

GUJARAT UNIVERSITY
B.Sc. SEMESTER IV
CHEMISTRY
ACCORDING TO NEP-2020

Course Structure with credit, hours and marks

Course Type	Course	Credit	Work hours/week	Exam hours	Marks		Total Marks
					Internal	External	
Discipline Specific Courses- Core (Major)	DSC-C-CHE- 241T Organic Chemistry	4	4	2	50	50	100

DSC – C - CHE 241T
ORGANIC CHEMISTRY

Learning Objectives:

- To Learn the mechanism of the electrophilic aromatic substitution reaction.
- To Learn the nomenclature, synthesis, and reactions of polynuclear hydrocarbons.
- To develop the basic knowledge determination of structure of monosaccharides and disaccharides. It's classification, increase, and decrease of carbon numbers in carbohydrates.
- To Learn the open chain and cyclic structure of glucose.
- To Learn heterocyclic compound, nomenclature, structure, aromaticity, preparation, and it's chemical reactions.
- To study active methylene compounds like EAA and Malonic Ester and few syntheses of their derivatives.
- To Learn the effect of hybridization on acidity.
- To Learn the condition of resonance and the drawing of resonating structures.
- To Understand the basic principles of UV spectra and various transitions of UV.
- To Learn calculations of λ max.

Learning Outcomes:

By the end of the course, the students will be able to:

- Gain detailed knowledge of the mechanism of the SE.
- Gain knowledge of the synthesis and reactions of polynuclear hydrocarbons.
- Gain knowledge of the cyclicity of glucose and the structures of the disaccharides.
- Gain knowledge of heterocyclic compounds and active methylene compounds.
- Gain detailed knowledge of chemical reactivity, resonance, and tautomerism.
- Gain knowledge of UV spectroscopy and calculations of λ max.

**B.Sc. SEMESTER-IV
DSC-C-CHE 241T
ORGANIC CHEMISTRY**

Unit I:

[A] Acid- Base Properties Of Organic Compounds **[13 Marks]**
[8 Hours]

Introduction To Acids And Bases, Scale (PK_a And PK_b) Of Acidity And Basicity, Factors Affecting Strength of Acid And Base: Inductive Effect, Resonance Effect, Steric Effects, Effect Of Hydrogen Bonding, Effect Of Change Of Hybridization, Solvent Effect, Brief Introduction To Tautomerism, Keto – Enol Tautomerism.

[B] UV Spectroscopy **[12 Marks]**
[7 Hours]

Principle, Origin Of UV Spectra, Transitions, Relative Position Of λ_{max} , Effect Of Solvents, Steric Effect, Conjugative Effect, Hyperchromic Shift, Hypochromic Shift, Bathochromic Shift, Hypsochromic Shift, Woodward-Fieser Rules, Problems Of Dienes, Enones, Aromatic Ketones, Aldehydes And Esters.

Unit II: Carbohydrates: Monosaccharides And Disaccharides

[A] Mono Saccharides: **[13 Marks]**
[8 Hours]

Introduction, Determination Of Simple Structures Of Glucose And Fructose, Fischer's Proof, Epimerization, Step Up And Step Down Reactions, Mutarotation, Anomers, Cyclicity Of D-Glucose, Proof Of Ring Size, Conformational Analysis Of D-Glucopyranose.

[B] Disaccharides: **[12 Marks]**
[7 Hours]

Disaccharides, Determination of structure: (+) Maltose, (+) Cellobiose And (+) Sucrose.

Unit III:

[A] Aromatic Electrophilic Substitution Reactions **[13 Marks]**
[8 Hours]

Introduction, Classification Of Substituent Groups, Orientation In Mono Substituted Benzene, Ortho Attack, Meta Attack, Para Attack, Effect Of Directing Nature Of $-\text{Cl}$, $-\text{NH}_2$, $(^+)\text{NR}_3$, $-\text{CH}_3$, $-\text{O}-$ and $-\text{NO}_2$ Groups On Aromatic Substitution, Orientation Of Groups In Disubstituted Benzene, Conversion Reactions.

[B] Polynuclear Hydrocarbons**[12 Marks]****[7 Hours]**

Nomenclature, Structure And Synthesis Of Naphthalene, Anthracene And It's Derivatives. Reactions (Oxidation, Reduction And Electrophilic Substitution Reaction (ESR)) Of Naphthalene.

Unit IV:**[A] Heterocyclic Compounds.****[13 Marks]****[8 Hours]**

Introduction, Structure Of Pyrrole, Furan And Thiophene, Paal Knorr Synthesis And Electrophilic Substitution Of Pyrrole, Furan And Thiophene, Reactivity And Orientation Of Electrophilic Substitution Reactions (ESR) In Five Membered Heterocycles (Pyrrole, Furan And Thiophene) Structure Of Pyridine, Electrophilic And Nucleophilic Substitution Reactions Of Pyridine, Basicity Of Pyridine.

[B] β -Di carbonyl compounds.**[12 Marks]****[7 Hours]**

Introduction, Synthesis Of Ethyl Acetoacetate (EAA) Claisen Condensation, Synthesis Of Diethyl Malonate, Acidic And Ketonic Hydrolysis Of β -Di carbonyl Compounds, Synthetic Applications Of β -Di carbonyl Compounds. Synthesis Of 2-Heptanone, 3-Methyl 2-Hexanone, Isobutyric Acid and Crotonic Acid From EAA. Synthesis Of Valeric Acid, Succinic Acid and Adipic Acid From Malonic Ester.

REFERENCE BOOKS

1. **‘Organic Chemistry’** by Robert Thornot Morrison and Robert Neilson, Pearson Publication, Seventh edition, 2010.
2. **‘Organic Chemistry’** by I. L. Finar, Pearson Education Pvt Ltd, New Delhi, Sixth Edition.
3. **‘Organic Chemistry’** by James B Hendrickson, Donald J. Cram and George S.Hammond, Mc-Graw-Hill, Third Edition.
4. **‘Advance Organic Chemistry’** by Arun Bahl, B. S. Bahl, S.Chand and Co. Ltd. New Delhi, Fifth Edition, 2012.
5. **‘Organic Chemistry’** by Bhupinder Mehta, Manju Mehta, Prentice Hall of India Pvt Ltd, New Delhi, 2005.
6. **‘Organic Chemistry’** by G. Marc Loudon, Oxford University Press, Fourth Indian edition 2010.
7. **‘Organic Chemistry Of Natural Products’** by G.R.Chatwal, Vol. I &II, Himalaya Publishing House-2005.
8. **‘Advanced General Organic Chemistry- A modern Approach’** by S.K.Ghosh, Third Edition, Part I and II, New Central book agency (p) Ltd.-2011
9. **‘Elementary Organic spectroscopy’** by Y.R.Sharma, S Chand and Company Ltd.- 2008.
10. **‘Spectrometric Identification of Organic compound’** by Silverstein, John wiley and Sons, 2005.
11. **‘Spectroscopy of Organic Chemistry’** by P.S.Kalsi, New Age International Publishers, Sixth Edition, 2015.
12. **‘The Applications Of Absorption Spectroscopy Of Organic Compounds’** by J.R.Dyer, Prentice-Hall, 1965.

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Course Structure with credit, hours and marks

Course Type	Course	Credit	Work hours/week	Exam hours	Marks		Total Marks
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Discipline Specific Courses- Core (Major)	DSC-C-CHE- 242T Analytical Chemistry	4	4	2	50	50	100

DSC-C-CHE 242T
ANALYTICAL CHEMISTRY

Learning Objective:

- To study the basic principles of quantitative and qualitative analysis.
- To know different types of volumetric analysis.
- To understand the basic principles of different types of volumetric analysis.
- To study acid – base, Redox, Complexometric and precipitation titration.
- To know basic principles and different steps involved in the gravimetric analysis.

Learning Outcomes:

By the end of the course, the students will be able to:

- Identify different cations and anions present in the given sample.
- Calculate different types of concentration terms of the solution.
- Perform acid – base, Redox, Complexometric and precipitation titration.
- Know the amount of the substance present in the sample by different qualitative analysis method.
- Carry out different gravimetric analysis with high accuracy.

B.Sc. SEMESTER IV
DSC-C-CHE 242T
ANALYTICAL CHEMISTRY

UNIT I: Basic Concepts Of Qualitative And Quantitative Analysis

[25 Marks]

[15 Hours]

Introduction, Solubility Product Principle, Common Ion Effect, Separation Of Cations Into Groups, Detection And Separation Of Cations Of Each Groups, Separation And Detection Of Anions (Acid Radicals), Introduction Quantitative Analysis, Titration, End Point And Equivalence Point, Indicator, Standard Solution, Primary Standard, Secondary Standard, Volumetric (Titrimetric) Calculation, Calculation Based On Normality And Molarity Of The Solution. Conditions For Volumetric Analysis And Types Of Titrimetric Analysis.

UNIT II: Acid-Base And Redox Titrations

[25 Marks]

[15 Hours]

Theory Of Acid-Base Titration, Acid-Base Titration And Ways Of Locating End Point, Titration Of Strong Acid With Strong Base, Titration Of Weak Acid With Strong Base, Titration Of Weak Base With Strong Acid, Titration Of Weak Acid With Weak Base, Factors Determining The Exact Form Of A PH Curve. Theory Of Redox Titration, Study Of Redox Titration By Electrochemical Potential Method, Ways Of Locating The End Point For Redox Titration.

UNIT III: Complexometric And Precipitation Titration

[25 Marks]

[15 Hours]

Theory Of Complexometric Titration Involving EDTA, Study Of EDTA Complex Formation Taking Disodium Salt Of EDTA And Effect Of Ph, Ways Of Locating The End Point, Estimation Of Calcium And Magnesium By Complexometric Titration By EDTA. Theory Of Precipitation Titration, Preparation Of Solutions And Indicators, Mohr's, Volhard's And Fajans' Methods, Factors Affecting Solubility.

UNIT IV: Precipitation Gravimetric

[25 Marks]

[15 Hours]

Introduction, Precipitation Gravimetry, Gravimetric Calculation And Factor, Precipitation And Its Condition, Theories Of Precipitation, Homogeneous Precipitation, Errors In Precipitation, Contamination Of The Precipitate, Co- Precipitation, Post Precipitation, Digestion, Filtration, Washing Of The Precipitate, Drying And/Or Incineration Of The Precipitate, Weighing, Specific And Selective Precipitation, Organic Precipitants, Masking Or Sequestering Agent, Problems Involved In Precipitation Gravimetry.

REFERENCE BOOKS

1. **‘Analytical Chemistry’** by Dhruba Charan Dash, PHI Learning Pvt. Ltd., New Delhi, 2011.
2. **‘Quantitative Analysis’** by R. A. Day, A. L. Underwood, , Prentice-Hall of India Pvt. Ltd., New Delhi, Sixth Edition, 2004.
3. **‘Analytical Chemistry’** by Gary D. Christian, John Wiley & Sons, INC, NewYork, Fifth Edition, 1994.
4. **‘Analytical Chemistry an Introduction’** by Douglas A. Skoog, Donald M. West, F. James Holler, Saunders College Publishing, Harcourt Brace College Publishers, Philadelphia, Sixth Edition, 1994.
5. **‘A Textbook of Analytical Chemistry’** by Y. Anjaneyulu, K. Chandrasekhar, Valli Manickam, Pharma Book Syndicate, Hyderabad, India, 2006.

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CHEMISTRY
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Course Structure with credit, hours and marks

Course Type	Course	Credit	Work hours/week	Exam hours	Marks		Total Marks
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Discipline Specific Courses-Core (Major)	DSC-C-CHE-243P Organic and Analytical Chemistry Practicals	4	8	6	50	50	100

***Practical Exam (3 Hour + 3 Hour)**

***DSC-C-CHE 243P = CHEMISTRY PRACTICAL**

N.B.: Each practical batch should have 10 students

No.Of students per batch during practical exam = 10

DSC-C-CHE-243P

Organic and Analytical Chemistry Practicals

Learning Objectives:

1. To learn the Principle of Organic spotting.
2. To learn the qualitative analysis of Organic compounds.
3. To learn the Spotting of bi-functional Organic compound.
4. To learn the spotting of Organic liquid compounds.
5. To learn the determination of amount of Organic substance from the given solution.
6. To learn different steps involved in the Quantitative analysis.
7. To learn back titration and it's necessity in analysis.
8. To learn Concept and types of Volumetric and Gravimetric analysis.
9. To learn the Estimation of Amount / functional group in the Organic compound.

Learning Outcome:

By the end of the course, the students will be able to:

1. Gain knowledge of the qualitative analysis of bi-functional organic compound.
2. Gain knowledge of various type of tests involved in the organic qualitative analysis.
3. Gain detailed knowledge to maintain accuracy during Gravimetric and Volumetric analysis.
4. Gain knowledge of principles involved in the back titration.
5. Gain knowledge of the mathematical calculations involved in the quantitative analysis.
6. Gain knowledge of the estimation of organic compounds and it's calculations.

B.Sc. SEMESTER-IV
DSC-C-CHE 243P
ORGANIC & ANALYTICAL CHEMISTRY PRACTICALS
CHEMISTRY LAB.-VII

[50 Marks]
[60 Hours]

Organic Qualitative Analysis.

(Minimum Fifteen (15) compounds: (9 solids and 6 liquids))

Acids: Cinnamic acid, Para nitro Benzoic acid, Phthalic acid, Anthranilic acid.

Phenols: p-Nitrophenol, Resorcinol, β -Naphthol.

Bases: m-Nitroaniline, p-Toluidine, Aniline (liquid base).

Neutral: Solids: Acetanilide, Benzamide, MDNB, Glucose, Acetamide, Thiourea.

Liquids: Chlorobenzene, Bromobenzene, Acetophenone, Toluene, Methanol,

Methyl acetate.

Viva-Voce Questions.

CHEMISTRY LAB.-VIII

[50 Marks]
[60 Hours]

Analytical Chemistry Practicals.

Volumetric Analysis:

- (1) Determine the amount of Nitrite (NO_2^{-1}) in the given solution of KNO_2 or NaNO_2 by back titration using KMnO_4 and $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ solution.
- (2) Determine the amount of Nickel (Ni^{+2}) in the given solution of $\text{NiCl}_2 \cdot 2\text{H}_2\text{O}$ by back titration using EDTA solution.
- (3) Determine the Amount of Ca & Mg by EDTA (Complexometric Titration) in the given solution of $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ and $\text{MgCl}_2 \cdot 2\text{H}_2\text{O}$.
- (4) Determination of available Cl_2 in bleaching powder.
- (5) Standardization of HCl with Borax.
- (6) Determine the number of water molecules of crystallisation in sodium carbonate (washing

soda) using 0.1 N HCl solution.

- (7) Determine the amount of Acetamide in the given solution.
- (8) Determine the amount of Glucose in the given solution.
- (9) Determine the amount of Aniline or Phenol in the given solution.

Gravimetric Analysis:

- (1) Determine the amount of iron (Fe^{+2}) as Fe_2O_3 gravimetrically in the given solution of $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ or $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ and free H_2SO_4 .
- (2) Determine the amount of Aluminium (Al^{+3}) as Al_2O_3 gravimetrically in the given solution of $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$ and free H_2SO_4 .
- (3) Determine the amount of Barium (Ba^{+2}) as BaSO_4 gravimetrically in the given solution of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ and free HCl.
- (4) Determine the amount of Nickel (Ni^{+2}) as $\text{Ni}(\text{DMG})_2$ gravimetrically in the given solution of $\text{NiCl}_2 \cdot 2\text{H}_2\text{O}$ and free HCl.

Viva-voce questions

REFERENCE BOOKS

1. 'Elementary Practical Organic Chemistry Part-II, Qualitative Organic Analysis', by A.I Vogel, CBS Publishers & Distributors, New Delhi, Second Edition, 2004.
2. 'Elementary Practical Organic Chemistry Part III Quantitative Organic Analysis', Part III Quantitative Organic Analysis", by A.I Vogel, CBS Publishers & Distributors, New Delhi, Second Edition, 2004.
3. 'Comprehensive Practical Organic Chemistry – Qualitative Analysis', by V.K. Ahluwalia, Sunita Dhingra, First India Edition, 2010, University Press (India) Private Limited, Hyderabad,
4. 'Organic Analytical Chemistry theory and Practice' by Mohan Jag, Narosa Publication, New Delhi, 2003.
5. 'Advanced Practical Organic Chemistry' by J Leonard, B Lygo, G Procter, , Stanley Thornes Publishers Ltd., First Indian Edition, 2004.
6. 'Analytical Chemistry: Practice' by John H. Kennedy, Saunders College Publishing, New York, Second Edition, 1990.
7. 'Quantitative Analysis' by R.A.Day, A.L.Underwood, Prentice-Hall of India Pvt.Ltd., New Delhi, Sixth Edition, 2004.

8. **'Analytical Chemistry'** by Gary D. Christian, , John Wiley & Sons, INC, New York, Fifth Edition, 1994.