides: Aldoses & ketosis, Epimers, Muta-rotation and anomers of glucose, Sugar derivatives. Glucosamine, Galactosamine, Muramic acid, N-acetyl neuramic acid, Disaccharides, and polysaccharides

Amino acids and proteins: Types, Structure, and functions. Classification of enzymes. Active site and activation energy. Lock and key hypothesis. Induced-fit hypothesis.

Lipids: Physico, chemical, and biological properties of lipids. Introduction to storage and structural lipids. Storage lipids: Triglycerols, Building blocks, Fatty acid structure, and properties, essential Fatty acids. Saponification. Structural lipids. Phosphoglycerides- building blocks.

MODULE II - MICROBIAL GROWTH AND METABOLISM:**(15Hrs)**

Nutritional requirements of microbes, nutrient uptake. Definitions of growth, Batch culture, Continuous culture, generation time and specific growth rate. Synchronous growth, diauxic growth curve. Measurement of microbial growth. Microbial growth in response to environment - Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), Solute and water activity (halophiles, xerophiles, osmophiles), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), barophiles with examples.

MODULE III- AEROBIC RESPIRATION & PHOTOTROPHISM:**(15 Hrs)**

Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain. Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to phototrophism in Green bacteria, Purple bacteria, Cyanobacteria.

MODULE IV- ANAEROBIC RESPIRATION & FERMENTATION:**(15Hrs)**

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction Fermentation- Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways. Introduction to traditional fermentation.

Resources:**5a. Text Books:**

1. A textbook of Microbiology, Biomolecules (2026). Dr. Chand Pasha and Dr. Hameeda Bee. Professional Books Publisher.
2. Joanne M. Willey, Linda M Sherwood, Christopher J Woolverton (2011). Prescott's Microbiology. 8th edition, Mc.Graw Hill publishers.
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.

5b. Reference Books:

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
3. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
4. Gopal Reddy *et al*, (2006), Laboratory experiments in Microbiology, Himalaya Publishers.
5. Prescott, Harley and Klein Wim. (2002), Microbiology, Mc.Graw Hill Publishers.
6. R.C Dubey, D.K Maheshwari, Practical Microbiology, S Chand and Company, New Delhi.
7. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited.

5c. Online Resources:

1. <http://webbuild.knu.ac.kr/~appmic//introduction%20to%20microbiology/chap8-metabolism.pdf>
2. [https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_\(OpenStax\)/08%3A_Microbial_Metabolism](https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(OpenStax)/08%3A_Microbial_Metabolism)
3. <https://www.ncbi.nlm.nih.gov/books/NBK7919/>
4. <https://microbenotes.com/anaerobic-respiration/>
5. <https://www.khanacademy.org/science/ap-biology/cellular-respiration-ap/a/fermentation-and-anaerobic-respiration>

6. Syllabus Focus:

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

Module	FOCUS Local/Regional/National /Global Development Needs	Relevance
Module I	National & Global	Understanding biomolecules helps in the development of drugs, vaccines, and diagnostic tools used in treating diseases.
Module II	Global	The study of microbial nutrition, growth patterns, and environmental responses is globally important for medicine, biotechnology, food production, environmental sustainability, and industrial microbiology.
Module III	National & Global	Knowledge of Aerobic Respiration helps explain microbial energy production and its applications in biotechnology and environmental processes. Phototrophic bacteria are important for sustainable technologies such as carbon sequestration and renewable bioenergy production.
Module IV	National & Global	The study of anaerobic metabolism is essential for understanding microbial roles in global nutrient cycles and environmental sustainability. Microbial fermentation processes such as Lactic Acid Fermentation are widely used in the production of fermented foods and industrial bioproducts.

b) Components on Skill Development/Entrepreneurship Development/Employability

FOCUS Skill Development /Entrepreneurship Development /Employability	Syllabus Content	Description of Activity
Skill Development	MODULE II	<p>To facilitate the learning process, the students would be trained to cultivate bacteria in different environmental conditions to demonstrate as how it affects their growth and patterns. Problems based questions will be framed to calculate the generation time of bacteria.</p> <p>This procedure aims at developing the skills necessary to analyze different (and perhaps more complex) metabolic processes.</p>

c) IKS Component

IKS	Syllabus Content	MODULE
IKS	Introduction to traditional fermentation.	IV

d) Aligned with SDG 3 (Good health and wellbeing) SDG 4 (Quality education)

7. Pedagogy:

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Interactive class session	Participative Learning
2.	Quiz	Experiential Learning
3.	Group Discussion	Participative Learning

8. Course Assessment Plan:

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

Maximum Marks: 20M		Maximum Marks: 20M	
CIA 1	CIA 2	Skill Base Test: 10M	Assignment: 10M
Section A: 1x10=10M Essay question: Answer any 1 out of 2 Section B: 2x5=10M Short questions: Answer any 2 out of 3	Section A: 1x10=10M Essay question: Answer any 1 out of 2 Section B: 2x5=10M Short questions: Answer any 2 out of 3	Discretion of the faculty	Discretion of the faculty

External QP Pattern		
4 Credits 4 Modules (CORE)	SECTION A - Internal Choice	4 Q X 10 M = 40M
	SECTION B – Answer any 4 out of 6 (To compulsorily have ONE question from each module)	4 Q X 5 M = 20M

b) Aligning COs with Continuous Internal Assessments

Cos	Continuous Internal Assessments - CIA (40%)	End Semester Examination - (60%)
CO1	CIA-1	End Semester examination
CO2	CIA-1	
CO3	CIA-2 Presentation, Quiz	
CO4	CIA-2 Assignment	

b) Model Question Paper- End Semester Exam

BIOMOLECULES AND MICROBIAL PHYSIOLOGY

Course Code: U26/MIC/DSC/201

Max. Marks: 60

Credits: 4

Time: 2 Hrs.

SECTION A - INTERNAL CHOICE		4 Q X 10 M = 40 M			
Q.No	Question	Module	CO	BTL	
1	Question	Module I	CO 1	II, III	
OR					
2	Question	Module I	CO 1	II, III	
OR					
3	Question	Module II	CO 2	II	
OR					
4	Question	Module II	CO 2	II	
OR					
5	Question	Module III	CO 3	IV	
OR					
6	Question	Module III	CO 4	IV	
OR					
7	Question	Module IV	CO 4	IV	
OR					
8	Question	Module IV	CO 4	IV	

SECTION B - ANSWER ANY 5 OUT OF 8		5 Q X 4 M = 20 M			
Q.No	Question	Module	CO	BTL	
9	Question	Module I	CO 1	II	
10	Question	Module I	CO 1	III	
11	Question	Module II	CO 2	II	
12	Question	Module II	CO 2	II	
13	Question	Module III	CO 3	III	
14	Question	Module III	CO 4	IV	

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Dr. Hameeda Bee
 HOD Microbiology
 St. Francis College for Women
 Begumpet, Hyderabad-16

Hameeda
 Dr. Hameeda Bee¹⁷
 Professor
 Department of Microbiology
 Osmania University, Hyd-07

c. Question paper pattern

SECTION A - INTERNAL CHOICE				4Q X 10 M = 40 M	
Question Number	Module	Question	CO	BTL (Blooms Taxonomy Level)	
1	Module I	Explain the structural differences between monosaccharides, disaccharides, and polysaccharides with suitable examples.	CO 1	Level II, III	
2	Module I	Describe the structural and functional differences between storage lipids and structural lipids.	CO 1	Level II, III	
3	Module II	How would you classify the different phases of bacterial growth curve with different types of microorganisms and environmental conditions.	CO 2	Level II	
4	Module II	What can you write about the different methods involved in measurement of microbial growth.	CO 2	Level II	
5	Module III	How can you identify the various steps involved in EMP pathway	CO 3	Level IV	
6	Module III	What is the original way to differentiate between Oxygenic and Anoxygenic photosynthesis with examples.	CO 3	Level IV	
7	Module IV	What conclusions can you draw between dissimilatory and assimilatory nitrate reduction.	CO 4	Level IV	
8	Module IV	Compare and contrast between homo-lactic acid and Hetero-lactic acid fermentation	CO 4	Level IV	
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have ONE question from each module)				4 Q X 5M = 20M	
9	Module 1	Compare and contrast Disaccharides from Polysaccharides	CO 1	Level III	
10	Module I	Explain Lock and Key Hypothesis	CO 1	Level II	
11	Module II	Explain about Synchronous growth	CO 2	Level II	
12	Module II	Compare and contrast Halophiles and Osmophiles	CO 2	Level II	
13	Module III	Construct the steps involved in ED pathway	CO 3	Level III	
14	Module IV	Justify Pasteur effect	CO 4	Level IV	

a) Question Paper Blueprint:

Modules	Hours Allotted in the Syllabus	COs Addressd	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15	CO-1	2	10	2	5
2	15	CO-2	2	10	2	5
3	15	CO-3	2	10	2	5
4	15	CO-4	2	10	2	5

9. CO-PO Mapping:

CO	PO	Cognitive Level	Class room sessions (Hrs)
1	1	Remember	15
2	1, 2	Understand	15
3	1	Analyse	15
4	1, 2	Analyse	15

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Begumpet, Hyderabad-16

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

BIOMOLECULES AND MICROBIAL PHYSIOLOGY
Practical Syllabus**1. Course Description:****Programme: B.Sc****Course Code: U26/MIC/DSC/201/P****Max. Hours: 30****Course Type: Discipline Specific Core****Hours per week:2****No. of credits: 1****Max. Marks: 50****2. Course Objectives:**

- To enable the students to understand the growth pattern and factors affecting bacterial growth by performing bacterial growth curve experiments.
- To equip and expose students to various culturing techniques for growth of specific microorganisms.


3. Course Outcomes:

CO 1: Measuring microbial growth, calculate growth kinetic parameters of steady state and continuous growth.

CO 2: Analyze the growth characteristics of the microorganisms capable of growing under different environmental conditions of temperature, oxygen, and solute and water activity.

4. Course Content:

1. Enrichment culturing and isolation of phototrophs.
2. Culturing and isolation of chemoautotrophs- nitrifiers.
3. Study and plot the growth curve of *E. coli* by turbidometric method.
4. Determination and study of growth curve by standard plate count methods.
5. Calculation of generation time and specific growth rate of bacteria from the graph plotted with the given data.
6. Determination of viable count of bacteria.
7. Effect of temperature, pH and salt on growth of *E. coli*.
8. Effect of carbon and nitrogen sources on growth of *E.coli*.
9. Demonstration of the thermal death time and decimal reduction time of *E. coli*.
10. Cultivation of Anaerobic bacteria from dental samples and acne.
11. Study the growth pattern of Thermophiles and Alkaliphiles.



Dr. Hameeda Bee
Professor

BIOMOLECULES AND MICROBIAL PHYSIOLOGY

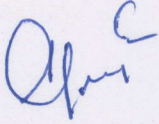
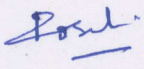
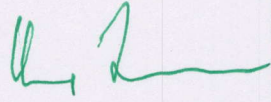
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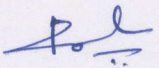
Credits: 1

Max Marks: 50

Time: 2 Hrs

I. MAJOR	20M
II. MINOR	10 M
III. Identify the given spots (A-E) and write few significant points	5x2=10 M
IV. Record	5M
V. Viva	5M

Prepared by Faculty	Checked & Verified by HoD	Approved by the Principal
 Dr. Arsheen Tabassum	 Dr. P. Roselin	 Prof. Uma Joseph

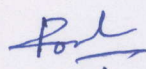

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Dr. Hameeda Bee
 Professor
 Department of Microbiology
 Osmania University, Hyd-07

Panel of Examiners

BSc Semester I and II

S. No	B.Sc- Course Title	Examiner	Designation Place of Work	Years of Experience	Contact No.	Email Id.
1.	Sem I Bacteriology and Systematics	Dr. Anuradha	Assistant Professor Bhavans College	26	9849977396	anuradhapmv@gmail.com
2.		Dr. Jeevitha	Assistant Professor MNR College	7	9791759105	jeevithathangaraj@gmail.com
3.	Sem II Biomolecules & Microbial physiology	Dr. Ramchander	Assistant Professor Mahathma Gandhi University	20	9989427725	rajumerugu01@rediffmail.com
4.		Ms. Rajeetha.M	Assistant Professor St Pious College	7	9000285314	rajeetha.mondal@gmail.com



HOD Microbiology
St. Francis College for Women
Begumpet, Hyderabad-16



Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07