K. C. E. Society's
Moolji Jaitha College

NAAC Reaccredited Grade - A (CGPA : 3.15 - 3rd Cycle) |
UGC honoured "College of Excellence"
Dept. of Biotechnology, Ministry of Science & Technology honoured
"Star College" | DST(FIST) Assisted College

ESTD. 1945

के. सी. ई. सोसायटीचे
मूळजी जेठा महाविद्यालय

नॅकद्वारा पुनर्मानांकित श्रेणी – 'ए' (सी.जी.पी.ए. : ३.१५ – तिसरी फेरी)
विद्यापीठ अनुदान आयोगाद्वारा घोषित 'कॉलेज ऑफ एक्सलन्स'
भारत सरकारच्या विज्ञान, तंत्रज्ञान, जैवतंत्रज्ञान विभागातर्फे
घोषित 'स्टार कॉलेज' : डी.एस.टी. (फीस्ट) अंतर्गत अर्थसहाय्य प्राप्त

Date :- 29/06/2019

NOTIFICATION

Sub :- CBCS Syllabi of B. Sc. in Chemistry (Sem I & II)

Ref. :- Decision of the Academic Council at its meeting held on 28/06/2019.

The Syllabi of B. Sc. in Chemistry (First and Second Semesters) as per CBCS-UG Regulations, 2016 and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2019-20.

Copy of the Syllabi shall be downloaded from the College Website (www.kcesmjcollege.in)

HEAD
Department of Chemistry
M.J. College, Jalgaon

MOOLJI JAITHA COLLEGE • AUTONOMOUS

Principal,
M. J. College, Jalgaon

To :

1) The Head of the Dept., M. J. College, Jalgaon.
2) The Director, School of Chemical Sciences, M. J. College, Jalgaon.
3) The office of the COE, M. J. College, Jalgaon.
4) The office of the Registrar, M. J. College, Jalgaon.
5) Office File.

KhandeshCollege Education Society's

MooljiJaitha College, Jalgaon

An "Autonomous College"Affiliated to

KBC North Maharashtra University, Jalgaon

SYLLABUS STRUCTURE OF

B. Sc. Chemistry

Under Choice Based Credit System (CBCS)

[w.e.f. Academic Year: 2019-20]

F. Y. B. Sc. Chemistry Course Structure

Term / Semester	Course Module	Subject code	Title of Paper	Credit	Hours per week
I	DSC	CH-111	Inorganic Chemistry-I	2	2
	DSC	CH-112	Organic Chemistry-I	2	2
	DSC	CH-113	Practical Course- I	2	4
II	DSC	CH-121	Physical Chemistry-I	2	2
	DSC	CH-122	Organic Chemistry-II	2	2
	DSC	CH-123	Practical Course- II	2	4

S. Y. B. Sc. Chemistry Course Structure

Term / Semester	Course Module	Subject Code	Title of Paper	Credit	Hours per Week
III	DSC	CH-231	Physical Chemistry-II	2	2
	DSC	CH-232	Organic Chemistry-III	2	2
	DSC	CH-233	Practical Course III	2	4
	SEC	CH-230	IT Skills for Chemist	2	2
I V	DSC	CH-241	Physical Chemistry-III	2	2
	DSC	CH-242	Inorganic Chemistry-II	2	2
	DSC	CH-243	PracticalCourse IV	2	4
	SEC	CH-240	Basic Analytical Chemistry	2	2

T. Y. B. Sc. Chemistry Course Structure

Term / Semester	Course Module	Subject Code	Title of Paper	Credit	Hours per Week
V	DSE	CH-351	Physical Chemistry-IV	2	2
	DSE	CH-352	Inorganic Chemistry-III	2	2
	DSE	CH-353	Organic Chemistry-IV	2	2
	DSE	CH-354	Analytical methods in chemistry-I	2	2
	DSE	CH-355	Instrumental Methods of Analysis-I	2	2
	DSE	CH-356	Polymer Chemistry OR Research Methodology of Chemistry	2	2
	DSE	CH-357	Practical Course-V	2	4
	DSE	CH-358	Practical Course-VI	2	4
	DSE	CH-359	Practical Course-VII	2	4
	SEC	CH-350 A/ CH-350 B	Analytical Clinical Biochemistry OR Green Methods in Chemistry	2	2
VI	DSE	CH-361	Physical Chemistry-V	2	2
	DSE	CH-362	Inorganic Chemistry-IV	2	2
	DSE	CH-363	Organic Chemistry-V	2	2
	DSE	CH-364	Analytical methods in chemistry-II	2	2
	DSE	CH-365	Instrumental Methods of Analysis-II	2	2
	DSE	CH-366	Polymer Chemistry OR Research Methodology of Chemistry	2	2
	DSE	CH-367	PracticalCourse-V	2	4

	DSE	CH-368	Practical Course-VI	2	4
	DSE	CH-369	Practical Course-VII	2	4
	SEC	CH-360 A/ CH-360 B	Pharmaceutical Chemistry OR Chemoinformetics	2	2

Examination Pattern for the all Courses (40:10)

Nature	Marks
External Marks	**40**
Internal Marks	**10**
Total Marks	**50**

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KNOWLEDGE IS POWER

ESTD. 1945

SYLLABUS

Chemistry

F.Y.B. Sc.

(Semester I& II)

Under Choice Based Credit System (CBCS)

[w.e.f. Academic Year: 2019-20]

F. Y. B.Sc. Chemistry

SEMESTER-I

CH- 111 Inorganic Chemistry-I (2 Credits, 30L)

Objective:

1. To study Atomic Structure.
2. To understand Radial and angular nodes and their significance.
3 .To study the Chemical Bonding and Molecular Structure Ionic Bonding.

Course Outcome:

After successful completion of the course the student :

1. Can understand structure of an atom by using nature of electron.
2. Can apply concept of nodes in orbital's of an atom.
3. Can apply concept of general characteristics of ionic bonding.

1.Atomic Structure (14 L)

Review of: Bohr's theory and its limitations, Dual behavior of matter and radiation, de Broglie's relation., Heisenberg Uncertainty principle, Hydrogen atom spectra, Need of a new approach to Atomic structure.

Quantum mechanics, Time independent Schrodinger equation and meaning of various terms in it.Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance.Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and ms, Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, Electronic configurations of the atoms.Stability of half-filled and completely filled orbitals, concept of exchange energy.Relative energies of atomic orbitals, Anomalous electronic configurations.

2. Chemical Bonding and Molecular Structure (16 L)

Ionic Bonding: General characteristics of ionic bonding. Energy consideration in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds.Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability.Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonalbipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches.

Reference:

1. J.D. Lee, (1991), Concise Inorganic Chemistry.
2. F.A Cotton, P.L. Gaus, Basic Inorganic Chemistry, 3rd ed., Wiley.
3. B.E Douglas, D.H McDaniel, J.J Alexander, Concepts and Models in Inorganic Chemistry John Wiley & Sons.
4. J.E Huheey, E.A Keiter, R.L Keiter, O.K Medhi, Inorganic Chemistry
5. P. Atkins, T . Overton, Shriver and Atkins,2010, Inorganic chemistry, Oxford University Press, USA

CH- 112 Organic Chemistry-I (2 Credits, 30L)

Objective:

1. To study Fundamentals of Organic Chemistry
2. To understand the IUPAC Nomenclature.
3 .To study the interpretation on Aliphatic Hydrocarbons

Course Outcome:

After successful completion of the course the students :

1. Can understand electronic and structural effect in organic molecules..
2. Can apply concept IUPAC Nomenclature to give name to the compounds.
3. Can apply concept of functional group approach.

1.Fundamentals of Organic Chemistry (8 L)

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

2.IUPAC Nomenclature of organic compounds (10 L)

Rules for IUPAC nomenclature for: Saturated hydrocarbons, unsaturated hydrocarbons, organic compounds containing one functional group, organic compounds containing functional group and multiple bonds, organic compounds containing two or more than two functional groups, cyclic organic compounds, bicyclic organic compounds, Aromatic compounds.

3.Aliphatic Hydrocarbons (12 L)

Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule): cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine).Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.
Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alkaline $KMnO_4$.

Reference :

1. T.W. Graham Solomon, C.B. Fryhle, S.A. Dnyder, Organic Chemistry, 2014, John Wiley & Sons.

2. J.E. McMurry, 2013, Fundamentals of Organic Chemistry, 7th Ed., Cengage Learning India Edition.
3. P. Sykes, O. Longman, 1988, A Guidebook to Mechanism in Organic Chemistry.
4. E.L. Eliel, 2000, Stereochemistry of Carbon Compounds, Tata McGraw Hill education
5. I.L Finar, (Vol. I & II), Organic Chemistry.
6. R.N., Pearson , Morrison,. & Boyd, , 2010, Organic Chemistry
7. B.S. Bahl, A. Bahl, 2010, Advanced Organic Chemistry, S. Chand
8. R. Elliot, Alexander, Principles of ionic organic reactions,2013, John Wiley and Sons, Inc; London; Toppan Company, Ltd.Japan.

CH- 113 Practical Course –I (2 Credits, 60L)

Objective:

1. To study Organic preparations
2. To understand organic synthesis by halogenations and nitration.
3 .To study reaction products and intermediates.
4. To study Atomic Structure
5. To understand titration analysis.
6 .To study the inorganic qualitative analysis.

Course Outcome:
After successful completion of the course the students:
1. Can understand preparation of organic compounds.
2. Can apply concept preparation of organic compounds containing Nitrogen and halogen.
3. Can understand how to determine intermediates in reaction.
4. Can prepared solutions of different Molarity/Normality.
5. Can apply concept of nodes in orbital's of an atom.
6. Can determine quality of substance.

I) Inorganic Chemistry (Any Eight)

1. Preparation of solutions of different Molarity/Normality of titrants.

2.Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

3. Estimation of oxalic acid by titrating it with $KMnO_4$

4. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$

5. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator and external indicator

6. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

7. Estimation of carbonate and hydroxide present together in mixture.

8. Estimation of carbonate and bicarbonate present together in a mixture.

9. Estimation of free alkali present in different soaps/detergents.

10. Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution.

11. Estimation of oxalic acid and sodium oxalate in a given mixture.

12. Inorganic Qualitative Analysis (Any Four compounds) - Analysis of inorganic compound containing one cation and anion

II) Organic Chemistry (Any Eight)
1. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)

2. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100°C by distillation and capillary method.

3. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)

4. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given) (Any Two)

a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.
b) Identify and separate the sugars present in the given mixture by paper chromatography.

5. Organic Qualitative Analysis (Any Four)

a) Type determination
b) Physical constants
b) Preliminary tests
d) Functional group tests.

Reference:

1. G. Svehla, 2012, Vogel's Qualitative Inorganic Analysis, Pearson Education
2. J. Mendham, 2009, Vogel's Quantitative Chemical Analysis.
3. A.I Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford & P.W.G Smith, 1996, Practical Organic Chemistry, 5th edition Textbookof, Prentice-Hall.
4. F.G. Mann, B.C. Saunders, 1960, Practical Organic Chemistry

SEMESTER – II

CH- 121 Physical Chemistry-I (2 Credits, 30L)

Objective:

1. Tocalculate bond energy, bond dissociation energy and resonance energy from Thermo-chemical data.
2 . To study chemical equilibrium and thermodynamics.

Course Outcome:
After successful completion of the course the students:
1. Can understand Free energy change in a chemical reaction.
2. Can understand reactions involving ideal gases.

1. Chemical Energetics (10 L)

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry, Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

2. Chemical Equilibrium (8 L)
Free energy change in a chemical reaction, Thermodynamic derivation of the law of chemical equilibrium, Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.

3. Ionic Equilibria (12 L)
Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect, Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions, Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Reference:

1. G.M. Barrow, 2007, Physical Chemistry, Tata McGraw-Hill
2. G.W. Castellan, Physical Chemistry,2004, 4th Ed, Narosa
3. J.C. Kotz, P.M. Treichel, and J.R. Townsend , General Chemistry, 2009, Cengage Learning India Pvt. Ltd.
4. , B.H. Mahan, University Chemistry, 3rd Ed, 1998, Narosa
5. R.H. Petrucci, General Chemistry, 5th Ed 1985, Macmillan Publishing Co

CH-122 Organic Chemistry-II (2 Credits, 30L)

Objective:

1. To study reaction and preparation of aromatic hydrocarbons.
2 .To study the reactions of aldehydes ketones.

Course Outcome:
After successful completion of the course the students :
1.Can understand the mechanism of various electrophilic and nucleophilic reactions.
2. Can distinguish between elimination substitution reactions.
3. Can understand the mechanism of SN_1, SN_2 and SNi reactions.

1. Aromatic hydrocarbons (6 L)

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.
Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene).Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

2. Alkyl and Aryl Halides (8 L)

a) Alkyl Halides: (Upto 5 Carbons) Types of Nucleophilic Substitution (SN_1, SN_2 and SNi) reactions.
Preparation: from alkenes and alcohols.
Reactions: hydrolysis, nitrite & nitro formation, nitrile &isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

b) Aryl Halides: Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.
Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).
Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

3. Alcohols, Phenols and Ethers (Upto 5 Carbons) (10 L)

a) Alcohols: Preparation: Preparation of 1^o, 2^o and 3^o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.
Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3).Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

b) Phenols: (Phenol case) Preparation: Cumenehydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation, Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, chottenBaumann Reaction.

c) Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

4.Aldehydes and ketones (aliphatic and aromatic):(6L)

(Formaldehyde, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles.
Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test, Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation, Clemensen reduction and Wolff Kishner reduction, Meerwein-Pondorff Verley reduction.

Reference :

1. T.W. Graham, C.B. Fryhle, S.A. Dnyder, Organic Chemistry , 2014, John Wiley & Sons.

2. J.E. McMurry, Fundamentals of Organic Chemistry, 2013, 7th Ed, Cengage Learning India Edition

3. P. Sykes, O. Longman, A Guidebook to Mechanism in Organic Chemistry,1998, New Delhi

4. I.L. Finar, Organic Chemistry, Vol. I & II, E.L.B.S.

5. R.T. Morrison, R.N. Boyd, Organic Chemistry, 2010,

6. A. Bahl, B.S. Bahl, Advanced Organic Chemistry, 2110, S. Chand

CH-123 Practical Course -II (2 Credits, 60L)

Objective:

1. To study Organic preparations of organic derivatives.
2. To understand organic synthesis by Bromination.
3. To study pH of drinks, fruit juices and shampoos.

Course Outcome:

After successful completion of the course the students:

1. Can understand preparation of organic compounds by green method.
2. Can apply concept of purification for synthesized product.
3. Can understand how to prepare buffer solutions.

I) Physical Chemistry (Any Eight)

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of *H.*
7. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH- meter.
8. Preparation of buffer solutions:
   (i) Sodium acetate-acetic acid
   (ii) Ammonium chloride-ammonium hydroxide
9. Measurement of the pH of buffer solutions and comparison of the values with theoretical

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallization, determination of melting point and calculation of quantitative yieldsto be done.
   a) Bromination of Phenol/Aniline
   b) Benzoylation of amines/phenols
   c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone.

4. Organic derivatives:

   a) Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, -*p*toluidines and *o*.*m*-, *p*-anisidine) and phenols (β -naphthol, vanillin, salicylic acid) by any one method:
      i. Using conventional method.
      ii. Using green approach

b) Benzolyation of one of the following amines (aniline, *o*-, *m*-, *p*- toluidines and *o*-,*m*-, *p*-anisidine) and one of the following phenols (β-naphthol, resorcinol, pcresol) by Schotten-Baumann reaction.
c) Oxidation of ethanol/ isopropanol (Iodoform reaction).
d) Bromination of any one of the following:
    i. Acetanilide by conventional methods.
    ii. Acetanilide using green approach (Bromate-bromide method)
e) Nitration of any one of the following:
    i. Acetanilide/nitrobenzene by conventional method
    ii. Salicylic acid by green approach (using ceric ammonium nitrate).
f) Selective reduction of *meta*dinitrobenzene to *m*-nitroaniline.
g) Reduction of *p*-nitrobenzaldehyde by sodium borohydride.
h) Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
i) *S*-Benzylisothiouronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).
j) Aldol condensation using either conventional or green method.

(The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC).

Reference:

1. A.I. Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford and P.W.G Smith, Textbook of Practical Organic Chemistry, 5th edition,1996, Prentice-Hall.
2. F.G. Mann, B.C. Saunders, Practical Organic Chemistry, 1960, Orient-Longman
3. B. D. Khosla, V. C. Garg, and A. Gulati, Senior Practical Physical Chemistry,2011, R. Chand & Co.: New Delhi