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

DISCIPLINE SPECIFIC CORE I
CHEMISTRY I
B.Sc. I - SEMESTER- I 60 h

Module 1: Inorganic Chemistry
Chemistry of p-Block elements

Module 2: Organic Chemistry
Structural Theory in Organic Chemistry
Acyclic Hydrocarbons
Aromatic Hydrocarbons

Module 3: Physical Chemistry
Elementary Quantum Mechanics
Chemical Kinetics
Photochemistry

Module 4: General Chemistry
General Principles of Inorganic Quantitative Analysis
Isomerism
Colloids & Surface Chemistry

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SEMESTER - I
CHEMISTRY - I

1. Course Description

Programme: B.Sc.
Course Code: U26/CHE/DSC/101
Course type: DSC - 1
No. of credits: 4

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

2. Course Objectives

- To develop an understanding of the periodic trends, electronic configuration, bonding, structure, and reactivity of p-block elements and their compounds.
- To enable students to comprehend structural theory, bonding, stereochemistry, and the preparation, properties, and reactions of acyclic and aromatic hydrocarbons.
- To introduce the fundamental principles of quantum mechanics, chemical kinetics, and photochemistry, and apply them to explain molecular behavior and reaction mechanisms.
- To equip students with foundational knowledge of inorganic quantitative analysis, structural and stereoisomerism, and the principles governing colloids and surface phenomena.

3. Course Outcomes

On completion of the course the student will be able to

- Analyze the electronic configuration, periodic trends, bonding, and reactivity of p-block elements to predict the properties of their compounds.
- Apply principles of structural theory and mechanistic reasoning to interpret and predict the reactions of acyclic and aromatic hydrocarbons.
- Explain and apply the fundamental concepts of quantum mechanics, chemical kinetics, and photochemistry to analyze molecular systems and reaction rates.
- Demonstrate analytical and conceptual understanding of inorganic quantitative analysis, isomerism, and colloidal and surface phenomena in chemical systems.

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Alkynes– Preparation by dehydrohalogenation of vicinal dihalides, dehalogenation of tetrahalides. Physical Properties: Chemical reactivity – electrophilic addition of X_2, HX, H2O (tautomerism), Oxidation (formation of enediol) and reduction (catalytic hydrogenation).

Aromatic Hydrocarbons **5h**

Introduction to aromaticity: Huckel's rule – Benzene, Naphthalene and Anthracene. Reactions - General mechanism of electrophilic substitution, mechanism of nitration, sulphonation and halogenation, Friedel Crafts alkylation and acylation. Orientation of aromatic substitution - Definition of ortho, para and meta directing groups. Ring activating and deactivating groups with examples. Orientation – (i) activating groups: Amino, methoxy and alkyl groups. (ii) Deactivating groups - nitro, nitrile, carbonyl, carboxylic acid, sulphonic acid and halo groups.

IKS: Traditional distillation methods in the extraction of perfumes.

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

Elementary quantum mechanics **3h**

Limitations of classical mechanics and Origin of quantum mechanics-Black body radiation, Rayleigh Jeans law; Planck's radiation law, photoelectric effect, Compton effect, de Broglie's hypothesis. Heisenberg's uncertainty principle. Schrödinger wave equation (derivation not required) – significance of ψ and ψ^2.

Chemical Kinetics **8h**

Introduction to chemical kinetics, rate of reaction, rate laws and rate constant. Molecularity and Order of a reaction. Factors influencing the reaction rates. First order reaction, derivation of equation for rate constant. Characteristics of first order reaction. Units for rate constant. Half- life period, graph of first order reaction, Example - Decomposition of H_2O_2. Problems. Pseudo first order reaction, Hydrolysis of methyl acetate, inversion of cane sugar, problems. Second order reaction, derivation of expression for second order rate constant, example-Saponification of ester. Characteristics of second order reaction, units for rate constants, half- life period and second order plots. Problems. Methods for determining the order of a reaction. Arrhenius equation – activation energy -problems.

Photochemistry **4h**

Introduction to photochemistry – differences between dark and photo reactions. Laws of photochemistry; Quantum Yield – problems; Examples of photo chemical reactions with different quantum yields. Photo chemical combinations of H_2–Cl_2 and H_2–Br_2 reactions. Abnormal quantum yield – high and low-examples with reasons. Singlet and triplet states. Jablonski diagram – non radiative processes – Internal conversion and Intersystem crossing; radiative processes- Fluorescence and phosphorescence.

4. Course Content

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

Chemistry of p-Block Elements **15 h**

Structure and bonding in diborane (B_2H_6), Boron nitrogen compounds ($B_3N_3H_6$ and BN), Lewis acid nature of BX_3.

Carbides- Classification -ionic, covalent, interstitial-Structures and reactivity. Industrial applications. Silicones-Classification-straight chain, cyclic and cross-linked and applications.

Nitrides-Classification -ionic, covalent and interstitial- Reactivity – hydrolysis.

Oxides and Oxyacids- Definition and Types of oxides (a) Normal- acidic, basic amphoteric and neutral (b) Mixed oxide (c) sub oxide (d) peroxide (e) superoxide. Structure of oxides and oxyacids of B, C, N, P, S and Cl - reactivity, thermal stability, hydrolysis.

Interhalogens- Classification- general preparation- structures of AB, AB_3, AB_5 and AB_7 type and reactivity.

Poly halide- Definition and structure of ICl_2^-, ICl_4^- and I_3^-.

Pseudohalogens- Comparison with halogens.

Structure, bonding and reactivity of Xenon Compounds-Oxides, Halides and Oxy-halides.

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

Structural Theory in Organic Chemistry **5h**

Bond polarization: Factors influencing the polarization of covalent bonds, electro negativity – inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance - Mesomeric effect, application to (a) acidity of phenol. (b) acidity of carboxylic acids and basicity of anilines. Stability of carbo cations, carbanions and free radicals. Hyper conjugation and its application to stability of carbonium ions, free radicals and alkenes.

Acyclic Hydrocarbons **5h**

Alkanes– Methods of preparation: Preparation of Alkanes from Grignard reagent. Chemical reactivity- inert nature, free radical substitution, Halogenation example. **Alkenes** - Preparation of alkenes (with mechanism) (a) by dehydration of alcohols (b) dehydrohalogenation of alkyl halides (c) by dehalogenation of 1,2 dihalides, Zaitsev's rule. Properties: Anti-addition of halogen and its mechanism. Addition of HX, Markovnikov's rule, addition of H_2O, HOX with mechanism and addition of HBr in the presence of peroxide (anti Markovnikov's addition). Oxidation (cis–additions) hydroxylation by $KMnO_4$, OsO_4, anti-addition- peracids (via epoxidation), ozonolysis – location of double bond.

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

General Principles of Inorganic Quantitative Analysis 5h

Volumetric Analysis: Introduction, standard solutions, indicators, end point, titration curves, Types of titrations: i) neutralization titration- principle, theory of acid base indicators, titration curves and selection of indicators- strong acid - strong base, strong acid –weak base, weak acid- strong base and weak acid –weak base. Theory of redox titrations – internal ($KMnO_4$) and external indicators – use of diphenylamine and ferroin indicators. Theory of complexometric titrations – use of EBT, Murexide and Fast sulphone black indicators. Role of pH in complexometric titrations. Precipitation titrations – theory of adsorption indicators.

Isomerism 5h

Isomerism: Definition of isomers. Classification of isomers: Constitutional and Stereoisomers - definition and examples. Constitutional isomers: chain, functional and positional isomers. Stereoisomers: enantiomers and diastereomers – definitions and examples. Representation of stereoisomers – Wedge, Fischer, Sawhorse, Newmann projection formulae.

Conformational analysis: Classification of stereoisomers based on energy. Definition and examples Conformational and configurational isomers. Conformational analysis of ethane, n- butane, 1,2- dichloroethane, 2-chloroethanol. Cis-trans isomerism: E-Z Nomenclature.

Colloids & Surface Chemistry 5h

Colloids: Definition of colloids-classification of colloids-examples. Solid in liquid (sol)-Preparation, kinetic and electrical properties, stability and protection of colloids - Hardy-Schulze rule and Gold number. Liquid in liquid (emulsion)-types of emulsions and emulsifiers. Liquid in solid (gel)-types and properties. Applications of colloids.

Adsorption: Types of adsorptions; Factors influencing adsorption; Freundlich adsorption isotherm and Langmuir adsorption isotherm. Applications.

5. Reference Books

General reference: B.Sc I Year Chemistry : Semester I, 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.

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4. Huheey, J. E., Keiter, E. A., & Keiter, R. L. (1993). Inorganic chemistry: Principles of structure and reactivity (4th ed.). Harper Collins College Publishers.
5. Greenwood, N. N., & Earnshaw, A. (1989). Chemistry of the elements. Pergamon Press.
6. Shriver, D. F., & Atkins, P. W. (1999). Inorganic chemistry (3rd ed.). Oxford University Press.
7. Gopalan, R. (2009). Textbook of inorganic chemistry. University 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. Puri, B. R., Sharma, L. R., & Pathania, M. S. (2013). Principles of physical chemistry (46th ed.). Vishal Publishing Company.
2. Raj, G. (2009). Advanced physical chemistry (35th ed.). Goel Publishing House.
3. Lewis, G., & Glasstone, S. (1966). Elements of physical chemistry. Macmillan.
4. Atkins, P. W. (2001). Physical chemistry (7th ed.). Oxford University Press.
5. Kapoor, K. L. (1994). A textbook of physical chemistry (Vols. 4 & 5). Macmillan India Ltd.
6. Laidler, K. J. (1987). Chemical kinetics (3rd ed.). McGraw Hill.
7. Rajaraman, J., & Kuriacose, J. (1993). Kinetics and mechanism of chemical transformations. Macmillan India.
8. Turro, N. J. (1978). Molecular photochemistry. W. A. Benjamin, Inc.
9. Rohatgi-Mukherjee, K. K. (1978). Fundamentals of photochemistry. Wiley Eastern. Dogra, S. K., & Dogra, S. (1996). Physical chemistry through problems (4th ed.). New Age International.
10. Kalidas, C., & Sangaranarayanan, M. V. (2019). Physical chemistry: Problems and solutions. University's Press.

Module- IV

1. Jeffery, G. H., Bassett, J., Mendham, J., & Denney, R. C. (1999). Vogel's textbook of quantitative chemical analysis (5th ed.). Addison Wesley Longman Inc.
2. Day, R. A., & Underwood, A. L. (2004). Quantitative analysis (6th ed.). Prentice Hall of India.

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3. Svehla, G. (1996). Vogel's qualitative inorganic analysis (7th ed.). Prentice Hall.
4. Morrison, R. T., & Boyd, R. N. (2011). Organic chemistry. Pearson Education.
5. Solomons, T. W. G., & Fryhle, C. B. (2016). Organic chemistry. Wiley.
6. Bruice, P. Y. (2017). Organic chemistry. Pearson Education.
7. Soni, P. L. (2012). Textbook of organic chemistry. Sultan Chand & Sons.
8. Levine, I. N. (2009). Physical chemistry (6th ed.). McGraw Hill.
9. Kapoor, K. L. (1994). A textbook of physical chemistry (Vols. 4 & 5). Macmillan India Ltd.
10. Atkins, P., & de Paula, J. (2010). Atkins' physical chemistry (9th ed.). Oxford University Press.
11. McQuarrie, D. A., & Simon, J. D. (1997). Physical chemistry: A molecular approach. Viva Books Pvt. Ltd.
12. Satake, M., Hayashi, Y., Mido, Y., Iqbal, S. A., & Sethi, M. S. (2014). Colloidal and surface chemistry. Discovery Publishing Pvt. Ltd.

6. Syllabus Focus

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

Local/Regional/ National/Global Development Needs	Relevance
Local	Helps individuals understand and safely use everyday chemical products such as fuels, medicines, fertilizers, and cleaning agents.
Regional	Supports regional industries like agriculture, petrochemicals, pharmaceuticals, and environmental monitoring.
National	Contributes to national economic growth through industrial development, technological innovation, and scientific research.
Global	Plays a vital role in addressing global challenges such as climate change, sustainable energy, food security, and healthcare advancements.

b. Components on Skill Development/Entrepreneurship Development/Employability

SD/ED /EMP	Syllabus Content	Description of Activity

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SD	Module I	Encourage them to compare and discuss trends in reactivity and chemical behaviour.
EMP	Module II	Students will create a brief dossier on a hydrocarbon compound, highlighting its structure–property link, synthesis, safety, and industrial uses to build employability skills.
ED	Module III	Students will develop a startup proposal for a light-driven or catalytic process applying concepts of quantum mechanics, chemical kinetics, and photochemistry to assess feasibility and market potential.
EMP **NSQF level 3 & 4**	Module IV	Hands on practical training and field visits.

c. IKS component:

IKS	Syllabus Content	Module
	Introduced Traditional distillation methods in the extraction of perfumes.	**II**

7. Pedagogy

S. No.	Student Centric Methods Adopted	Type / Description of Activity
1	Experiential Learning	Micro-scale experiments in Volumetric analysis and field visits.
2	Participative Learning	Collage/ Quiz/ JAM/Game based

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:** Collage/Quiz/JAM/	
CO3	**CIA-1:** Written Exam	
CO4	**CIA-2:** Assignment/ Game based/ Poster making	

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 -I
CHEMISTRY - I

Time: 2 hrs **Course Code: U26/DSC/CHE/101**

Max. Marks: 60

SECTION –A (Essay Questions)

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

1. a. Classify the oxides based on the oxygen content. 4M

   b. What are interhalogen compounds? Explain the structure of AX_5 type of molecules. 6M

   OR

2. a. Discuss the structure of Diborane. 5M

   b. What are silicones? Give their classification. 5M

3. a. What is the Mesomeric effect? How does it explain the acidity of phenols? 5M

   b. Explain the acidic strength of carboxylic acids by applying the concept of Inductive effect. 5M

   OR

4. a. Write the mechanism for Friedel Crafts alkylation of benzene. 5M

   b. What are ortho, meta and para directing groups? Explain with one example each. 5M

5. a. Write the Schrodinger wave equation and explain the significance of ψ and ψ^2 and draw shapes of p and d atomic orbitals. 10M

   OR

6. a. Derive an expression for the rate constant of first order reaction. 5M

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b. A first order reaction is 50% complete in 100 minutes. How long will it take for 90% completion? 5M

7. Explain the principle involved in Redox titrations? Add a note on the detection of end points. 10M

OR

8. a. Classify various types of colloids. 5M

b. Deduce the expression for Langmuir adsorption isotherms. 5M

SECTION –B (Short Answer Questions)

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

9. Discuss the structure of XeO_3.
10. State and explain Markovnikov's rule with mechanism.
11. What is Huckel's rule? State whether naphthalene, cyclopentadienyl anion and tropylium cation are aromatic or not based on Huckel's rule.
12. Determine the order of reaction using Van't Hoff differential method.
13. State and explain Grothus and Draper's law.
14. Discuss the conformations of n-Hexane. Which is more stable and why?

Question Paper Format - Blooms Taxonomy Level

SECTION A - INTERNAL CHOICE				4 X 10 = 40 M
Question Number	**Module**	**Question**	**CO**	**BTL**
1	I	a. Classify the oxides based on the oxygen content. 4M b. What are interhalogen compounds? Explain the structure of AX_5 type of molecules. 6M OR	CO1	Level 1 & 2
2	I	a. Discuss the structure of Diborane. (CO1) 5M b. What are silicones? Give their classification. 5M	CO1	Level 1 & 2

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3	II	a. What is the Mesomeric effect? How does it explain the acidity of phenols? 5M b. Explain the acidic strength of carboxylic acids by applying the concept of Inductive effect. 5M OR	CO2	Level 3
4	II	a. Write the mechanism for Friedel Crafts alkylation of benzene. 5M b. What are ortho, meta and para directing groups? Explain with one example each. 5M	CO2	Level 2 & 3
5	III	a. Write the Schrodinger wave equation and explain the significance of ψ and ψ^2 and draw shapes of p and d atomic orbitals. 10M OR	CO3	Level 2
6	III	a. Derive an expression for the rate constant of first order reaction. 5M b. A first order reaction is 50% complete in 100 minutes. How long will it take for 90% completion? 5M	CO3	Level 4 & 5
7	IV	Explain the principle involved in Redox titrations? Add a note on the detection of end points. 10M OR	CO4	Level 2
8	IV	a. Classify various types of colloids. 5M b. Deduce the expression for Langmuir adsorption isotherms. 5M	CO4	Level 2 & 4
SECTION B - Short answer questions **ANSWER ANY 4 OUT OF 6**				**4 x 5 = 20M**
9	I	Discuss the structure of XeO_3.	CO1	Level 2
10	II	State and explain Markovnikov's rule with mechanism.	CO2	Level 1 & 4
11	II	What is Huckel's rule? State whether naphthalene, cyclopentadienyl anion	CO2	Level 3

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		and tropylium cation are aromatic or not based on Huckel's rule.		
12	**III**	Determine the order of reaction using Van't Hoff differential method.	**CO3**	**Level 3**
13	**III**	State and explain Grothus and Draper's law.	**CO3**	**Level 2**
14	**IV**	Discuss the conformations of n-Hexane. Which is more stable and why?	**CO4**	**Level 2 & 4**

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)	4x5=20
2	15	CO2	2	10		
3	15	CO3	2	10		
4	15	CO4	2	10		

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 -I
LABORATORY COURSE-I - QUANTITATIVE ANALYSIS

1. Course description

Program: B.Sc.
Course Code: U26/CHE/DSC/101/ P
Course type: DSC-1
No. of Credits: 1

Max. Hours: 20
Max. Marks: 50
Hours per week: 2

2. Course Objective

- To enable students to understand the principles of volumetric analysis and apply titrimetric methods for precise quantitative estimation of chemical substances.

3. Course outcomes

CO 1: Students will be able to accurately prepare and standardize solutions, select suitable indicators, and perform various titrimetric methods with proper laboratory technique.

CO 2: Students will be able to apply volumetric analysis techniques to determine the composition or strength of constituents in market samples and interpret the results with appropriate calculations.

4. Course content

QUANTITATIVE ANALYSIS

Acid-Base Titrations

1. Estimation of Carbonate in Washing Soda.
2. Estimation of Bicarbonate in Baking Soda.
3. Estimation of Carbonate and Bicarbonate in the Mixture.
4. Estimation of Alkali content in Antacid using HCl.

Redox Titrations

1. Determination of Fe(II) using $K_2Cr_2O_7$
2. Determination of Fe(II) using $KMnO_4$ with sodium oxalate as primary standard.
3. Determination of Cu(II) using $Na_2S_2O_3$ with $K_2Cr_2O_7$ as primary standard

Complexometric Titrations

1. Estimation of Mg^{2+} by EDTA
2. Estimation of Cu^{2+} by EDTA

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5. Reference Books

1. Jeffery, G. H., Bassett, J., Mendham, J., & Denney, R. C. (1999). Vogel's textbook of quantitative chemical analysis (5th ed.). Addison Wesley Longman Inc.
2. Vogel, A. I. Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, Pearson Education, 2000. ISBN: 9780582226289
3. Giri, A. N. (2010). A textbook of practical chemistry. Himalaya Publishing House.
4. O.P. Pandey, D.N. Bajpai, & S. Giri. (2020). Practical chemistry. 10th Revised Edition, S. Chand Publishing. ISBN: 9789352535859
5. Gopalan, R., Subramanian, P. S., & Raghavan, K. (2004). Elements of analytical chemistry. Sultan Chand & Sons.
6. Gopalan, R., Venkappayya, D., and Nagarajan, S. (2012). Textbook of Inorganic Chemistry (Lab Manual), 3rd Edition, Universities Press, Hyderabad, ISBN: 9788173718204 7. 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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6. Model Question Paper - End Semester Exam Practical

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Faculty of Science – Department of Chemistry
MODEL PAPER
B.Sc. I YEAR SEMESTER -I
LABORATORY COURSE-I - QUANTITATIVE ANALYSIS

Program: B.Sc. **Course Code: U26/DSC/CHE/101/P**
Type of course: DSC-1 **Time: 2 hrs**
No. of credits: 1 **Max. Marks: 50**

1. Estimate the amount of Oxalic acid present in 100 mL of the given unknown solution. You are provided with a pure sample of sodium oxalate and $KMnO_4$ solution of 0.02 M approximately. 30M

2. Viva 10 M
3. Record & attendance 10 M

Prepared by	Checked & Verified by	Approved by
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SEMESTER I

Core Course 1

CHEMISTRY OF BIOMOLECULES

Code : **U26/BIC/DSC/101**

Credits : **4**

Total hours : **60**

Hours/week : **4**

Module I : **WATER & BUFFERS**

Module II : **CARBOHYDRATES**

Module III : **AMINO ACIDS & PROTEINS**

Module IV : **LIPIDS**

SEMESTER -1

CHEMISTRY OF BIOMOLECULES

1. Course Description

Programme : B.Sc.
Course Code : U26/BIC/DSC/101
Type of course : DSC 1
No. of credits : 4

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

2. Course Objectives

1. To understand the basic molecules of life about the structures, properties, functions and classification.
2. To elucidate the importance of knowledge on the biochemical aspects of the biomolecules in biological systems.

3. Course Outcomes

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

CO1: Understand basic biochemical principles related to water, acids and bases, pH and buffer systems, and functional groups in biomolecules. (L1)

CO2: Understand the classification, structure, and biological roles of carbohydrates. (L1)

CO3: Summarize the structures of amino acids, reactions of amino acids, protein classification, different levels of organization of proteins(L2)

CO 4: Illustrate the structure and function of lipids, fatty acids and lipoproteins(L3)

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4. Course Content:

MODULE 1: WATER & BUFFERS **15 Hours**

Scope of Biochemistry, introduction to Biomolecules, water as a biological solvent, weak acids and weak bases, pH and the concept of buffers, biological buffers and their physiological importance, the Henderson–Hasselbalch equation with simple numerical problems, and the common functional groups present in biomolecules.

MODULE 2: CARBOHYDRATES **15 Hours**

Classification of carbohydrates; monosaccharides including their structures and Fischer and Haworth projections; reactions of monosaccharides with special reference to mutarotation; derivatives of monosaccharides such as amino sugars and glycosides; glycosidic bond formation along with disaccharides and oligosaccharides; polysaccharides including storage and structural polysaccharides; and bacterial cell wall polysaccharides.

MODULE 3: AMINO ACIDS & PROTEINS **15 Hours**

Classification, structure, stereochemistry, and chemical reactions of amino acids; the titration curve of glycine and pK values; essential, nonessential, and non-protein amino acids; peptide bond formation and naturally occurring peptides such as glutathione and enkephalin; protein classification and levels of structural organization including primary, secondary, tertiary, and quaternary structures with examples of haemoglobin and myoglobin; general properties of proteins including denaturation and renaturation; and determination of amino acid composition and amino acid sequencing of proteins.

MODULE 4: LIPIDS **15 Hours**

Classification of lipids along with their reactions and properties; saturated, unsaturated, and essential fatty acids; the structure and functions of neutral fats, waxes, phospholipids, and sphingolipids; the structure and functions of cholesterol and glycolipids; prostaglandins and lipoproteins; bio membranes with emphasis on the behaviour of amphipathic lipids in water and the formation of micelles, bilayers, vesicles, and liposomes; and membrane composition with the fluid mosaic model.

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5. Reference Books

1. Dr. U.Satyanarayana and U.Chakrapani **Biochemistry** 5th ed. (2001) Elsevier (New Delhi), Books and Allied Private Limited. ISBN: 81-87134-80-1
2. J.L.Jain : **Fundamentals of Biochemistry**, (2001), S. Chand & Company (New Delhi)
3. Albert L. Lehninger: **Principles of Biochemistry** (2013) 6th ed. Nelson, D.L. and Cox, M.M.W.H. Freeman and Company (New York)
4. Jeremy M Berg, John L Tymoczko, and LubertStryer **Biochemistry**, 5thedW H Freeman; (2002) ISBN-10: 0-7167-3051-0
5. Dr. A.C Deb: **Fundamentals of Biochemistry**, (1999), New Central Book Agency Private Limited. ISBN : 81-7381-144-X

6. Syllabus Focus

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

Local /Regional/National /Global Development Needs	Relevance
Global Development needs	Understanding biomolecules has far-reaching implications, addressing global challenges and contributing to advancements in science and Diet therapies across the world.

b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
SD	Module I, II, IV	Practicals- Qualitative analysis

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7. **Pedagogy**

S. No	Type/Description of Activity	Student Centric Methods Adopted
1.	Science Experiments, Field Trips	Experiential Learning
2.	Presentation/Assignment	Participative Learning
3.	Quiz	Experiential 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	
C03	CIA-2 – Objective	
C04	CIA-2 – Assignment/ model making/ PPT	

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b) Model Question Paper

CHEMISTRY OF BIOMOLECULES

Code : U26/BIC/DSC/101 **Max Marks : 60 M**
Credits : 4 **Time : 2 Hrs**

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

1. Describe water as a biological solvent, highlighting its properties and biological significance.

OR

2. Define weak acids and weak bases. What is pH? Explain the concept of buffer solutions

3. Define carbohydrates. Give their classification with suitable examples indicating their structures.

OR

4. List the reactions of monosaccharides.

5. Explain the forces that stabilize the tertiary & quaternary structure of proteins.

OR

6. Describe the determination of N & C terminal amino acid of a peptide?

7. Illustrate the structural features & functions of phospholipids.

OR

8. Categorize the reactions of fatty acids & add a note on their biological importance.

II. Write Short notes on any 4 questions (out of 6) **(4x5=20M)**

9. Henderson-Hasselbalch Equation
10. Bacterial cell wall Polysaccharides
11. Mutarotation
12. Denaturation of proteins
13. Essential amino acids
14. Lipoproteins

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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	Describe water as a biological solvent, highlighting its properties and biological significance.	CO 1	Level I
2	Module 1	Define weak acids and weak bases. What is pH? Explain the concept of buffer solutions	CO 1	Level I
3	Module 2	Define carbohydrates. Give their classification with suitable examples indicating their structures.	CO 2	Level I
4	Module 2	List the reactions of monosaccharides	CO 2	Level I
5	Module 3	Explain the forces that stabilize the tertiary & quaternary structure of proteins.	CO 3	Level II
6	Module 3	Describe the determination of N & C terminal amino acid of a peptide?	CO 3	Level II
7	Module 4	Illustrate the structural features & functions of phospholipids.	CO 4	Level III
8	Module 4	Categorize the reactions of fatty acids & add a note on their biological importance.	CO 4	Level III
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	Henderson-Hasselbalch Equation	CO 1	Level I
10	Module 2	Bacterial cell wall Polysaccharides	CO 2	Level I
11	Module 2	Mutarotation	CO 2	Level I
12	Module 3	Denaturation of proteins	CO 3	Level II
13	Module 3	Essential amino acids	CO 3	Level II
14	Module 4	Lipoproteins	CO 4	Level III

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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=40	6 (Open Choice) At least 1 Question from each Module	4X5=20
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	Remember	15
2	2	Understand	15
3	1	Application	15
4	2	Application	15

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QUALITATIVE ANALYSIS OF BIOMOLECULES PRACTICAL

1. Course Description:

Max. Hours: 30
Course Code: U24/BIC/DSC/101/P
Type of course: DSC 1

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

2. Course objectives:

Introduce the basic molecules of life with respect to their isolations and qualitative estimations.

3. Course Outcomes:

This course will help the students to-

CO1: Demonstrate the procedures to isolate biomolecules from food sources.

CO2: Apply the skills in qualitative identification of Sugars and lipids by following a series of tests and procedures

4. Course Content

PRACTICAL SESSIONS

1. General Laboratory practices and safety procedures
2. Isolation of starch from potato.
3. Isolation of casein from milk.
4. Qualitative Analysis of Carbohydrates. (4 sessions)
5. Qualitative Analysis of Lipids. (3 sessions)
6. Preparation of buffers & determination of pH.
7. Achromic Point
8. Determination of specific rotation of sugars using Polarimeter (Glucose & Fructose)

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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6. Model Question Paper – End Semester Exam Practical

QUALITATIVE ANALYSIS OF BIOMOLECULES

Course Code: U26/BIC/DSC/101/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. Carbohydrates
   b. Principle involved in the isolation of casein from milk. (10 M)
2. Identify the given sugars present in the given solutions **A** and **B** (10 + 10 M)
3. Extract casein from the given sample of milk (10 M)
4. Viva (5M)
5. Record (5M)

Prepared by Course Teacher	Checked &verified by	Approved by
Dr.G. Sony Teaching faculty	Dr.G. Sony HOD Biochemistry	Prof. Uma Joseph Principal

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SEMESTER I

Core Course 1

BACTERIOLOGY & SYSTEMATICS

Code : **U26//MIC/DSC/101**

Credits : **4**

Total hours : **60**

Hours/week : **4**

Module I : HISTORY OF MICROBIOLOGY

Module II : GENERAL CHARACTERS AND SYSTEMATICS

Module III : BACTERIAL CELL STRUCTURE AND MICROSCOPY

Module IV : CULTURE MEDIA AND STERILIZATION

SEMESTER – I
BACTERIOLOGY AND SYSTEMATICS

1. Course Description:

Programme: B.Sc.
Course Code: U26/MIC/DSC/101
Course Type: Discipline Specific Core
No. of credits: 4

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

2. Course Objectives:

- To recognize, identify and differentiate the internal and external structures of bacterial cell.
- To enable the student to learn morphology, ecology, genetics and biochemistry of bacteria as well as many other aspects related to them.

3. Course Outcomes:

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

CO 1: Understand the Scope, importance of different branches of microbiology and diversity of microbial world to differentiate between Prokaryotes and Eukaryotes. (L I)
CO 2: Understand Bacterial taxonomy and general characters of different groups of microorganism. (L II)
CO 3: Apply the principles and handling of microscope to identify and differentiate between Gram Positive and Gram negative bacterial cell structure. (L III)
CO 4: Analyse different types of media and sterilization techniques. (L IV)

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4. Course Content

MODULE I - HISTORY OF MICROBIOLOGY: (15 Hrs)

Scope and importance of Microbiology, Different branches of Microbiology, importance of microorganisms in human welfare, spontaneous generation- biogenesis theory, Germ theory of diseases. Important contributions of Beijernick, Winogradsky, Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Ivanowski, Edward Jenner. Diversity of microbial world- concepts of Whittaker and Carl Woese. Differences between Prokaryotes and Eukaryotes.

MODULE II - GENERAL CHARACTERS AND SYSTEMATICS: (15Hrs)

Principles of bacterial taxonomy & classification, Numerical taxonomy, Outlines of bacterial classification (as per Bergey's manual of systematic bacteriology). General characters and classification of the following groups: Eubacteria, Archaebacteria, Mycoplasma, Rickettsia and Chlamydia.

MODULE III - BACTERIAL CELL STRUCTURE AND MICROSCOPY: (15 Hrs)

Bacterial Cell size, shape and arrangement, glycocalyx, capsule, flagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaebacterial cell wall, sphaeroplasts, protoplasts, and L-forms, Cytoplasm: ribosomes, mesosomes, inclusion bodies, nucleoid, and plasmids. Bright field Microscope, Dark field Microscope, Phase contrast Microscope, Fluorescence Microscope, Scanning and Transmission Electron Microscope, Introduction to Confocal Microscope.

MODULE IV- CULTURE MEDIA AND STERILIZATION: (15 Hrs)

Culture media: Components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, enriched, enrichment media and transport media. General methods of sterilization & disinfection: Physical methods-moist heat, boiling, autoclaving, pasteurization and tyndallisation. Dry heat – Hot air oven, incineration, inflammation, sunlight, filteration methods. Chemical methods: Phenol and phenolic alcoholic compounds, halogen, heavy metals and their compounds, dyes. Traditional Preservation Techniques. Pure culture isolation: Streaking, serial and plating methods, cultivation, Maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria.

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5. Resources:

5a. Text books:

1. Introductory Microbiology, Dr. Chand Pasha & Dr. Hameeda Bee (2025), Professional Books Publisher.
2. Joanne M. Wiley, Linda M Sherwood, Christopher J Wooolverton (2011).
3. Prescott's Microbiology.8th edition, McGraw Hill, publishers.
4. Black JG. (1999), Principles and Explorations- 4th edition. Microbiology Prentice Hall.
5. S. Sunder Rajan (2003), Text Book of Microbiology – 1st edition, Vardana publishers.
6. R.P Singh (2005), General Microbiology - 1st edition, Kalyani publishers.

5b. Reference Books:

1. Madigan MT and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th Edition Parker J. Prentice Hall International, Inc.
2. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.
3. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology 5th edition McMillan.
4. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education
5. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited.
6. Gopal Reddy et al., (2006), Laboratory experiments in Microbiology, 2nd Edition, Himalaya publishers.
7. Prescott, Harley and Klein Wim (2002), Laboratory Exercises in Microbiology, 5th edition, Mc Graw Hill Publishers.
8. R.C Dubey, D.K Maheshwari (2006), Practical Microbiology, S Chand and Company, New Delhi.

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5c. Online Resources:

1. https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology
2. https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(Boundless)/01%3A_Introduction_to_Microbiology
3. https://www.biologydiscussion.com/microbial-taxonomy/notes-on-microbial-taxonomy-major-characteristics-and-principles/86773
4. https://openstax.org/books/microbiology/pages/1-2-a-systematic-approach
5. https://www.onlinebiologynotes.com/bacterial-cell-structure
6. https://www.biosciencenotes.com/sterilization-of-culture-media/
7. https://microbenotes.com/types-of-culture-media

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	To understand Scope & importance of Microbiology
Module II	Global	Understand Bacterial taxonomy and general characters of different groups of microorganism
Module III	National & Global	To identify and differentiate different microorganisms
Module IV	Regional & Local	To understand Sterilization techniques as valuable tools used by Bacteriologists, epidemiologists, doctors, forensic scientists, farmers etc.

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b) Components on Skill Development/Entrepreneurship Development/Employability

FOCUS Skill Development /Entrepreneurship Development /Employability	Syllabus Content	Description of Activity
Skill Development	Module IV	Students will be provided with the opportunity to prepare different types of media by aseptic means and hands on training in operating various instruments in the lab.

c) IKS component

IKS	Syllabus Content	Module
IKS	Traditional Preservation Techniques.	Module 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

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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	

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b) Model Question Paper- End Semester Exam

BACTERIOLOGY AND SYSTEMATICS

Course Code: U26/MIC/DSC/101 **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
	OR			
2	Question	Module I	CO 1	II
3	Question	Module II	CO 2	II
	OR			
4	Question	Module II	CO 2	II
5	Question	Module III	CO 3	III
	OR			
6	Question	Module III	CO 3	III
7	Question	Module IV	CO 4	IV
	OR			
8	Question	Module IV	CO 4	IV

SECTION B - ANSWER ANY 4 OUT OF 6		4 Q X 5M = 20 M		
Q.No	Question	Module	CO	BTL
9	Question	Module I	CO 1	II
10	Question	Module I	CO 1	II
11	Question	Module II	CO 2	II
12	Question	Module II	CO 2	II
13	Question	Module III	CO 3	III
14	Question	Module IV	CO 4	IV

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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	Describe the significance of microbiology in healthcare, including the diagnosis, treatment, and prevention of infectious diseases. Provide examples of how microbiologists contribute to the development of vaccines, antibiotics, and diagnostic tests. (OR)	CO 1	II
2	Module I	Illustrate the contributions of Louis Pasteur and Robert Koch	CO 1	II
3	Module II	Explain general characters of Rickettsia and its classification (OR)	CO 2	II
4	Module II	How would you summarize the Ecological and Morphological identification of bacteria	CO 2	II
5	Module III	Organize the detail structure of Gram positive and Gram negative bacterial cell wall (OR)	CO 3	III
6	Module III	How would you apply the principle and working mechanism of TEM microscopy you had learnt.	CO 3	III
7	Module IV	How can you make a distinction between differential media, selective media and transport media (OR)	CO 4	IV
8	Module IV	Distinguish between Physical methods of sterilization.	CO 4	IV
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have **ONE** question from **each** module)			4 Q X5M = 20M	
9	Module I	Explain five kingdom classification	CO 1	II
10	Module I	Outline the contribution of Louis Pasteur	CO 1	II
11	Module II	What is Numerical Taxonomy	CO 2	II
12	Module II	Describe Archaebacteria cell wall	CO 2	II
13	Module III	How would you identify bacteria under Dark field microscope	CO 3	III
14	Module IV	List out Phenol and phenolic compounds	CO 4	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	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 with BTL

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

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BACTERIOLOGY AND SYSTEMATICS
Practical Syllabus

1. Course Description:

Programme: B.Sc
Course Code: U26/MIC/DSC/101/P **Max. Hours: 30**
Course Type: Discipline specific core **Hours per week: 2**
No. of credits: 1 **Max. Marks: 50**

2. Course Objectives:

1. To make students to understand as how to use different instruments in microbiology lab and to demonstrate basic laboratory skills and techniques related to the cultivation, isolation, staining, and identification of microorganisms.

3. Course Outcomes:

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

CO 1: Understand importance of different medias to isolate and identify bacteria.

CO 2: Evaluate different cultivation and staining technique to detect microbes.

4. Course Content:

1. Preparation of different media: -Nutrient agar, Czapek Dox agar, Potato Dextrose Agar Media
2. Simple staining
3. Negative staining
4. Gram's staining
5. Acid fast staining-permanent slide only
6. Capsule staining
7. Endospore staining
8. Isolation of pure cultures of bacteria by streaking, spread plate and pour plate techniques
9. Isolation of soil bacteria by dilution plate technique
10. Isolation of bacteria from air by impingement method.
11. Motility by hanging drop method

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BACTERIOLOGY AND SYSTEMATICS

Course Code: U26/MIC/DSC/101/P **Max Marks: 50**
Credits: 1 **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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