



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY.
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

Programme / Class: Bachelor of Science	Year: Third	Semester: Fifth
Subject: Chemistry		
Course Code: B020501T	Course Title: Organic Synthesis A	
Course outcomes:		Bloom Taxonomy
<ul style="list-style-type: none">• CO1. Hydrocarbons are the principal constituents of petroleum and natural gas. They serve as fuels and lubricants as well as raw materials for the production of plastics, fibers, rubbers, solvents and industrial chemicals. This course will provide a broad foundation in for the synthesis of hydrocarbons. Hydroxy and carbonyl compounds are industrially important compounds. The industries of plastics, fibers, petroleum and rubbers will specially recognize this course. Students will gain an understanding of which are used as solvents and raw material for synthesis of drug and other pharmaceutically important compounds.		K1-K6
<ul style="list-style-type: none">• CO2. Synthesis and chemical properties of aliphatic and aromatic hydrocarbons.		K2, K4
<ul style="list-style-type: none">• CO3. Synthesis and chemical properties of alcohols, halides carbonyl compounds, carboxylic acids and esters.		K2, K4
<ul style="list-style-type: none">• CO4. How to design and synthesize aliphatic and aromatic hydrocarbons.		K3, K5
<ul style="list-style-type: none">• CO5. How to convert aliphatic and aromatic hydrocarbons to other industrially important compounds.		
<ul style="list-style-type: none">• CO6. Functional group interconversion.		K2, K4
Credits: 4		Core : Compulsory
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	Total No. of Lectures/ Hours (60)
	Chemistry of Alkanes and Cycloalkanes:	



I	<p>Alkanes: Classification of carbon atom in alkanes, General methods of preparation, physical and chemical properties of alkanes: Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.</p> <p>Cycloalkanes: Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Chair, Boat and Twist boat forms of cyclohexane with energy diagrams ring strain in small rings, theory of strain less rings. The case of cyclopropane ring, banana bonds.</p>	8
II	<p>Chemistry of Alkenes:</p> <p>Methods of formation of alkenes, Addition to C=C: mechanism (with evidence wherever applicable), reactivity, regioselectivity (Markownikoff's and anti-Markownikoff's additions) and stereoselectivity; reactions: hydrogenation, halogenation, hydrohalogenation, hydration, oxymercuration demercuration, hydroboration-oxidation, epoxidation, <i>syn</i> and <i>anti</i>-hydroxylation, ozonolysis, addition of singlet and triplet carbenes; Simmons-Smith cyclopropanation reaction; electrophilic addition to diene (conjugated dienes and allene); radical addition: HBr addition; mechanism of allylic and benzylic bromination in competition with brominations across C=C; use of NBS; interconversion of <i>E</i>- and <i>Z</i> alkenes.</p>	12
III	<p>Chemistry of Alkynes:</p> <p>Methods of formation of alkynes, Addition to C≡C, mechanism, reactivity, regioselectivity and stereoselectivity; reactions: hydrogenation, halogenations, hydrohalogenation, hydration, oxymercuration demercuration, hydroboration-oxidation, dissolving metal reduction of alkynes (Birch); reactions of terminal alkynes by exploring its acidity; inter conversion of terminal and non-terminal alkynes.</p>	6
IV	<p>Aromaticity and Chemistry of Arenes:</p> <p>Nomenclature of benzene derivatives, MO picture of benzene, Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions.</p>	10



	Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their Mechanism. Directing effects of the groups. Birch reduction, Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and anthracene.	
V	Chemistry of Alcohols Classification and nomenclature, Monohydric alcohols – nomenclature, methods of formation by reduction of Aldehydes, Ketones, Carboxylic acids and Esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage $[\text{Pb}(\text{OAc})_4$ and HIO_4] and pinacol-pinacolone rearrangement. Trihydric alcohols - nomenclature, methods of formation, chemical reactions of glycerol.	8
VI	Chemistry of Phenols: Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.	6



VII	Chemistry of Ethers and Epoxides: Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions – cleavage and autoxidation, Ziesel's method. Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.	05
VIII	Chemistry of Organic Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN_2 and SN_1 reactions with energy profile diagrams; Polyhalogen compounds: Chloroform, carbon tetrachloride; Methods of formation of aryl halides, nuclear and side chain reactions; The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions; Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides, Synthesis and uses of DDT and BHC.	05

Suggested Readings:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
3. Carey, F. A., Guiliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
4. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
5. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, 2 nd edition, Oxford University Press, 2012.
6. Graham Solomons, T.W., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
7. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
8. March, J. Advanced Organic Chemistry, Fourth edition, Wiley. \
9. Bariyar and Goyal , Organic Chemistry-II, Krishna Prakashan Media, Meerut , Third Edition, 2019
10. Mukherji, Singh, Kapoor, Organic Chemistry, volume 1,2 and 3, 2014, New Age International.
11. Geeta Rani, General Organic Chemistry , Manakin press
12. Arun Bahl & B S Bahl, Advanced Organic Chemistry, S. Chand Publishing
13. TN SRIVASTVA AND PC KAMPOJ, SYSTEMATIC ANALYTICAL CHEMISTRY, SHOBAN LAL NAGIN



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)

Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY.

(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

CHAND Suggestive digital platforms web links-

[https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical-pharmacology-of- antimicrobials](https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical-pharmacology-of-antimicrobials)

<https://vlab.amrita.edu/?sub=3&rch=73>

<https://www.mooc-list.co/tags/pathology>

<https://online.creighton.ed/program/medical-microbioogy-and-immunology-ms>

This course can be opted as an elective by the students of following subjects: Open for all

.....

Course prerequisites: To study this course, a student must have had the subject “Chemistry” in IV Semester of Diploma course in Chemistry

Suggested Continuous Evaluation Methods:

House Examination/ Test: 10 marks

Written Assignment/ Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks
Class performance/ Participate: 5 Marks

Suggested equivalent online courses:

.....

Further Suggestions: None



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY.
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

Programme / Class: Bachelor of Science	Year: Third	Semester: Fifth
Subject: Chemistry		
Course Code: B020502T	Course Title: Rearrangements and Chemistry of Group Elements	
Course outcomes:		Bloom Taxonomy
<ul style="list-style-type: none">• CO1. This paper provides detailed knowledge of synthesis of various class of organic compounds and functional groups inter conversion.		K2, K4
<ul style="list-style-type: none">• CO2. Organic synthesis is the most important branch of organic chemistry which provides jobs in production & QC departments related to chemicals, drugs, medicines, FMCG <i>etc.</i> industries.		K3, K4
<ul style="list-style-type: none">• CO3. It relates and gives an analytical aptitude for synthesizing various industrially important compounds.		K2, K4
<ul style="list-style-type: none">• CO4. This paper also provides a detailed knowledge on the elements present in our surroundings, their occurrence in nature.		K4, K5
<ul style="list-style-type: none">• CO5. Their position in periodic table, their physical and chemical properties as well as their extraction. This paper also gives detailed understanding of the s, p, d and f block elements and their characteristics.		K2, K4
Credits: 4		Core: Compulsory
Max. Marks: 25+75		Min. Passing Marks: as per rule
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	Total No. of Lectures/ Hours (60)



I	Rearrangements: A detailed study of the following rearrangements: Pinacol-pinacolone, Demjanov, BenzilBenzilic acid, Favorskii, Hofman, Curtius, Schmidt, Baeyer-Villiger and Fries rearrangement.	6
II	Catalysis: General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts. Enzyme catalysis; Michaelis-Menten equation, turn-over number.	8
III	Chemistry of Main Group Elements: s-Block Elements: Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls. p-Block Elements: Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of group 13-16, hydrides of boron-diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenone compounds.	10



IV	Chemistry of Transition Elements: Chemistry of Elements of First Transition Series: Characteristic properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry. Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.	6
V	Chemistry of Lanthanides: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, ceric ammonium sulphate and its analytical uses.	4
VI	Chemistry of Actinides: Electronic configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.	4
VII	Metal Carbonyls: Metal carbonyls, 18-electron rule, preparation, structure and nature of bonding in the mononuclear and di-nuclear carbonyls.	6
VIII	Bioinorganic Chemistry: Essential and trace elements in biological processes, metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+} . Nitrogen fixation.	6

Suggested Readings:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
3. Carey, F. A., Giuliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
4. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
5. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, 2nd edition, Oxford University Press, 2012.
6. Graham Solomons, T.W., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
7. Mukherji and Singh, Reaction Mechanism in Organic Chemistry, Laxmi Publications, 2016 39
8. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
9. March, J. Advanced Organic Chemistry, Fourth edition, Wiley.
10. Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)

Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY.

(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

11. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006
12. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
13. Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.
14. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.
15. Francis, P. G. Mathematics for Chemists, Springer, 1984
16. Prakash Satya, Tuli G.D., Basu S. K. Madan R.D., Advanced inorganic Chemistry, S. Chand publishing.
17. PURI, SHARMA KALIA, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand & Co.
18. R.D. Madan, Principles of Inorganic Chemistry, S CHAND PUBLISHERS
19. TN SRIVASTVA AND PC KAMPOJ, SYSTEMATIC ANALYTICAL CHEMISTRY, SHOBAN LAL NAGIN CHAND

Digital links

- <http://heecontent.upsdc.gov.in/Home.aspx>

<https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm> <https://nptel.ac.in/courses/104/103/104103071/#>

<https://swayam.gov.in>

This course can be opted as an elective by the students of following subjects: Open for all

Course prerequisites: To study this course, a student must have had the Chemistry in IV Semester of Diploma course in Chemistry

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 marks

Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks

Class performance/Participate: 5 Marks

Suggested equivalent online courses:

Further Suggestions: None



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY.
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

Programme / Class: Bachelors of Science	Year: Third	Semester: Fifth
Subject: Chemistry		
Course Code: B020503P	Course Title: Qualitative Analysis	
Course outcomes:		Bloom Taxonomy
<ul style="list-style-type: none">CO1. Upon completion of this course the students will have the knowledge and skills to: understand the laboratory methods and tests related to inorganic mixtures and organic compounds.		K2-K5
<ul style="list-style-type: none">CO2. Identification of acidic and basic radicals in inorganic mixtures.		K4, K5
<ul style="list-style-type: none">CO3. Separation of organic compounds from mixture.		K2, K5
<ul style="list-style-type: none">CO4. Elemental analysis in organic compounds.		K2, K4
<ul style="list-style-type: none">CO5. Identification of functional group in organic compounds.		K3, K4
<ul style="list-style-type: none">CO6. Identification of organic compounds.		K2, K3
Credits: 2		Core: Compulsory
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2		
S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	Inorganic Qualitative Analysis: Semi micro Analysis – cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI, Anion analysis. Mixture containing 6 radicals- 2+4 or 4+ 2 or 3+3.	16
2	Elemental analysis and identification of functional groups: Detection of extra elements (N, S and halogens) and functional groups (phenolic,	14



	carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds	
3	Separation of Organic Mixture: Analysis of an organic mixture containing two solid components using water, NaHCO_3 and NaOH for separation and preparation of suitable derivatives.	10
4	Identification of organic compounds: Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives. Identification of the organic compounds by IR and PMR Spectroscopy. (Photocopies of the spectra to be provided to the students).	20

Suggested Readings:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
 2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
 3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
 4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
 5. Harris, D.C. Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.
 6. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009. Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University
- Digital Links
 - <https://www.labster.com/chemistry-virtual-labs/>
 - <https://www.vlab.co.in/broad-area-chemical-sciences>
 - <http://chemcollective.org/vlab>

This course can be opted as an elective by the students of following subjects: Open for all

.....

Course prerequisites: To study this course, a student must have had the subject "Chemistry" in IV Semester of Diploma course in Chemistry.



ख़्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY.
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

Suggested Continuous Evaluation Methods:

.....

Suggested equivalent online courses:

.....

Further Suggestions: None



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY.
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

Programme/Class: Bachelor of Science		Year: Third	Semester: Sixth
Subject: Chemistry			
Course Code: B020601T		Course Title: Organic Synthesis B	
Course outcomes:			Bloom Taxonomy
<ul style="list-style-type: none">CO1. This paper provides detailed knowledge of synthesis of various class of organic compounds and functional groups inter conversion.			K4, K5
<ul style="list-style-type: none">CO2. Organic synthesis is the most important branch of organic chemistry which provides jobs in production & QC departments related to chemicals, drugs, medicines, FMCG etc. industries.			K2, K4
<ul style="list-style-type: none">CO3. The study of natural products and heterocyclic compounds offers an excellent strategy toward identifying novel biological probes for a number of diseases.			K2, K4
<ul style="list-style-type: none">CO4. Historically, natural products have played an important role in the development of pharmaceutical drugs for a number of diseases including cancer and infection. It relates and gives an analytical aptitude for synthesizing various industrially important compounds.			K3, K5
<ul style="list-style-type: none">CO5. Learn the different types of alkaloids, & terpenes <i>etc.</i> and their chemistry and medicinal importance. Explain the importance of natural compounds as lead molecules for new drug discovery.			K2, K5
Credits: 4		Core : Compulsory	
Max. Marks: 25+75		Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topics		
	Total No. of Lectures/		



		Hours (60)
I	Reagents in Organic Synthesis: A detailed study of the following reagents in organic transformations Oxidation with DDQ, CAN and SeO ₂ , <i>m</i> -CPBA, Jones Oxidation, PCC, PDC, PFC, Collin's reagent and ruthenium tetroxide. Reduction with NaBH ₄ , LiAlH ₄ , Meerwein- Ponndorf- Verley (MPV) reduction, Wilkinson's catalyst, Birch reduction, DIBAL- H.	6
II	Organometallic Compounds: Organomagnesium compounds: The Grignard reagents, formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions.	4
III	Chemistry of Aldehydes and ketones: Nomenclature and structure of the carbonyl groups, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones uses 1, 3-dithianes, synthesis of ketones from nitrites and from carboxylic acids, Physical properties. Mechanism of nucleophillic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Oxidation of aldehydes, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, LiAlH ₄ and NaBH ₄ reductions. Halogenation of enolizable ketones. An introduction to α , β -unsaturated aldehydes and Ketones.	10
IV	Carboxylic acids and their Functional Derivatives: Nomenclature and classification of aliphatic and aromatic carboxylic acids. Preparation and reactions. Acidity (effect of substituents on acidity) and salt formation, Reactions: Mechanism of reduction, substitution in alkyl or aryl group. Preparation and properties of dicarboxylic acids such as oxalic, malonic, succinic, glutaric, adipic and phthalic acids and unsaturated carboxylic acids such as acrylic, crotonic and cinnamic acids, Reactions: Action of heat on hydroxy and amino acids, and saturated dicarboxylic acids, stereospecific addition to maleic and fumaric	8



	acids. Preparation and reactions of acid chlorides, acid anhydrides, amides and esters, acid and alkaline hydrolysis of esters, <i>trans</i> -esterification.	
V	Organic Synthesis via Enolates: Acidity of α -hydrogens, alkylation of diethyl malonate and ethyl acetoacetate, Synthesis of ethyl acetoacetate: the Claisen condensation, Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1, 3-dithianes, Alkylation and acylation of enamines.	5
VI	Organic Compounds of Nitrogen: Preparation of nitroalkanes and nitroarenes, Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media, Picric acid. Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties, Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts, Preparation of alkyl and aryl amines (reduction of nitro compounds, nitrites), reductive amination of aldehydic and ketonic compounds, Gabriel phthalimide reaction, Hofmann bromamide reaction. Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.	10
VII	Heterocyclic Chemistry: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution, Mechanism of nucleophilic substitution reaction in pyridine derivatives, Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and six membered heterocycles, Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Nepieralski synthesis, Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinolin.	8
VIII	Natural Products Alkaloids & Terpenes: Natural occurrence, General structural features, their physiological action,	7



	Hoffmann's exhaustive methylation, Emde's modification; Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine. Natural Occurrence and classification of terpenes, isoprene rule.	
--	---	--

Suggested Readings:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003
3. Carey, F. A., Giuliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
4. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
5. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, 2nd edition, Oxford University Press, 2012. 22. Graham Solomons, T.W., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
6. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
7. March, J. Advanced Organic Chemistry, Fourth edition, Wiley.
8. Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, John Welly & Sons (1976).
9. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
10. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural
11. Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
12. Singh, J.; Ali, S. M. & Singh, J. Natural Product Chemistry, Pragati Prakashan (2010).
13. Organic Chemistry III, Krishna Prakashan Media, Meerut, Third Edition, 2019.
14. Mukherji and Singh, Reaction Mechanism in Organic Chemistry, Laxmi Publications, 2016.
15. Mukherji, Singh, Kapoor, Organic Chemistry, Vol 1,2, and 3, New Age International 2014.
16. Arun Bahl & B S Bahl, Advanced Organic Chemistry, S. Chand Publishing.
17. TN SRIVASTVA AND PC KAMPOJ, SYSTEMATIC NALYTICAL CHEMISTRY, SHOBAN LAL NAGIN CHAND

Suggestive digital platforms web links:

<http://heecontent.upsdc.gov.in/Home.aspx> <https://nptel.ac.in/courses/104/103/104103111/>
<https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm>
<https://nptel.ac.in/courses/104/103/104103071/#> <https://swayam.gov.in>



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY.
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

This course can be opted as an elective by the students of following subjects: Open for all

But special for B.Sc. Math, B.Sc. Statistic, B.Sc. Nutrition, B.Sc. Biotech, B.Sc. Forestry & B.Sc. Agriculture, B.Sc. Biology

Course prerequisites: To study this course, a student must have had the subject **Medical Microbiology & Immunology** in V Semester of Degree in Bachelor of Science.

Suggested Continuous Evaluation Methods :

House Examination/Test : 10 marks

Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks

Class performance/Participate: 5 Marks

Suggested equivalent online courses:

Further Suggestions: None



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY.
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

Programme/Class: Bachelor of Science		Year: Third	Semester: Sixth
Subject: Chemistry			
Course Code: B020602T		Course Title: Chemical Energetics and Radio Chemistry	
Course outcomes :			Bloom Taxonomy
<ul style="list-style-type: none">• CO1. Upon successful completion of this course students should be able to describe laws of thermodynamics and its applications, phase equilibria of one and two component system, electro chemistry, ionic equilibrium applications of conductivity and potentiometric measurements.			K1-K6
Credits: 4		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: as per rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topics		Total No. of Lectures/ Hours (60)
I	Thermodynamics-I: First Law of Thermodynamics: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law – Joule Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. Thermochemistry: Standard state, standard enthalpy of formation – Hess's law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.		8



II	Thermodynamics II: Second Law of Thermodynamics, Need for the law, different statements of the law, Carnot cycle and its efficiency. Carnot theorem. Thermodynamic scale of temperature. Concept of Entropy, Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases. Gibbs and Helmholtz Functions Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities. A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. Third Law of Thermodynamics; Nernst heat theorem, statement and concept of residual entropy. Nernst distribution law – Thermodynamic derivation, applications.	10
III	Electrochemistry: Electrical transport:- Conduction in metals and in electrolyte solutions, specific conductance molar and equivalent conductance, measurement of equivalent conductance, variation of molar, equivalent and specific conductances with dilution. Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations. Weak and strong electrolytes. Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method.	8
IV	Ionic Equilibrium: Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode-reference electrodes and their applications, standard electrode potential, sign conventions, Electrolytic and Galvanic cells–Reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurement. Definition of pH and pKa, determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods. Buffers – Mechanism of buffer action, Henderson-Hassel equation, application of buffer solution. Hydrolysis of salts.	10
V	Photo Chemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus- Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring	04



	in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions – energy transfer processes (simple examples), kinetics of photochemical reactions.	
VI	Colligative Properties: Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination, Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, Elevation of boiling point and depression of freezing, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, Van't Hoff factor, Colligative properties of degree of dissociation and association of solutes.	6
VII	Surface Chemistry: Adsorption: Physical and chemical adsorption; Freundlich and Langmuir adsorption isotherms; multilayer adsorption and BET isotherm (no derivation required); Gibbs adsorption isotherm and surface excess; Heterogenous catalysis (single reactant). Colloids: Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids, Coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer (qualitative idea), Tyndall effect; Electrokinetic phenomena (qualitative idea only); Stability of colloids and zeta potential; Micelle formation.	7
VIII	Radiochemistry: Natural and induced radioactivity; radioactive decay- α -decay, β -decay, γ -decay; neutron emission, positron emission, electron capture; unit of radioactivity (Curie); half-life period; Geiger-Nuttall rule, radioactive displacement law, radioactive series. Measurement of radioactivity: ionization chamber, Geiger counters, scintillation counters. Applications: energy tapping, dating of objects, neutron activation analysis, isotopic labelling studies, nuclear medicine- ^{99m}Tc radiopharmaceuticals.	7



Suggested Readings:

1. Foye, W.O., Lemke, T.L. & William, D.A.: Principles of Medicinal Chemistry, 4th ed., B.I. Waverly Pvt. Ltd. New Delhi.
2. Peter Atkins & Julio De Paula, Physical Chemistry 9th Ed., Oxford University Press (2010).
3. Metz, C. R. Physical Chemistry 2nd Ed., Tata McGraw-Hill (2009).
4. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press (2006).
5. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
6. Castellan, G. W. Physical Chemistry 4th Edn. Narosa (2004).
7. Allen Bard, J Larry. Faulkner R, Fundamentals of Electrochemical methods –fundamentals and applications, new York John, Wiley & sons, 2001.
8. H. J. Arnika, Essentials of Nuclear Chemistry, 4th ed., New Age International, New Delhi, 1995.
9. Bariyar, and Goyal, Physical Chemistry-II, Krishna Prakashan Media, Meerut, Third Edition, 2019.
10. TN SRIVASTVA AND PC KAMPOJ, SYSTEMATIC ANALYTICAL CHEMISTRY, SHOBAN LAL NAGIN CHAND.
11. KL KAPOOR, THERMODYNAMICS AND CHEMICAL EQUILIBRIUM VOL-2, Macmillan.
12. Bahl and Bahl, Essential of physical chemistry, S CHAND

Suggestive digital platforms web links

- <http://heecontent.upsdc.gov.in/Home.aspx> <https://swayam.gov.in/> <https://www.coursera.org/learn/physical-chemistry> <https://www.mooc-list.com/tags/physical-chemistry> <https://www.openlearning.com/courses/introduction-to-physical-chemistry>

This course can be opted as an elective by the students of following subjects: Open for all

But special for B.Sc. Math, B.Sc. Statistic, B.Sc. Nutrition, B.Sc. Biotech, B.Sc. Forestry, B.Sc. Biology & B.Sc. Agriculture

Course prerequisites: To study this course, a student must have had the subject "Chemistry in V Semester of Degree in Bachelor of Science.

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 marks

Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks

Class performance/Participate: 5 Marks

Suggested equivalent online courses:

<https://www.classcentral.com/course/swayam-food-microbiology-and-food-safety-17609>

Further Suggestions: **None**



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)

Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY.

(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE)

Programme/ Class: Bachelor of Science		Year: Third	Semester: Sixth
Subject: Chemistry			
Course Code: B020603P		Course Title: Analytical Methods	
Course outcomes:			Bloom Taxonomy
<ul style="list-style-type: none">CO1. Upon successful completion of this course students should be able to quantify the product obtained through gravimetric method; determination of R_f values and identification of organic compounds through paper and thin layer chromatography laboratory techniques: perform thermo chemical reactions.			K2, K5
Credits: 2		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2			
S. No.	Objectives Experiments should be only for demonstration.		Total No. of Lectures/ Hours (60)
1	Gravimetric Analysis: 1. Analysis of Cu as CuSCN. 2. Analysis of Ni as Ni (dimethylglyoxime). 3. Analysis of Ba as BaSO ₄ .		30
2	Paper Chromatography: Ascending and Circular. Determination of R_f values and identification of organic compounds: Separation of a mixture of phenylalanine and glycine. Alanine and aspartic acid Leucine and glutamic acid. Spray reagent – ninhydrin. Separation of a mixture of D, L – alanine, glycine, and L-leucine using n-butanol:acetic acid: water (4:1:5). Spray reagentninhydrin. Separation of monosaccharides – a mixture of D-galactose and D -fructose using n- butanol: acetone: water (4:5:1). Spray reagent – aniline hydrogen phthalate.		8
3	Thin Layer Chromatography: Determination of R_f values and identification of organic compounds:Separation of green leaf pigments (spinach leaves may be used) Preparation of separation of		8



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY.
 (Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

	2,4- dinitrophenylhydrazones of acetone, 2-butanone, hexan-2, and 3-one using toluene and light petroleum (40:60) Separation of a mixture of dyes using cyclohexane and ethyl (8.5:1.5).	
4	Thermochemistry: <ol style="list-style-type: none"> To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process. To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born- Haber cycle. 	14

Suggested Readings:

1. Skoog .D.A., West.D.M and Holler F. J., “Analytical Chemistry: An Introduction”, 7th edition, Saunders college publishing, Philadelphia, (2010).
2. Larry Hargis.G” Analytical Chemistry: Principles and Techniques” Pearson©(1988) Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University.

Digital links

- <https://www.labster.com/chemistry-virtual-labs/>
- <https://www.vlab.co.in/broad-area-chemical-sciences>.
- <http://chemcollective.org/vlab>

This course can be opted as an elective by the students of following subjects: Open for all

.....

Course prerequisites: To study this course, a student must have had the subject “Chemistry” in V Semester of Degree in Bachelor of Science.

Suggested Continuous Evaluation Methods:

.....

Suggested equivalent online courses:

.....

Further Suggestions: None