Shri Vile Parle Kelavani Mandal's

MITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF SCIENCE & AMRUTBEN JIVANLAL COLLEGE OF COMMERCE AND ECONOMICS (AUTONOMOUS)

NAAC Reaccredited 'A' grade, CGPA: 3.57 (February 2016),

Granted under RUSA, FIST-DST & -Star College Scheme of DBT, Government of India

Best College (2016-17), University of Mumbai

Affiliated to the

UNIVERSITY OF MUMBAI

Program: S.Y. B.Sc.

Course: CHEMISTRY

Semester-III

Choice Based Credit System (CBCS) with effect from the Academic year

2018-2019

PROGRAMME SPECIFIC OUTCOMES (PSO'S)

On completion of the B.Sc.- Chemistry the learners should be enriched with knowledge and be able to-

PROGRAMME SPECIFIC OUTCOMES (PSO'S)

On completion of the B.Sc Chemistry the learners should be enriched with knowledge and be able to-

PSO1: To have sound knowledge about the fundamentals and applications of various chemical and scientific theories.

PSO2: To introduce the different branches of chemistry like analytical, organic, inorganic, physical, environmental, polymer and biochemistry etc.

PSO3: To explain nomenclature, stereochemistry, structures, reactivity, chemical formulae, and mechanism of the chemical reactions.

PSO4: To apply appropriate techniques for the qualitative and quantitative analysis of chemicals in laboratories and in industries.

PSO5: To develop better understanding of good laboratory practices and safety.

PSO6: To develop research oriented skills, analytical skills and problem solving skills requiring application of chemical principles.

PSO7: To recognize causes of environmental pollution, environmental pollution act and the methods for environmental pollution control.

Preamble

The well-organized curriculum including basic as well as advanced concepts in chemistry from first year to third year shall inspire the students for pursuing higher studies in chemistry and for becoming an entrepreneur and also enable students to get employed in the Research Institutes, Industries, Educational Institutes and in the various concerning departments of State and Central Government based on subject chemistry.

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Evaluation Pattern

The performance of the learner will be evaluated in two components. The first component will be a Continuous Assessment with a weightage of 25% of total marks per course. The second component will be a Semester end Examination with a weightage of 75% of the total marks per course. The allocation of marks for the Continuous Assessment and Semester end Examinations is as shown below:

a) Details of Continuous Assessment (CA)

25% of the total marks per course:

Continuous Assessment	Details	Marks
Component 1 (CA-1)	TEST	15 marks
Component 2 (CA-2)	ASSIGENMENT	10 marks

b) Details of Semester End Examination

75% of the total marks per course. Duration of examination will be two and half hours.

Question Number	Description	Marks	Total Marks
Q.1	Attempt **any four** of the following	5 marks each	20
Q.2	Attempt **any four** of the following	5 marks each	20
Q.3	Attempt **any four** of the following	5 marks each	20
Q.4	Attempt **any five** of the following	3 marks each	15
		Total Marks	**75**

Signature Signature Signature

HOD Approved by Vice –Principal Approved by Principal

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Program: SY B.Sc. (2018-19)				**Semester: III**	
Course: Physical Chemistry				**Course Code: USMACH301**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Lectures per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
3	3	NIL	2+1	25	75

Learning Objectives:

1. To orient learner about the importance of thermodynamics in chemistry and its different laws.
2. To orient learner about the kinetics of reaction and factors affecting it.
3. To teach learner about the various physical properties of liquids.
4. To teach learner about the basic concept and processes of electrochemistry.
5. To acquaint learner about the concept of partition and solvent extraction.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: understand the important concept of chemical thermodynamics and its different laws.

CO2: understand the concept of conductance and factors affecting it and Kohlrausch's law and its applications.

CO3: understand ideal and non-ideal solutions, Raoult's law, distillation process and its different types.

CO4: understand the basic concept of partition and solvent extraction and its different types.

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	1.1 Chemical Thermodynamics-II, 1.2 Electrochemistry-I	15L
2	2.1 Chemical Kinetics -II 2.2 Phase Equilibria-I	15L
3	3.1 Physical Properties of Liquids-I	15L
	Total	**45L**
PRACTICALS		

Module	Description	No of Hours
1	**1.1Chemical Thermodynamics-II (7L)** 1.1.1 Free Energy Functions: Helmholtz Free Energy, Gibb's Free Energy, Variation of Gibb's free energy with Pressure and Temperature, Gibbs- Helmholtz equation. (Numericals expected). 1.1.2 Thermodynamics of Open System: Partial Molal Properties, Chemical Potential and its variation with Pressure and Temperature, Gibb's Duhem equation. (Numericals expected). 1.1.3 Concept of Fugacity and Activity. 1.1.4 Chemical Equilibrium and Equilibrium Constant: Equilibrium constant, Kp and Kc and their inter-relation, van't Hoff reaction isotherm, van't Hoff reaction isochore. (Numericals expected). **1.2Electrochemistry-I (8L)** 1.2.1 Conductance: Equivalent, Specific, Molar conductance,Variation of molar conductance with dilution. (Numericals expected). 1.2.2 Mobility of ions – Kohlrausch's law, Application of Kohlrausch's law– determination of i) degree of dissociation ii) Solubility of sparingly soluble salt. iii) Ionic product of water. (Numericals expected). 1.2.3 Arrhenius theory of electrolytic dissociation and its limitations 1.2.4 Transference number and its experimental determination using moving boundary method. Factors affecting transport number.(Numericals expected).	15L
2	**2.1Chemical Kinetics –II (4L)** Types of Complex Chemical reactions. Reversible or opposing, consecutive and parallel reactions. (No derivations, only examples expected) Effect of temperature on rate of reaction, Arrhenius equation, Concept of energy of activation (Ea). (Numericals expected). **2.2 Phase Equilibria-I(11L)** 2.2.1 Terms involved, components and degrees of freedom of a system, Gibbs Phase Rule.(Numericals expected). 2.2.2 Raoult's Law, Ideal and Non ideal Solutions (Positive and Negative Partially Miscible Liquids: Partially Miscible Liquids with Upper Critical Solution Temperature (Example: Phenol-Water System), Partially Miscible Liquids with Lower Critical Solution Temperature (Example: Triethylamine-Water System), Partially Miscible Liquids with Upper and Lower Critical Solution Temperature (Example: Nicotine-Water System). 2.2.4Fractional distillation,Azeotropic mixture, Steam Distillation, Nernst distribution law and its applications. (Numericals expected).	15L
3	**Physical Properties in Liquids-I** 3.1 Conductometry: Introduction, Principle, Instrumentation, Methods of determination of conductance.Conductometric titrations. 3.2 pH metry: Introduction, Principle, Instrumentation,Applications. 3.3Polarimetry: Introduction, Principle, Instrumentation,Methods of determination of angle of polarisation, Applications. 3.4 Refractometry: Introduction, Principle, Instrumentation, Applications.	15L
	Total	**45L**

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I
(If applicable)

PRACTICALS	
1	To study reaction between potassium persulphate and potassium iodide kinetically and hence to determine order of reaction.
2	To verify Ostwald's dilution law conductometrically.
3	To determine dissociation constant of weak acid by incomplete titration method using pH meter.
4	To determine specific rotation of glucose solution using polarimeter.
5	Determine the refractance of methyl alcohol/ acetone/ chloroform.
6	Determination of the amount of Strong acid in the given solution by titration with strong base using Conductometry.

Suggested Readings

Reference Books:

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press, 2014.
2. Ball D.W., Physical Chemistry, Thomson Press, India, 2007.
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa, 2004.
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson (2013).
6. Peter A. and Paula J. de, Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd.,New Delhi (2004).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill (2010).
9. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).
10. ArunBahl, B. S. Bahl and G. D. Tuli, Essential of Physical Chemistry, S. Chand Publication (2015).
11. Puri, Sharma and Pathania, Element of Physical Chemistry, Vishal Publication, 46th Ed., (2013)

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Program: SY B.Sc. (2018-19)				**Semester: III**	
Course: Inorganic Chemistry				**Course Code: USMACH302**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
3	3	NIL	2+1	25	75

Learning Objectives:
To give insight of fundamental concepts and industrial applications of inorganic chemistry.

Course Outcomes:
After completion of the course, learners would be able to:

CO1: explain formation of bonds between two atoms with the theories of chemical bonding.
CO2: identify geometry and structures of co-ordination compounds with proper stereochemistry.
CO3: use gravimetric analysis effectively for quantitative analysis.
CO4: explain process involved in bulk manufacturing of sulfuric acid and ammonia, and factors affecting production of the same.
CO5: describe metallurgical processes for extraction of Silver, Aluminum and Copper.

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	Chemical Bonding	15L
2	Chemistry of co-ordination compounds	15L
3	Industrial Inorganic Chemistry	15L
	Total	**45L**
PRACTICALS		

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Module	Description	No of Hours
1	**Chemical Bonding** **1.1 Directional Bonding: Orbital approach (5L)** 1.1.1 Covalent Bonding The Valence Bond Theory- Introduction and basic tenets 1.1.2 Interaction between two hydrogen atoms and the Potential energy diagram of the resultant system 1.1.3 Corrections applied to the system of two hydrogen atoms- Formation of H_2 1.1.4 Homonuclear diatomic molecules from He_2 to Ne_2 1.1.5 Resonance and the concept of Formal Charge; Rules for Resonance or Canonical structures. 1.1.6 Bonding in Polyatomic Species: The role of Hybridization. And types of hybrid orbitals-*sp, sp^2, sp^3, sp^3d, sp^2d^2 and sp^2d sp^3d^2* 1.1.7 Equivalent and Non-Equivalent hybrid orbitals 1.1.8 Contribution of a given atomic orbital to the hybrid orbitals (with reference to sp^3 hybridisation as in CH_4, NH_3 and H_2O and series like NH_3, PH_3, AsH_3, BiH_3) **1.2 Molecular Orbital Theory (6L)** 1.2.1 Comparing Atomic Orbitals and Molecular Orbitals. 1.2.2 Linear combination of atomic orbitals. to give molecular orbitals LCAO-MO approach for diatomic homonuclear molecules). 1.2.3 Wave mechanical treatment for molecular orbitals (H_2^+ and H_2) 1.2.4 Molecular orbital Theory and Bond Order and magnetic property: with reference to O_2,O_2^+ O_2^-,O_2^{2-} (Problems and numerical problems expected wherever possible) **1.3 Inorganic Polymers (4L)** 1.3.1 Introduction 1.3.2 Classification, Preparation and Properties Applications of silicones and borazinesreference to O_2,O_2^+ O_2^-,O_2^{2-}	15L
2	**2.1 Chemistry of co-ordination compounds (8L)** Distinction between double salts and co-ordination compounds Experimental evidences of co-ordinate bond formation Terms involved in co-ordination compounds; IUPAC nomenclature Werner's theory of co-ordination compounds; Effective atomic number rule Isomerism in co-ordination compounds - Ionization isomerism; - Hydrate isomerism; - Linkage isomerism; - Co-ordination isomerism; - Stereoisomerism (geometrical and optical isomerism with special reference to co-ordination number 4 and 6) Applications of co-ordination compounds **2.2 Gravimetric Analysis (7L)** 2.2.1 Definition and types of gravimetric analysis 2.2.2 Precipitation Gravimetry with respect to theory and practise: Solubility consideration, common ion effect, diverse ion effect, pH, temperature and nature of solubility 2.2.3 Treatment of precipitates in gravimetry	15L

	Digestion, Filtration and Washing, Drying and Ignition 2.2.4 Use of organic reagents in gravimetric analysis.	
3	**Industrial Inorganic Chemistry** **3.1 Physico-Chemical Principles (6L)** 3.1.1 Criteria for spontaneity of chemical reactions 3.1.2 Electrolysis 3.1.3 Effect of catalyst 3.1.4 General Principles of metallurgy **3.2 Manufacture of Bulk chemicals (4L)** 3.2.1 Sulfuric acid 3.2.2 Ammonia **3.3 Extraction and Purification of metals (5L)** 3.3.1 Copper by pyrometallurgy 3.3.2 Silver by hydrometallurgy 3.3.3 Aluminum by electrometallurgy.	15L
	Total	**45L**

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I
(If applicable)

1	**Identification of an inorganic compound involving qualitative and quantitative analysis** (minimum four compounds)
2	**Volumetric Analysis** 1. Determination of total alkalinity of water sample using double indicators. 2. Redox titration using internal indicator (Fe vs $K_2Cr_2O_7$)

Suggested Readings

Reference Books:

1. B. R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 2014.
2. W. W. Porterfield, Inorganic Chemistry-A Unified Approach, 2nd Ed., Academic Press, 1993.
3. B. W. Pfennig, Principles of Inorganic Chemistry, Wiley, 2015.
4. C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Pearson Education Limited, 2nd Edition 2005.
5. J. Huheey, F. A. Keiter and R. I. Keiter, Inorganic Chemistry–Principles of Structure and Reactivity, 4th Ed., Harper Collins, 1993.

6. P. J. Durrant and B. Durrant, Introduction to Advanced Inorganic Chemistry, Oxford University Press, 1967.
7. R. L. Dekock and H.B.Gray, Chemical Structure and Bonding, The Benjamin Cummings Publishing Company, 1989.
8. G. Miessler and D. Tarr, Inorganic Chemistry, 3rd Ed., Pearson Education, 2004.
9. R. Sarkar, General and Inorganic Chemistry, Books & Allied (P) Ltd., 2001.
10. C. M. Day and J. Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt. Ltd., 1985.
11. J. N. Murrell, S. F. A. Kettle and J. M. Tedder, The Chemical Bond, Wiley, 1978.
12. G. A. Jeffrey, An Introduction to Hydrogen Bonding, Oxford University Press, Inc., 1997.
13. D. Banerjea , Coordination Chemistry
14. P.W. Atkins, T. Overton, J. Rourke, M. Weller and F. Armstrong; Shriver & Atkins: Inorganic Chemistry, 4th ed. Oxford University Press, 2006.
15. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann; Advanced Inorganic Chemistry, 6th ed. Wiley, 1999,
16. B. Douglas, D. McDaniel and J. Alexander. Concepts and Models of Inorganic Chemistry(3rd edn.), John Wiley & Sons (1994).

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Program: SY B.Sc. (2018-19)				**Semester: III**	
Course: Organic Chemistry				**Course Code: USMACH303**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
3	3	NIL	2+1	25	75

Learning Objectives:

To provide broad foundation in organic chemistry by providing insights into the different topics such as electronic structure and bonding in carbonyl compounds as well asconcept of toxicology and related topics.

Course Outcomes:

After completion of the course, learners would be able to:

CO6: have working knowledge of chemical principles appropriate to a chemistry degree program

CO7: understand topics such as the fundamentals of structure and bonding in carbonyl compounds, the reactivity of carbonyl compounds with nucleophiles, toxicology and related topics.

CO8: develop the basic practical skills for the synthesis and analysis of organic compounds and justify a reasonable mechanism for a chemical reaction.

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	1.1 Halogenated Hydrocarbons 1.2 Aromatic electrophilic substitution 1.3 Alcohols, Phenols, Epoxides	15L
2	2.1 Carbonyl Chemistry 2.2 Stereochemistry	15L
3	3.1 Toxicology 3.2 Unit Operation 3.3 Unit Processes 3.4 Overview of Chemical Industries	15L
	Total	**45L**
PRACTICALS		

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Module	Description	No of Hours
1	**1.1 Halogenated Hydrocarbons (4L)** 1.1.1 Alkyl Halides Nucleophilic substitution reactions: S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects Factors affecting nucleophilic substitution reactions : nature of substrate, solvent, nucleophilic reagent and leaving group 1.1.2 Aryl halides Reactivity of aryl halides towards nucleophilic substitution reactions. Nucleophilic aromatic substitution (S_NAr) addition – elimination mechanism and benzyne mechanism **1.2 Aromatic Electrophilic Substitution (3L)** 1.2.1 Mechanistic principles of electrophilic aromatic substitution reaction (nitration, sulphonation, halogenations, Friedel – Craft alkylation and acylation) of benzene. 1.2.2 Substituent effect on rate and orientation of reaction **1.3 Alcohols, Phenols, Epoxides (8L)** 1.3.1 Alcohols Nomenclature Preparation: Reduction of aldehyde and ketones, Grignard reaction Properties: Hydrogen bonding and acidity of alcohols Reactions 1.3.2 Phenols Preparation Physical properties and acidic character, resonance stabilization, comparative acidic strength of alcohols and phenols 1.3.3 Epoxides Nomenclature Preparation Reactions: Reactivity, ring opening reactions by nucleophiles (a) In acidic conditions: Hydrolysis, reaction with halogen halide, alcohol, hydrogen cyanide (b) In neutral or basic conditions: ammonia, amines, Grignard reagents, alkoxides	15L
2	**2.1 Carbonyl Chemistry (11L)** 2.1.1 Nomenclature 2.1.2 Structure and reactivity 2.1.3 Methods of preparation: Oxidation of alcohols by using PCC, hydration of alkynes, action of Grignard reagent on ester, Rosenmund reduction, Gattermann -Koch formylation and Friedel Craft acylation of arenes 2.1.4 Reactions : General mechanism of nucleophilic addition, Addition of cyanide, hydride, organometallic reagents, water, alcohol, bisulphite and amines. 2.1.5 Keto enol tautomerization: Mechanism for acid and base catalysed enolization 2.1.6 Active methylene compounds : Alkylation and their synthetic poential **2.2 Stereochemistry (4L)** 2.2.1 Molecular chirality and elements of symmetry:	15L

	Mirror plane of symmetry, inversion center, rotation-rotation-reflection (alternating) axis. 2.2.2 Chirality of compound without a stereogenic centre: Cummulene, spirans and biphenyl.	
3	**3.1 Toxicology (5L)** 3.1.1 Concept and important terms 3.1.2 Effect of toxic substances 3.1.3 General aspects of mechanism of metal ion toxicity Biochemical effects Observable physiological effects Reversible and irreversible effects Effect of immune system 3.1.4 Toxicity of various chemicals Heavy metals : As, Hg, Pb, Cd Non metals: SOx, NOx, CO Organic : Hydrocarbons 3.1.5 Case Studies Minamata episode Bhopal gas tragedy **3.2 Unit Operations (3L)** 3.2.1 Introduction 3.2.2 Fractional distillation 3.2.3 Azeotropic distillation 3.2.4 Vaccum distillation 3.2.5 Extractive distillation **3.3 Unit Processes (4L)** 3.3.1 Nitration : Mechanism, Industrial preparation of Nitrobenzene, m-dinitrobenzene 3.3.2 Sulphonation : Mechanism, Industrial preparation of DDB and DDBS (detergent) **3.4 Overview of Chemical Industries (3L)**	15L
	Total	**45L**
PRACTICALS		

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PRACTICAL I
(If applicable)

1	**<u>Organic preparations [07]</u>** 1. Cyclohexanone oxime from cyclohexanone. 2. Glucosazone from dextrose or fructose 3. β-Naphthylbenzoate from β-Naphthol 4. m-dinitrobenzene from nitrobenzene

	5. Phthalic anhydride from phthalic acid by sublimation 6. Acetanilide from aniline 7. Iodoform from acetone
2	**<u>Organic estimations [03]</u>** 1. Estimation of Aspirin 2. Estimation of Benzoic acid 3. Estimation of Acetone 4. Estimation of Amide

Suggested Readings

Text Books:

1. Rao, P.S. et al, College Organic Chemistry, Himalaya Publication, 2018
2. College Industrial and Environmental Chemistry, Himalaya Publication, 2015.
3. Patel H. N. et al, College Practical Chemistry, Himalaya Publication, 2019

Reference Books:

1. Sanyal S. N., Reactions, Rearrangements and Reagents, Bharati Bhawan Publishers & Distributors
2. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.
(Pearson Education).2012
3. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson
Education).
4. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural
Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
5. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
6. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University
Press.
7. Kalsi, P. S. Textbook of Organic Chemistry 1st Ed., New Age International (P) Ltd. Pub.
8. Barton and Ollis, Comprehensive Organic chemistry, , Vol 1
9. Carey F.A. and Sundberg R.J., Advanced Organic Chemistry, Part A and B, Plenum Press.
10. Kalsi P.S., Stereochemistry: Conformation and Mechamism, New Age International, New Delhi.
11. Eliel E.L, Wilen S.H and Manden L.N, Stereochemistry of carbon compounds, Wiley.
12. Nasipuri D., Stereochemistry of Organic Compounds- Principles and Applications, New International Publishers Ltd.
13. Smith Michael B., March Jerry, March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Wiley.
14. Sykes Peter,Mechanism in Organic Chemistry, 6th edition onwards.

15. Carruthers W. and Coldham Iain, Modern Methods of Organic Synthesis, Cambridge University Press.
16. Singh Jagdamba, Yadav L.D.S.,Organic Synthesis, PragatiPrakashan.
17. 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

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UNIVERSITY OF MUMBAI

Program: S.Y. B.Sc.

Course: CHEMISTRY

Semester-IV

Choice Based Credit System (CBCS) with effect from the Academic year

2018-2019

PROGRAMME SPECIFIC OUTCOMES (PSO'S)

On completion of the B.Sc Chemistry the learners should be enriched with knowledge and be able to-

PSO1: To have sound knowledge about the fundamentals and applications of various chemical and scientific theories.

PSO2: To introduce the different branches of chemistry like analytical, organic, inorganic, physical, environmental, polymer and biochemistry etc.

PSO3: To explain nomenclature, stereochemistry, structures, reactivity, chemical formulae, and mechanism of the chemical reactions.

PSO4: To apply appropriate techniques for the qualitative and quantitative analysis of chemicals in laboratories and in industries.

PSO5: To develop better understanding of good laboratory practices and safety.

PSO6: To develop research oriented skills, analytical skills and problem solving skills requiring application of chemical principles.

PSO7: To recognize causes of environmental pollution, environmental pollution act and the methods for environmental pollution control.

Preamble

The well-organized curriculum including basic as well as advanced concepts in chemistry from first year to third year shall inspire the students for pursuing higher studies in chemistry and for becoming an entrepreneur and also enable students to get employed in the Research Institutes, Industries, Educational Institutes and in the various concerning departments of State and Central Government based on subject chemistry.

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c) Details of Continuous Assessment (CA)

25% of the total marks per course:

Continuous Assessment	Details	Marks
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Component 2 (CA-2)	ASSIGENMENT	10 marks

d) Details of Semester End Examination

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		Total Marks	**75**

Signature Signature Signature

HOD Approved by Vice –Principal Approved by Principal

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Program: SY B.Sc. (2018-19)				**Semester: IV**	
Course: Physical Chemistry				**Course Code: USMACH401**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Lectures per week)	**Practical** (Lectures per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
3	3	NIL	2 + 1	25	75

Learning Objectives:

6. To orient learner about the different types of electrochemical cells, sign conventions, different types of electrodes, Nernst equation and its applications and various thermodynamic properties.
7. To orient learner about the fundamentals of solid state chemistry and nuclear chemistry.
8. To acquaint learner about the basic concept of catalysis and chemical kinetics
9. To teach learner about various laws and instrumentation in colorimetry

To orient learner about qualitative and quantitative analysis in colorimetry.

Course Outcomes:

After completion of the course, learners would be able to:

CO5: understand the different types of electrochemical cell, different sign convention, electrochemical series and Nernst equation and its importance.
CO6: fundamental of solid state chemistry and different of types of crystal and their properties.
CO7: understand the basic concept of nuclear chemistry, different processes involve in it and its applications.
CO8: understand the importance of catalysis and its different types.
CO9: understand different types of complex reactions and factors affecting the rate of reactions.
CO10: understand different types of laws and instrumentation in colorimetry
CO11: understand the qualitative and quantitative analysis in colorimetry.

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	1.1 Electrochemistry-II 1.2 Molecular Spectroscopy-I	15L
2	2.1 Solid State 2.2 Catalysis	15L
3	3 .1 Physical Properties of Liquids -II	15L
	Total	**45L**
PRACTICALS		

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Module	Description	No of Hours
1	**1.1Electrochemistry-II (7 L)** 1.1.1 Electrochemical Conventions, Reversible and irreversible cells. 1.1.2 Nernst equation and its importance, Types of electrodes, Standard electrode potential, Electrochemical series, Applications of electrochemical series. (Numericals expected). 1.1.3Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. (Numericals expected) 1.1.4Calculation of equilibrium constant from EMF data. (Numericals expected) **2 Molecular Spectroscopy-I (8 L)** 1.2.1 Nature of electromagnetic radiations, interaction of electromagnetic radiations with matter viz Absorption, Emission, Fluorescence and Scattering 1.2.2 Terms: Energy of light,Intensity of light, Polychromatic and Monochromatic light, Wavelength of maximum absorption 1.2.3 Theory- Statement and Derivation of Lambert's law and Beer's law, Statement of Beer-Lambert's law–Combined expression, Absorbance, Transmittance, Percentage transmittance, Molar extinction coefficient, Validity of Beer-Lamberts law, Deviations from Beer-Lamberts law. Applications: Quantitative Analysis by calibration curve method. (Numerical problems expected)	15L
2	2. 1 **Solid State (8L)** 2. 1.1 Recapitulation of laws of crystallography and types of crystals. 2.1.2 Characteristics of simple cubic, face centered cubic and body centered cubic systems, Inter-planar distance in cubic lattice (only expression for ratio of inter-planar distances are expected). 2.1.3 Use of X-rays in the study of crystal structure, Bragg's equation, X-rays diffraction method of studying crystal lattice structure, 2.1.4 Structure of NaCl and KCl. Determination of Avogadro's number. (Numerical Problems) 2. 2.**Catalysis (7L)** 2. 2.1 Types of catalysis, catalytic activity, specificity and selectivity, inhibitors, catalyst poisoning and deactivation 2. 2.2 Mechanisms and kinetics of acid-base catalyzed reactions, effect of pH, Mechanisms and kinetics of enzyme catalyzed reactions (Michaelis-Menten equation) 2. 2.3 Effect of particle size and efficiency of nanoparticles as catalyst.	15L
3	**Physical Properties in Liquids-II** 3.1 Surface Tension: Introduction, Principle, Methods of determination of surface tension -drop number method.(Numerical expected). Applications 3.2Viscosity: Introduction, Principle,Coefficient of viscosity, Relative viscosity, Method of determination by Ostwald viscometer (Numerical expected).Applications. 3.3 Potentiometry: Introduction, Principle, Instrumentation, Applications, Advantages and Limitations.	15L

	3.4 Colorimetry: Introduction, Principle, Instrumentation, Applications, Advantages and Limitations.	
	Total	**45L**
PRACTICALS		

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I
(If applicable)

1	Determine the Surface Tension of methyl acetate/ ethyl acetate/ chloroform.
2	Determine the Viscosity of methyl acetate/ ethyl acetate/ chloroform by Ostwald's Viscometer.
3	To determine standard emf, standard free energy change and equilibrium constant of galvanic cell.
4	To determine the amount of Cu^{2+}ingiven copper sulphatesolutionby using colorimeter.
5	Determination of $\lambda_{max}$and molar absorptivity (ε) of $KMnO_4$ photometrically.
6	To determine the amount of Fe(II) in the given solution by titration with a standard $K_2Cr_2O_7$ solution and hence to find the formal redox potential of Fe^{3+}/Fe^{2+}.

Suggested Readings

Reference Books:

1. Peter Atkins and Julio de Paula, Atkin's Physical Chemistry, 7th Edn., Oxford University Press, 2002.
2. K.J. Laidler and J.H. Meiser, Physical Chemistry, 2nd Ed., CBS Publishers and Distributors, New Delhi, 1999.
3. Robert J. Silby and Robert A. Alberty, Physical Chemistry, 3rd Edn., John Wiley and Sons (Asia) Pte. Ltd., 2002.
4. Ira R. Levine, Physical Chemistry, 5th Edn., Tata McGraw-Hill New Delhi, 2002.
5. G.W. Castellan, Physical Chemistry, 3rd Edn., Narosa Publishing House, New Delhi, 1983.
6. S. Glasstone, Text Book of Physical Chemistry, 2nd Edn., McMillan and Co. Ltd., London, 1962
7. S. Glasstone, Thermodynamics for Chemists, Affiliated East-West Press, New Delhi, 1964.
8. W.G. Davis, Introduction to Chemical Thermodynamics – A Non – Calculus Approach, Saunders, Philadelphia, 19772.
9. Peter A. Rock, Chemical Thermodynamics, University Science Books, Oxford University Press, 1983.

10. Thomas Engel and Philip Reid, Physical Chemistry, 3rd Edn., Pearson Education Limited 2013.
11. D.N. Bajpai, Advanced Physical Chemistry, S. Chand 1st Edn., 1992.
12. Bockris, John O'M., Reddy, Amulya K.N., Gamboa-Aldeco, Maria E., Modern Electrochemistry, 2A, Plenum Publishers, 1998.
13. Physical Chemistry by Gurtu and Gurtu
14. A Text book of Physical Chemistry by K L kapoor Vol 5 , 2nd Edn

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Program: SY B.Sc. (2018-19)				**Semester: IV**	
Course: Inorganic Chemistry				**Course Code: USMACH402**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Lectures per week)	**Practical** (Lecture per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
3	3	NIL	2 + 1	25	75

Learning Objectives:
To give insight of fundamental concepts and industrial applications of inorganic chemistry.

Course Outcomes:
After completion of the course, learners would be able to:

CO1: explain formation of bonds between two atoms with the theories of chemical bonding.
CO2: identify geometry and structures of co-ordination compounds with proper stereochemistry.
CO3: use gravimetric analysis effectively for quantitative analysis.
CO4: explain process involved in bulk manufacturing of sulfuric acid and ammonia, and factors affecting production of the same.
CO5: describe metallurgical processes for extraction of Silver, Aluminum and Copper.

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	Bonding in Co-ordination compounds	15L
2	Ions in aqueous medium and Bio-inorganic Chemistry	15L
3	Industrial Inorganic Chemistry	15L
	Total	**45L**
PRACTICALS		

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Module	Description	No of Hours
1	**Bonding in Co-ordination compounds** **1.1 Valence Bond Theory (5L)** 1.1.1 Application to 4, 5, 6- coordinate compounds 1.1.2 Electro-neutrality principle and backbonding. **1.2 Organometallic compounds (5L)** 1.2.1 Introduction, definition, classification based on hapticity and nature ofmetal-carbon bond 1.2.2 Eighteen electron rule and its applications, exceptions 1.2.3 Metal carbonyls: bonding, general methods of preparation and properties 1.2.4 Applications **1.3 Chemistry of group 15 and Group 16 elements (5L)** 1.1.1 General discussion of trends in their physical and chemical properties Physical properties of hydrides of group 15 and group 16 elements with respect to hydrogen bonding	15L
2	**Ions in aqueous medium and Bio-inorganic Chemistry** **2.1 Acidity of cations and basicity of anions (8L)** 2.1.1 Hydration of Cations; Hydrolysis of Cations predicting degree of hydrolysis of Cations-effect of Charge and Radious 2.1.2 Latimer Equation. Relationship between pKa, acidity and z^2/r ratios of metal ions graphical Presentation 2.1.3 Classification of cations on the basis of acidity category – Non acidic, Moderately acidic, strongly acidic, very strongly acidic with pKa values range and examples 2.1.4 Hydration of Anions; Effect of Charge and Radius; Hydration of anions- concept, diagram classification on the basis of basicity **2.2 Bio-inorganic Chemistry (7L)** 2.2.1 Metaloporphyrins 2.2.2 Chlorophyll 2.2.3 Cytochromes 2.2.4 Hemoglobin and myoglobin: oxygen transport and storage	15L
3	**Industrial Inorganic Chemistry** **3.1 Corrosion and methods of protection of metals (7L)** 3.1.1 Introduction 3.1.2 Types of corrosion 3.1.3 Electrochemical theory of corrosion 3.1.4 Methods of protection **3.2 Environmental Studies (8L)** 3.2.1 Multidisciplinary nature of environmental studies: Definition, scope and importance 3.2.2 Environmental pollution: Definition, causes, effects and control measures of water and soil pollution 3.2.3 Role of individual in prevention of pollution and pollution case with reference to water and soil pollution	15L

	3.2.4 Environment Protection Act Air Act, Water Act and Public awareness	
	Total	**45L**
PRACTICALS		

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I
(If applicable)

1	**Gravimetric Analysis of** 1. Zinc as $Zn_2P_2O_7$ 2. Nickel as Ni-DMG 3. Barium as $BaSO_4$
2	**Volumetric Analysis** 1. Hardness of water samples. 2. Redox titration (oxalate versus $KMnO_4$)

Suggested Readings

Reference Books:

1. B. R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 2013-2014.
2. W. W. Porterfield, Inorganic Chemistry-A Unified Approach, 2nd Ed., Academic Press, 1993.
3. B. W. Pfennig, Principles of Inorganic Chemistry, Wiley, 2015.
4. C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Pearson Education Limited, 2nd Edition 2005.
5. J. Huheey, F. A. Keiter and R. I. Keiter, Inorganic Chemistry–Principles of Structure and Reactivity, 4th Ed., Harper Collins, 1993.
6. P. J. Durrant and B. Durrant, Introduction to Advanced Inorganic Chemistry, Oxford University Press, 1967.
7. R. L. Dekock and H.B.Gray, Chemical Structure and Bonding, The Benjamin Cummings Publishing Company, 1989.
8. G. Miessler and D. Tarr, Inorganic Chemistry, 3rd Ed., Pearson Education, 2004.
9. R. Sarkar, General and Inorganic Chemistry, Books & Allied (P) Ltd., 2001.
10. C. M. Day and J. Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt. Ltd., 1985.
11. J. N. Murrell, S. F. A. Kettle and J. M. Tedder, The Chemical Bond, Wiley, 1978.
12. G. A. Jeffrey, An Introduction to Hydrogen Bonding, Oxford University Press, Inc., 1997.

13. D. Banerjea ,Coordination Chemistry
14. Geary Coordination reviews
15. P.W. Atkins, T. Overton, J. Rourke, M. Weller and F. Armstrong; Shriver & Atkins: Inorganic Chemistry, 4th ed. Oxford University Press, 2006.
16. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann; Advanced Inorganic Chemistry, 6th ed. Wiley, 1999,
17. B. Douglas, D. McDaniel and J. Alexander. Concepts and Models of Inorganic Chemistry(3rd edn.), John Wiley & Sons (1994).

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Program: SY B.Sc. (2018-19)				**Semester: IV**	
Course: Organic Chemistry				**Course Code: USMACH403**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Lectures per week)	**Practical (Lectures per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
3	3	NIL	2+1	25	75

Learning Objectives:

To provide broad foundation in organic chemistry by providing insights into the different topics such as electronic structure and bonding in carbonyl compounds as well asconcept of toxicology and related topics.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: have working knowledge of chemical principles appropriate to a chemistry degree program

CO2: understand topics such as the fundamentals of structure and bonding in carbonyl compounds, the reactivity of carbonyl compounds with nucleophiles, toxicology and related topics.

CO3: develop the basic practical skills for the synthesis and analysis of organic compounds and justify a reasonable mechanism for a chemical reaction.

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	1.1 Carboxylic acids, derivatives and Sulphonic acids	15L
2	2.1 Enolate Chemistry 2.2 Nitrogen containing compounds	15L
3	3.1 Sources of organic compounds 3.2 Environmental aspects of chemistry 3.3 Oils, fats and soaps	15L
	Total	**45L**
PRACTICALS		

Module	Description	No of Hours
1	**1.1 Carboxylic acids derivatives and sulphonic acids** 1.1.1 Carboxylic acids 1.1.1.1 Nomenclature, structure and physical properties, acidity of carboxylic acids, effects of substituent on acid strength of aliphatic and aromatic carboxylic acids 1.1.1.2 Preparation: Oxidation of alcohols and alkyl benzenes, carbonation of Grignard and hydrolysis of nitriles 1.1.1.3 Reactions: Acidity, salt formation, decarboxylation, reduction of carboxylic acids with LiAlH4. Diborane, Hell- Volhard – Zelinsky reaction. Conversion of carboxylic acids to acid chlorides, esters, amide and acid anhydrides and their relative reactivity. 1.1.1.4 Mechanism of nucleophilic acyl substitution and acid catalysed nucleophilic acyl substitution. Interconversion of acid derivatives by nucleophilic acyl substitution. 1.1.1.5 Mechanisms of following reactions with examples and stereochemistry wherever applicable : Claisen condensation, Dieckmann condensation 1.1.2 Sulphonic acids 1.1.2.1 Nomenclature 1.1.2.2 Preparation of aromatic sulphonic acids by sulphonation of benzene (with mechanism), toluene and naphthalene 1.1.2.3 Reactions: Acidity of arene sulphonic acid, Comparitive acidity of carboxylic acid and sulphonic acids, Salt formation, desulphonation, Reaction with alcohol, phosphorous pentachloride, IPSO substitution.	15L
2	**2.1 Enolate Chemistry (8L)** Mechanisms of following reactions with examples and stereochemistry wherever applicable: Halogenation reaction, Michael reaction, Aldol and Crossed Aldol reactions, Intramolecular aldol condensation reaction, Claisen Schmidt reaction, Mannich reaction, Robinson Annelation reaction, Knoevenagel reaction **2.2 Nitrogen containing compounds (7L)** 2.2.1 Amines 2.2.1.1 Nomenclature 2.2.1.2 Effect of substituents on basicity of aliphatic and aromatic amines 2.2.1.3 Preparation: Reduction of aromatic nitro compounds using catalytic hydrogenation, Chemical reduction using Fe – HCl, Sn – HCl, Zn – acetic acid, reduction of nitriles, ammonolysis of halides, reductive amination, Hofmann bromamide reaction 2.2.1.4 Reactions: Salt formation, N – acylation, N – alkylation, Hofmann's exhaustive methylation, Hofmann – elimination reaction, reaction with nitrous acid, carbylamines reaction, Electrophilic substitution in aromatic amines: bromination, nitration and sulphonation 2.2.2 Diazonium salts Preparation and their reactions / synthetic application – Sandmeyer reaction, Gattermann reaction, Gomberg reaction, Replacement of diazo group by – H, - OH. Azo coupling	15L

	with phenols, naphthols and aromatic amines, reduction of diazonium salt to aryl hydrazine and hydroazobenzene.	
3	**3.1 Sources of organic compounds (7L)** 3.1.1 Non-renewable : Coal, Petroleum (crude oil) and Natural gas. 3.1.2 Renewable: Biomass Coal: Structure and types of coal, Destructive distillation of coal, Coal tar refining, coal liquefaction (coal to liquid) coal gasification Synthesis gas (syn gas),Hydropyrolysis. Petroleum: Characteristics, composition and origin of petroleum, Refining of petroleum, Catalytic cracking and reforming, hydrocracking, thermal cracking, steam cracking. Natural gas: Composition ,Conversion of methane higher alkanes, synthetic diesel (gas to liquid), methanol, aromatic compounds, Natural gas hydrates : occurrence, structure. Synthesis gas (Syn gas : production of syngas fromcoal, natural gas, biomass, Composition, Synthetic uses of syn gas. Separation of hydrogen, Production of methanol, alkanes, hydroformylation of olefins, synthesis of aromatic hydrocarbons, Fischer Tropsch synthesis. Synthetic diesel (biomass to liquid) Biomass: Transforming biomass into chemicals(pyrolysis) and synthesis gas 3.1.3 Biofuels: Methanol, Ethanol, biodiesel, synthetic diesel. **3.2 Environmental Chemistry (4L)** 3.2.1 Concept and scope of environmental chemistry. Components of environment : Biotic and Abiotic 3.2.2 Composition of various segments of environment – Atmosphere, Hydrosphere, Lithosphere, Biosphere (With respect to composition and interrelationship) 3.2.3 Natural chemical processes: Carbon cycle, Nitrogen cycle, oxygen cycle 3.2.4 Untoward chemical events causing hazards to the environment : London smog, Mithi River (Mumbai), Chernobyl accident Concept of 4 'R's: Reduce – Recover – Reuse - Recycle **3.3 Oils, fats and soaps (4L)** 3.3.1 Oils : Composition of some common oils and fats (peanut oil, sesame oil, cottonseed oil, butter fat, animal fat. 3.3.2 Classification of oils 3.3.3 Properties of oils and fats 3.3.4 Extraction of oil from oilseeds – Hydraulic pressing, solvent extraction process 3.3.5 Extraction of animal fats 3.3.6 Hydrogenation of oil 3.3.7 Manufacture of soaps, settled or grained soap, Laundry and bath soap, glycerol recovery	15L
	Total	**45L**
PRACTICALS		

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I
(If applicable)

1	**Analysis of bi-functional organic compounds on the basis of** 1. Preliminary examination 2. Solubility profile 3. Detection of elements C, H, (O), N, S, X. 4. Detection of functional groups 5. Determination of physical constants (m.p./b.p.) Solid or liquid containing not more than two functional groups from among the following classes may be given for analysis to be given: Carboxylic acids, phenol, carbohydrates, aldehydes, ketones, ester, amides, nitro, anilides, amines, alkyl and aryl halides. **Students are expected to write balanced chemical reactions wherever necessary.** **(Minimum 10 compounds to be analyzed)**

Suggested Readings

Reference Books:

1. Comprehensive Organic chemistry, Barton and Ollis, Vol 1
2. Organic Chemistry, J. Clayden, N. Greeves, S. Warren and P. Wothers, Oxford University Press.
3. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Part A and B, Plenum Press.
4. Stereochemistry: Conformation and Mechamism, P.S. Kalsi, New Age International, New Delhi.
5. Stereochemistry of carbon compounds, E.L Eliel, S.H Wilen and L.N Manden, Wiley.
6. Stereochemistry of Organic Compounds- Principles and Applications, D. Nasipuri. New International Publishers Ltd.
7. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Michael B. Smith, Jerry March, Wiley.
8. Mechanism in Organic Chemistry, Peter sykes, 6th edition onwards.
9. Modern Methods of Organic Synthesis, W. Carruthers and Iain Coldham, Cambridge University Press.
10. Organic Synthesis, Jagdamba Singh, L.D.S. Yadav, Pragati Prakashan.