

 <p>SHIVAJI UNIVERSITY, KOLHAPUR Estd. 1962 "A***" Accredited by NAAC(2021) With CGPA 3.52</p>	<p>SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA PHONE : EPABX – 2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in शिवाजी विद्यापीठ, लिहापूर - ४१६००४, महाराष्ट्र दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दूरध्वनी विभाग २३१-२६०९०९३/९४</p>	
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SU/BOS/Science/ 45

Date: 19/ 10/ 2022

To,
The Principal,
All Affiliated Concerned Science Colleges/Institutions
Shivaji University, Kolhapur.

Subject :- Regarding syllabi of M. Sc. & B. Sc. Part- I (NEP-2020) degree programme under the Faculty of Science and Technology as per National Education Policy 2020.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi and Nature of question paper of M. Sc. & B. Sc. Part- I under the Faculty of Science and Technology as per National Education Policy 2020 .

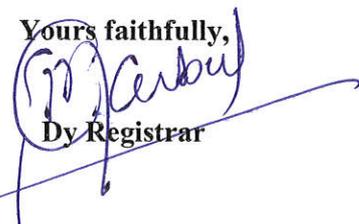
Sr. No.	Faculty of Science and Technology	Programme/ Course
1	Chemistry and Chemical Engineering	M.Sc. Part -I Chemistry, Applied, industrial, Organic, Inorganic, Physical and Analytical , Chemistry, B. Sc. Part -I Chemistry

This syllabi and nature of question paper shall be implemented from the Academic Year 2022-2023 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in (students Online Syllabus)

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,


Dy Registrar

Copy to:

1	The Dean, Faculty of Science & Technology	7	Appointment Section
2	Director, Board of Examinations and Evaluation	8	P.G.Seminar Section
3	The Chairman, Respective Board of Studies	9	Computer Centre (I.T.)
4	B.Sc. Exam	10	Affiliation Section (U.G.)
5	Eligibility Section	11	Affiliation Section (P.G.)
6	O.E. I Section	12	P.G.Admission Section

SHIVAJI UNIVERSITY, KOLHAPUR.



Accredited By NAAC with 'A++' Grade

Choice Based Credit System with Multiple Entry and Multiple Exit Option

(NEP-2020)

CHOICE BASED CREDIT SYSTEM

Syllabus for

B.Sc. Part – I

CHEMISTRY

Semester I & II

(Syllabus to be implemented from Academic Year 2022-23)

Choice Based Credit System with Multiple Entry and Multiple Exit Options

To be implemented from the Academic Year 2022-23

First Year Bachelor of Science (Level-5) Programme Structure (NEP-2020 PATTERN)

SEMESTER – I (Duration – 6 Months)															
Courses	Sr. No.	Course Code	TEACHING SCHEME						EXAMINATION SCHEME						
			THEORY			PRACTICAL			THEORY				PRACTICAL		
			Credits	No. of lectures	Hours	Credits	No. of lectures	Hours	Hours	Max	Total Marks	Min	Hours	Max	Min
CGPA COURSES	1	DSC-A	2	5	4	2	4	3.2	2	50	100	35	PRACTICAL EXAMINATION IS ANNUAL		
	2	DSC-A	2						2	50					
	3	DSC-A	2	4	2	4	3.2	2	50	100	35				
	4	DSC-A	2					2	50						
	5	DSC-A	2	4	2	4	3.2	2	50	100	35				
	6	DSC-A	2					2	50						
	7	DSC-A	2	5	4	2	4	3.2	2	50	100	35			
	8	DSC-A	2						2	50					
	9	AECC- A	2	4	3.2	-	-	-	2	50	50	18			
	TOTAL (A)			18			8	16			450				
Non CGPA	10	SEC-1	-	-	-	2	4	4							
	11	VBC-1				1	2	2							
SEMESTER – II (Duration – 6 Months)															
CGPA COURSES	1	DSC-B	2	5	4	2	4	3.2	2	50	100	35	As per BOS Guide-lines		
	2	DSC-B	2						2	50				50	18
	3	DSC-B	2	5	4	2	4	3.2	2	50	100	35			
	4	DSC-B	2						2	50				50	18
	5	DSC-B	2	5	4	2	4	3.2	2	50	100	35			
	6	DSC-B	2						2	50				50	18
	7	DSC-B	2	5	4	2	4	3.2	2	50	100	35			
	8	DSC-B	2						2	50				50	18
	9	AECC- B	2	4	3.2	--	--	--	2	50	50	18		200	18
	TOTAL (B)			18			8				450				
TOTAL (A+B)			36			16				900					
Non CGPA	10	SEC-2	-	-	-	2	4	4							
	11	VBC-2				1	2	2							

- Student contact hours per week : 32 Hrs (Minimum)
- Theory and Practical Lecture Duration: 48 min each
- Practical Examination will be conducted annually for 50 marks per course.
- AECC: Ability Enhancement Compulsory Course (A & B) : English for communication
- SEC: Skill Enhancement Course (Vocational Studies): Field Projects/ Internship/ Apprenticeship/ Community Engagement and Service. Any one from pool of courses. For SEC courses there shall be only practical examination of 50 marks. VBC: Value Based Course (NSS/NCC/Sports/Cultural, etc.)
- Except English, there shall be combined passing for two theory courses of 50 marks each. i.e. minimum 35 marks are required for passing out of 100. There shall be separate passing for theory and practical.

A] Ordinance and Regulations: (As applicable to Degree Course)

B] Shivaji University, Kolhapur

Revised Syllabus For **Bachelor of Science (B.Sc.)**

1. TITLE : Subject- Chemistry

Optional under the Faculty of Science and Technology

2. YEAR OF IMPLEMENTATION: -

Revised Syllabi implemented from August 2022 onwards.

3. PREAMBLE:-

[**Note :-**The Board of Studies should briefly mention foundation, core and applied components of the course / paper. The student should get into the prime objectives and expected level of study with required outcome in terms of basic and advance knowledge at examination level.]

4. GENERAL OBJECTIVES OF THE COURSE:

(as applicable to the Degree concerned)

Objectives:-

1. To impart knowledge of Science.
2. To develop scientific attitude, open Minded, critical, curious.
3. To develop skill in practical work, experiments and laboratory materials and equipments alongwith the collection and interpretation of scientific data to contribute the science.
4. To understand scientific terms, concepts, facts, phenomenon and their relationships.
5. To develop scientific ability to work in the field of research and other fields of their owninterest and to make them fit for society.
6. To develop ability for the application of the acquired knowledge to improve chemistry related fields to make the country self reliant and sufficient.

7. To create the interest of the society in the subject and scientific hobbies and other similar activities.

5. DURATION

The course shall be a full time course.

6. PATTERN:

Pattern of Examination will be Semester.

7. FEE STRUCTURE :-

As per Government /University rules.

1. Refer brochure and prospectus of concern affiliated college/institute to Shivaji University, Kolhapur.
2. Other fee will be applicable as per rules and norms of Shivaji University, Kolhapur.

8. ELIGIBILITY FOR ADMISSION:

As per guidelines obtained from Shivaji University, Kolhapur by following rules and regarding reservations by Govt. of Maharashtra.

9. MEDIUM OF INSTRUCTION:

The medium of instruction shall be in English.

10. STRUCTURE OF COURSE- B. Sc. I Chemistry

FIRST YEAR (SEMESTER I and II) (Total Number of papers - 04)

Sr. No.	Subjects/Papers	Theory	Internal	Total Marks
1.	Paper-I	50	-	50
2.	Paper-II	50	-	50
3.	Paper-III	50	-	50
4.	Paper-IV	50	-	50
	Practical			50
	Total			250

11. SCHEME OF TEACHING AND EXAMINATION:-

[The scheme of teaching and examination should be given as applicable to the course/paper concerned.]

FIRST YEAR - SEMESTER – I/ II : Chemistry (Optional)

Scheme of Teaching and Examination

Sr. No.	Subject/Paper	Teaching Scheme (Hrs/Week)				Examination Scheme (Marks)		
		L	T	P	Total	Theory	Term Work	Total
		Semester-I						
1	Paper-I	2.5	-	-	2.5	50		50
2	Paper-II	2.5	-	-	2.5	50		50
		Semester-II						
3	Paper-III	2.5	-	-	2.5	50		50
4	Paper-IV	2.5	-	-	2.5	50		50
	Practical- I (annual)	-	-	4	04	50	-	50
	Total	05	-	04	09	-	-	250

- ❖ Practical Examination will be conducted annually for 50 Marks.
- ❖ Except English, there shall be combined passing for two theory courses of 50 marks each.
 - i.e. Minimum 35 marks are required for passing out of 100.
- ❖ There shall be separate passing for theory and practical courses.
- ❖ CGPA Ability Enhancement Compulsory Course(AECC) for (A and B) is English
- ❖ SEC- Skill Enhancement Course (Vocational Studies –I):
Field Projects/ Internship/ Apprenticeships/ Community Engagement and Services, anyone Selected from Pool of Courses.
Total Marks for B.Sc.-I Chemistry (Excluding English) : 250
- ❖ Theory and practical lectures : 48 minutes each

Exit at Level 5:

Those who are interested to exit after Level 5 shall have to complete the SEC-I and SEC-II courses with allotted credits of Shivaji University Guidelines

U.G. structure for Science

SEM	DSC	DSE/OEC/ GEC/IDS	AECC Languages	Skill Enhancement courses(SEC) Multidisciplinary	Total
I	4 x (4+2)=24		4	SEC-1(1) VBC (1)	30
II	4 x (4+2)=24		4	SEC II (2)	30
III	3 x (4+4)=24			SEC III (2)	26
IV	3 x (4+4)=24		4(EVS)	SEC IV (2)	30
V		DSE[4x(2+2)= 16]	4	SEC V (2)	22
VI		DSE[4x(2+2)= 16]	4	SEC VI (2)	22
Total credits					160

Programme Structure for Bachelor of Science with Chemistry as a Major subject With Multiple Entry Multiple Exit Options

SEM	Discipline Specific Core Courses (DSC) (L+P) (Credits)	Discipline Specific Elective Courses (DSE) (L+P) (Credits)	Ability Enhancement Compulsory Courses (AECC) (L+P) (Credits)	Skill Enhancement Courses (SEC)		Total Credits
				Vocational Courses (L+P) (Credits) (Non	Value Based Courses (P)	
I	Chemistry- (Theory 4 + practical 2 = 6 credits). And any other three courses along with Chemistry / Physics / Botany / Zoology / Microbiology / Geology / Comp. Sc. / Biotech / Electronics / Geography / Industrial Microbiology / Maths / statistics (courses- 3 x credits- 6=18 credits) Total credits 24	--	AECC-1; (4 credits)- English for communication.	SEC-1: (1 –credit) Multidisciplinary (select From the Pool of Courses)	VBC (1 credit)	30
II	Chemistry- Theory credits 4 practical credits 2 Total credits for each subject= 6 credits). And any other three courses along with Chemistry / Physics / Botany / Zoology / Microbiology / Geology / Comp. Sc. / Biotech / Electronics / Geography / Industrial Microbiology / Maths / Statistics (courses- 3 x credits- 6=18 credits) Total credits 24	--	AECC- 2: (4 credits) Eng for communication	SEC-2: (2- credit) Multidisciplinary (select From the Pool of Courses)		30
Level 5 : Exit with Certificate Course in Science with the completion minimum credits as per the Shivaji University Guidelines.						

III	<p>Chemistry (Theory 4 + practical 4) = 8 credits</p> <p>Along with Chemistry select any two courses form Physics / Botany / Zoology / Microbiology / Geology / Comp. Sc./ Pollution / Biotech ./Electronics / Geography / Industrial Microbiology / Maths / Statistics / Astrophysics/ Plant Protection. (2 courses x 8 credits = 16 credits) Total credits 24</p>	--		SEC-3 (2 credits) Multidisciplinary(select from thePool of Courses)		26
IV	<p>Chemistry (Theory 4 + practical 4) = 8 credits</p> <p>Along with Chemistry select any two courses form Physics / Botany / Zoology / Microbiology / Geology / Comp. Sc. / Pollution / Biotech ./Electronics / Geography / Industrial Microbiology / Maths / statistics / Astrophysics/ Plant Protection. (2 courses x 8 credits = 16 credits) Total credits 24</p>	--	AECC-3 : (4 credits) Environmental Studies (Project)	SEC- 4 (2 credits) Multidisciplinary(select From thePool of Courses)		30
<p>Level 6 : Exit with Diploma in Science (with the completion of with the completion minimum credits as per the Shivaji University Guidelines.</p>						

V	--	Four DSE courses of Chemistry (Theory credits = 2 + practical credits = 2 Total credits for each course = 4 (4 courses x 4 credits each =16 credits) Total credits= 16	AECC-4 (4 credits) Professional Communication (Eng)	SEC- 5 (2 credits) Multidisciplinary(select From thePool of Courses)		22
VI	--	Four DSE courses of Chemistry (2+2) = 4 credits each (4 x 4 =16 credits) Total credits= 16	AECC-6 (4 credits) Professional Communication (Eng)	SEC- 6 Multidisciplinary (select From the Pool of Courses)		22
Total credits						160
Level 7 : Exit with three years Bachelor of Science (with the completion minimum credits as per the Shivaji University Guidelines.) or continue studies for Bachelor with (Honours/Research) four year Degree Programme.						
Note: 1. For first year Sem-I, students have to select any four DSC courses available at their respective colleges. Same four courses they have to continue for Sem-II.						
2. For second year Sem-III, students have to select any three out of four DSC courses of first year. Same three courses they have to continue For Sem-IV.						
3. For third year Sem –V, students have to select any one DSC course out of three DSC courses of second year. Same course they have to continue for Sem-VI.						
4. For semesters V & VI there shall be four DSE courses (papers) for each semester						
5. The DSC courses from C1 to C14 have two papers of 50 marks each with combined passing i.e. minimum 35 marks are required to pass out of 100 marks.						

6. Students can exit after Level 5 with Certificate Course in Science (with the completion of courses equal to minimum allotted credits as per shivaji university guidelines)
7. Students can exit after Level 6 with Diploma in Science (with the completion of courses equal to minimum credits allotted by the Shivaji University, Kolhapur
8. Students can exit after Level 7 with Bachelor of Science (with the completion of courses equal to minimum credits allotted by the Shivaji University, Kolhapur
9. SBC: Skill Based Courses (2 credits). Students have to select one for each semester from the pool of courses available at their respective colleges or the pool of courses from Shivaji university .
10. VBC: Value Based Courses , Students have to select one for each semester from the pool of courses available at their respective colleges

13. STANDARD OF PASSING:-

As Prescribed under rules & regulation for each degree.

14. NATURE OF QUESTION PAPER AND SCHEME OF MARKING:

(MODULE wise weightage of marks should also be mentioned)

Q. 1.A. Multiple choices questions	(5 Questions) ---	05 Marks
B. Answer in one sentence	(5 Questions) ---	05 Marks
Q.2. Attempt any two of the following.		
(Essay type/Broad answer questions) ----		20 Marks
Q.3. Write short notes (any four out of six) ---		20 Marks

15. SPECIAL INSTRUCTIONS, IF ANY. --- Nil

B. Sc. I Semester I

DSC-3A- Chemistry paper I (Inorganic Chemistry)

(Theory Credits:04 Hours:30 Lectures:-37.5 of 48 minutes each)

Unit I: Atomic Structure and Periodicity of Elements (09)

- 1.1 Bohr's theory of hydrogen atom and its limitations
- 1.2 Wave particle duality
- 1.3 Heisenberg uncertainty principle
- 1.4 Quantum numbers and their significance
- 1.5 Shapes of *s*, *p* and *d* atomic orbitals
- 1.6 Electrons filling rules in various orbitals: a) Aufbau's principle b) Hund's rule of maximum multiplicity c) Pauli's exclusion principle
- 1.7 Electronic configuration of elements. Stability of empty, half-filled and completely filled orbitals
- 1.8 Periodicity of the elements: General discussion of the following properties of the elements with reference to s block elements: a) electronic configuration b) atomic radii c) ionic radii d) ionization energy e) electron affinity f) electronegativity g) metallic characters h) reactivity i) oxidation state j) melting and boiling points k) chemical properties

Unit II: Chemical Bonding and Molecular structure (A) Ionic Bonding (07)

- 2:1 Definition and formation of ionic bond. General characteristics of ionic bonding
- 2:2 Energetic in Ionic bond formation
- 2:3 Born-Haber cycle for NaCl and its applications
- 2:4 Fajan's Rule, Applications of Fajan's rule for,
 - Polarizing power and polarizability
 - Ionic character in covalent compounds
 - Bond moment, dipole moment and percentage ionic character

Unit III: Chemical Bonding and Molecular structure (B) Valence bond theory (VBT). (07)

- 3.1 Concept of hybridization, different types of hybridization and geometry of following molecules,
 - Linear geometry- BeCl_2 (*sp* hybridization)

- Planer trigonal geometry- BF_3 (sp^2 hybridization)
- Tetrahedral geometry- SiCl_4 (sp^3 hybridization)
- Trigonal bipyramidal geometry- PCl_5 (sp^3d hybridization)
- Octahedral geometry- SF_6 (sp^3d^2 hybridization)
- Pentagonal bipyramidal geometry - IF_7 (sp^3d^3 hybridization)

Unit IV: Chemical Bonding and Molecular structure (C) Molecular orbital theory (MOT)

(07)

4.1 LCAO method, formation of bonding , anti bonding and nonbonding molecular orbitals.

4.2 Conditions for successful overlap, Types of overlaps - S-S ,S-px, Px-Px, Py-Py and Pz-Pz overlaps.

4.3 Bond order and its significance.

4.4 Energy level sequence for molecular orbital when $n=1$ & 2 .

4.5 MO diagrams for homonuclear diatomic molecule of 1st & 2nd period Elements (He_2 , Li_2 , B_2 , N_2 , O_2).

4.6 Molecular orbital diagrams for heteroatomic diatomic molecules. (CO , NO)

Reference Books:

- 1) Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
- 2) Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
- 3) Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
- 4) Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry:*
- 5) Principles of Structure and Reactivity, Pearson Education India, 2006.
- 6) Puri, Sharma, Kalia. *Principles of Inorganic Chemistry*
- 7) Madan R. L. Chemistry for Degree Students(B. Sc. First year), S. Chand Publications

B. Sc. I Semester I

DSC-4A- Chemistry paper II (Organic Chemistry)

(Theory Credits:04 Hours:30 Lectures:-37.5 of 48 minutes each)

Unit I: Fundamentals of Organic Chemistry (08)

Introduction, Curved arrow notations, Cleavage of Bonds: Homolysis and Heterolysis. Organic molecular species: Nucleophiles and electrophiles. Electronic Displacements: Inductive Effect Electromeric Effect, Resonance and Hyperconjugation effect, Reactive Intermediates: Generation, Structure, Stability and Reactions of Carbocations, Carbanions and carbon free radicals.

Unit II: Stereochemistry (09)

Introduction, Types of Stereoisomerism, Optical Isomerism: Concept of Chirality, Elements of Symmetry, Optical Isomerism in tartaric acid, 2, 3 Dihydroxybutanoic acid, Enantiomerism, Diastereomerism and Meso compounds, Geometrical isomerism in C=C, C=N and alicyclic compounds. Nomenclature of stereoisomers: D and L, erythro and threo, R and S, E and Z.

Unit III: Aromaticity

(07)

Introduction, Characteristics properties of organic compounds, Meaning of terms: Aromatic, Non aromatic, Antiaromatic, Pseudoaromatic, Structure of Benzene: Kekule structure, Resonance structure, M.O. picture, Modern theory of Aromaticity, Mechanism of Electrophilic substitution reactions: Nitration, Sulphonation, Halogenation and Friedelcraft reaction.

Unit IV: Cycloalkanes, cycloalkenes and alkadienes (06)

Cycloalkanes: - Introduction. Method of formation - a) By addition of carbene to alkene b) Action of metallic sodium on dihaloalkane c) Diels - Alder reaction d) By reduction of aromatic compounds, Chemical properties- a) Photohalogenation b) Catalytic halogenations c) Catalytic hydrogenation d) Effect of heat e) Reaction with hydrogen halide

Cycloalkenes : Introduction, Method of formation from cyclic compounds, Chemical Properties - a) Hydrogenation b) Addition of Halogens and halogen acids,

- c) Allylic halogenations Alkadienes : Introduction, Classification, Buta-1,3-diene - a) Structure b) Methods of formation - from cyclohexane, From Butane by dehydrogenation, From acetylene, From Butane-1,3 - diol, From ethanol and acetaldehyde (Industrial method), Chemical Properties - a) Reaction with hydrogen halide b) Reaction with halogens -With one molar equivalent of halogens (Cl₂ or Br₂) c) Diels- Alder reaction d) Reduction – hydrogenation
- e) Oxidation – Ozonolysis f) Polymerization

Reference Books:

- 1) Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
- 2) McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- 3) Sykes, P. A *Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
- 4) Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
- 5) Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
- 6) Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
- 7) Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
- 8) D.Nasipuri :Stereochemistry of Organic compounds
- 9) R. L. Madan, Chemistry for Degree Students (B. Sc. First Year), S. Chand.Publication

B. Sc. I Semester II

CHEMISTRY-DSC 3B: Chemistry Paper-III (Physical Chemistry)(Theory Credits:04 Hours:30 Lectures:-37.5 of 48 minutes each)

Unit -I Chemical Energetics (06)

A) Thermodynamics

Introduction, Basic concepts of thermodynamics, First law of thermodynamics Spontaneous and non-spontaneous process with examples, Statements of second law of thermodynamics, Carnot's cycle and its efficiency. Entropy, Physical Significance of entropy, Statement of Third Law of thermodynamics and calculation of absolute entropies of substances

B) Thermochemistry (04)

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 – Kirchoff's equation.

Unit II . Chemical Equilibrium: (06)

Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG° , Le Chatelier's principle. Relationships between K_p , K_c and K_x for reactions involving ideal gases.

Unit- III. Kinetic Theory of Gases (07)

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Ideal and Non ideal gases, Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. Van der Waals equation of state for real gases. Explanation of real gas behaviour by Van der Waal's equation, Boyle temperature (derivation not required). Critical Phenomena: PV-isotherms of real gases (Andrew's isotherms), Continuity of state, Critical constants and their calculation from vander Waals equation. Maxwell Boltzmann

distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Numerical Problems.

Unit- IV. Chemical Kinetics

(07)

Introduction, Rate of reaction, Definition and units of rate constant, Factors affecting rate of reaction. (Nature of reactant, Concentration, pressure, temperature and catalyst.) Order and Molecularity of reaction, Zero order reaction, First order reaction, Characteristics of first order reaction. examples, Pseudo-unimolecular reactions, examples. Second order reaction: Derivation of rate constant for equal and unequal concentration of the reactants. Characteristics of Second order reaction., Determination of order of reaction by i) integration method ii) graphical method
iii) Half life method, Effect of temperature on rate of reaction, Arrhenius equation, Concept of energy of activation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). Numerical problems.

Reference Books:

1. Principles of Physical Chemistry Puri, Sharma and Pathania, Vishal Publishing House, 44th Edition
2. Advanced Physical Chemistry Gurdeep Raj GOEL Publishing House, 36th Edition
3. Essentials of Physical Chemistry, Bahl, Tuli and Bahl
4. Text Book of Physical Chemistry, Soni and Dharmarha
5. Essentials of Nuclear Chemistry by H J Arnikar, New Age, 4th edition.
6. Mathematical preparation of Physical Chemistry : F. Daniel, McGraw Hill Book Company Ltd.
7. Elements of Physical Chemistry : S. Glasstone and D. Lewis (D. Van Nostrand Co. Inc)
8. Physical Chemistry : W. J. Moore (Orient Longman)
9. Principles of Physical Chemistry : Maron Prutton
10. University Chemistry : B. H. Mahan (Addison - Wesley Publ. Co.)
11. Chemistry for Degree students (B. Sc. First Year): R L Madan (S. Chand and Company)

B.Sc. I Semester II

DSC-4B-Chemistry Paper IV (Analytical Chemistry)(Theory Credits:04 Hours:30 Lectures:-37.5 of 48 minutes each)

- 1. Introduction to analytical Chemistry (06)**
 - 1.1 Introduction
 - 1.2 Importance of analysis
 - 1.3 Analytical processes (Qualitative and Quantitative)
 - 1.4 Methods of analysis (Only classification)
 - 1.5 Sampling of solids, liquids and gases
 - 1.6 Errors, types of errors (determinate and indeterminate), methods of expressing accuracy (Absolute and relative error)
 - 1.7 Significant figures, mean, median, standard deviation (Numerical problems expected)

- 2. Chromatography (06)**
 - 2.1 Introduction, Basic Principle of Chromatography, Basic terms, Classification of Chromatography
 - 2.2 Paper Chromatography- Principle, Methodology-types of papers and treatment, sample loading, choice of solvent, development-ascending, descending, circular, location of spots, determination of R_f value, Applications, advantages and disadvantages
 - 2.3 Thin layer chromatography; Principle, Solvent system, stationary phases, preparation of TLC plate, Detecting reagents, methodology-sample loading, development, detection of spot, R_f value, Applications, advantages and disadvantages
 - 2.4 Comparison of paper chromatography and TLC

- 3. Theory of titrimetric Analysis (06)**
 - 3.1 Introduction
 - 3.2 Acid-base indicators
 - 3.3 Theory of indicators w.r.t. Ostwald's ionization theory and quinoid theory
 - 3.4 Neutralization curves and choice of indicators for
 - a. Strong acid-strong base
 - b. Strong acid-weak base
 - c. Strong base-weak acid
 - 3.5 Complexometric titrations
 - a. Introduction
 - b. Types EDTA titrations
 - c. Metallochromic indicators-Eriochrome black- T
 - d. Indicator Action of Eriochrome black- T

4. Water Analysis

(06)

- 4.1 Physical analysis of water – pH, Conductance, Colour, odour, Turbidity and taste
- 4.2 Chemical Analysis – Total Dissolved solids , Hardness, Salinity, Alkalinity, Acidity, Sulphates, Nitrates, Dissolved Oxygen, Chemical Oxygen Demand, Biological Oxygen Demand

5. Analysis of Fertilizers

(06)

- 5.1 Introduction
- 5.2 Types of fertilizers
- 5.3 Necessity and requirements of good fertilizers
- 5.4 Sampling and sample preparation
- 5.5 Analysis of Nitrogen by Kjeldahl's method
- 5.6 Analysis of Phosphorus by phosphomolybdate method
- 5.7 Analysis of Potassium by sodium tetraphenyl borate method

References:

1. Textbook of quantitative Inorganic analysis-A.I. Vogel
2. Instrumental methods of Chemical analysis-H. Kaur
3. Instrumental methods of Chemical analysis-B.K. Sharma
4. Instrumental methods of Chemical analysis-Chatwal Anand
5. Fundamental of analytical Chemistry-Skoog and West
6. Basic Concepts of analytical Chemistry-S.M. Khopkar
7. Analytical Chemistry-Alka Gupta (Pragati Prakashan)
8. Indian Pharmacopoeia
9. Chromatography-H. Kaur
10. Chemistry for Degree students(B.Sc. First Year): R. L. Madan (S. Chand and Company)

B.Sc. I Semester I and II
Practical Course

(Credits 02: Lectures-04per week)

A) Inorganic Chemistry (Any Six)

1. To prepare standard 0.1 N KMnO_4 solution and to determine the strength of given oxalic acid solution.
2. To determine quantity of Fe(II) ions from the given solutions by titrating it with 0.1 N $\text{K}_2\text{Cr}_2\text{O}_7$ solution by using internal indicator
3. To estimate amount of Cu(II) ions by iodometric titration by using $\text{Na}_2\text{S}_2\text{O}_3$ solution.
4. To standardize supplied EDTA solution by titrating with 0.01 M ZnSO_4 solution and to estimate amount of calcium from given solution by using Erio-T as an indicator.
5. Quality control-To determines percentage purity of the given sample of soda ash Na_2CO_3 by titrimetric method.
6. Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method
7. Chromatography : Separation and identification of cations by Paper Chromatographic technique from the following mixtures :
 - a) $\text{Ni}^{2+} + \text{Cu}^{2+}$
 - b) $\text{Ni}^{2+} + \text{Co}^{2+}$

B) Organic Chemistry

1. **Estimations** (any two) :
 1. Estimation of aniline. (by bromination method)
 2. Estimation of acetamide.
 3. Estimation of Aspirin.
2. Organic Qualitative Analysis: Detection of physical constant, type, functional group, elements, and Confirmatory test.
 Identification of Organic Compounds (at least eight) (four containing at least one extra element- N, S, Cl, Br, I)
 - a) Acids: Oxalic acid, Benzoic acid, cinnamic acid
 - b) Phenols: Beta-Naphthol, Resorcinol
 - c) Base: Aniline, p-Nitroaniline

d) Neutral: Acetone, Acetanilide, Chloroform, m-Dinitrobenzene,
Thiourea, Bromobenzene

- Purification of organic compounds by crystallization (from water and alcohol) and distillation.

References:

- Vogel's Text Book of Quantitative Chemical Analysis. (Longmann) ELBS Edition.
- Vogel's Text Book of Qualitative Chemical Analysis. (Longmann) ELBS Edition.
- Hand book of Organic Qualitative Analysis : Clarke.
- Comprehensive Practical Organic Chemistry – Qualitative Analysis by V. K. Ahluwalia, Sunita Dhingra. University Press. Distributor – Orient Longman Ltd.
- Comprehensive Practical Organic Chemistry preparation and Quantitative Analysis V. K. Ahluwalia, Renu Aggarwal. University Press. Distributor – Orient Longman Ltd.
- A Laboratory Hand - Book of Organic Qualitative Analysis and Separation : V. S. Kulkarni. Dastane Ramchandra & Co. Pune

C) Physical Chemistry

Physical Chemistry (Any Six)

- Determination of equivalent weight of Mg by Eudiometer.
- Study of specific reaction rate of hydrolysis of methyl acetate in presence of HCl.
- Determination of heat of ionization of weak acid by using polythene bottle.
- Determination of heat capacity of calorimeter for different volumes.
- Determination of enthalpy of neutralization of hydrochloric acid with sodiumhydroxide.
- Determination of integral enthalpy of solution of salts (KNO₃, NH₄Cl).
- Determination of enthalpy of hydration of copper sulphate.
- Study of the solubility of benzoic acid in water and determination of ΔH .

References:

- Practical book of Physical Chemistry: Nadkarni, Kothari & Lawande.

- 2) Experimental Physical Chemistry: A. Findlay.
- 3) Systematic Experimental Physical Chemistry: S. W. Rajbhoj, Chondhekar.(Anjali Publication.)
- 4) Experiments in Physical Chemistry: R. C. Das and B. Behra. (Tata Mc Graw Hill)
- 5) Advanced Practical Physical Chemistry: J. B. Yadav (Goel Publishing House.)
- 6) Practical Physical Chemistry: B. D. Khosala. (R. Chand & Sons)
- 7) Experiments in Chemistry: D. V. Jahagirdar.
- 8) A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis: A.I. Vogel (Third Ed.) (ELBS)

Course Outcomes

- Understand the principles of various fields of chemistry (organic, inorganic, physical, analytical, and biochemistry)
- Develop as independent thinkers who are responsible for their own learning.
- Develop transferrable quantitative skills.
- Be able to work with others demonstrating leadership and collaborative skills.
- To provide knowledge on theory and applications of different Analytical Techniques used in Chemistry.
- Students will be able to develop a skill in the chromatography techniques.

(A) LABORATORY SAFETY EQUIPMENTS:

- i) Fire extinguishers at least two sets in each laboratory of 600 sq.ft. Area.
- ii) Leakage of gases be avoided.
- iii) First aid kit be made available.
- iv) Sugar / Glucose –500gm pack- a pinch of sugar and a cup of drinking water in hypoglycemic condition or in extreme weakness of student or a person concerned

B) GENERAL SAFETY RULES FOR LABORATORY WORK

- 1) List of equipments needed for Laboratory Safety:-
 1. Fire extinguisher
 2. First Aid Kit

3. Good ear thing and insulated wirings for electrical supply.
4. Emergency exit
5. Apron and goggles wherever necessary
6. Fuming Chambers
7. Masks flows and shoes while handling hazardous chemicals & gases (Goodvalves, manometers and regulators for gas supply)
8. Operational manuals for instruments (handling to be made as suggested.)
9. Leakage of gases to be avoided.
10. Cylinders or flow pipes to handle Acids.
11. No weighing for NaOH and hygroscopic substances.
12. Stabilized supply in the laboratory.
13. Inorganic heavy chemicals like acids must be kept in separate acid room
14. Solvents like ether, acetone must be stored in separate cold solvent room.
15. Storage of gas cylinder must be done in separate and safe gas room.

2) **There Is No Substitute for Safety**

1. Any injury no matter how small, it must be reported to teacher immediately.
2. a) In case any chemical enters your eyes go immediately to eye- wash facility and flush your eyes and face with large amount of water.
- b) For acid or phenol split, do not use water instead put some bicarbonate.
3. In case of fire, immediately switch of all gas connections in the laboratory and pour sand on the source of fire or cover it with asbestos or cement sheet.
4. While leaving laboratory, make sure that gas, water taps and electricity are switched off.
5. Remove your lab coat. Gloves and clean your hands before leaving laboratory.
6. Make your workplace clean before leaving the laboratory.
7. Keep your hands away from your face, while working in laboratory.
8. Each laboratory must have a first aid box.

3) **DO's**

1. Always wear lab coat, shoes in the laboratory. Every student must have their weight box, a napkin etc.

2. Maintain separate record book for each subject.
3. Keep your belongings at the place allotted for the same.
4. Maintain silence, order, cleanliness and discipline in the laboratory.
5. Work at the place allotted to you or specially used for certain operations.
6. Keep the working table clean.
7. Handle the laboratory equipments, glassware and chemical with great care.
8. Use only required quantities of material and apparatus of essential size.
9. Perform the test in their proper order.
10. Know the location of eye wash fountain and water shower.
11. Minimize your exposure to organic solvents.
12. The Metal like sodium should be kept under kerosene or liquid paraffin layer in a vessel with a cork stopper.
13. Sodium metal should be cut on dry filter paper. The cut off pieces of sodium should be immediately collected in a vessel containing kerosene or liquid paraffin.
14. Always pour acid into water when diluting and stir slightly.
15. All operations involving poisonous flammable gases and vapours should be carried out in the flame chamber (with exhaust facility)
16. Ladies should avoid wearing saree. If it is there, apron is essential.

4) **DON'T**

1. Don't work alone in the laboratory
2. Don't leave the glass wares unwashed.
3. Don't take apparatus, chemicals out of lab.
4. Don't leave any substance in a vessel or bottle without label.
5. Don't weigh the reagent directly on the balance pan.
6. Don't throw the cut off pieces of sodium metal in sink or water. Transfer it immediately in its container.
7. Don't take sodium metal with hands. Use forceps.
8. Don't panic and run in case of fire. Use the fire extinguishers or sand buckets.
9. Don't breathe the vapours of organic solvents.
10. Don't pour any unused reagent back in its stock bottle.
11. Don't eat or drink any food in laboratory.
12. Don't use inflammable solvents like benzene, ether, chloroform, acetone and alcohol around flame.
13. Don't distill to dryness.

14. Don't exchange stoppers of flasks and bottles containing different reagents.
15. Don't leave reagent bottle lying on the table.
16. Don't disturb the order of reagent bottles in which they are placed.
17. Don't bring reagent on your working table from the general shelf.
18. Don't throw burning matchstick into dustbin.
19. Don't leave the laboratory without permission.

PROGRAM SPECIFIC OUTCOMES (PSO) OF CHEMISTRY:

In life science plant science is one of the most important basic and applied subject. Plants synthesized their own food material and provides the food and oxygen to all living organism. Most of the basic requirements fulfilled by the plants. This course has been designed to give the fruitful knowledge and to develop the commercial soft skills in the various aspects of plant science.

PSO 1: To understands the basic ideas of subject in all the discipline like configuration, structure, reaction mechanism

PSO 2: 1. To promote understanding of basic facts and concepts in Chemistry while retaining the excitement of Chemistry

2. To make students capable of studying Chemistry in academic and Industrial courses and to expose the students to different processes used in Industries and their applications.

3. To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences.

4. To develop problem solving skills in students.

5. To developed ability and to acquire the knowledge of terms, facts, concepts, processes, techniques and principles of subjects.

6. To develop ability to apply the knowledge of contents of principles of chemistry.

7. To inquire of new knowledge of chemistry and developments therein.

8. To expose and to develop interest in the fields of chemistry

9. To develop proper aptitude towards the subjects

10. To develop the power of appreciations, the achievements in Chemistry and role in nature and society.

11. To develop skills required in chemistry such as the proper handling of apparatus and chemicals