

**NAGARJUNA GOVERNMENT COLLEGE, (AUTONOMOUS)**

**NALGONDA**

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***BOARD OF STUDIES - 2021-22***

**DEPARTMENT OF CHEMISTRY**

**NAGARJUNA GOVERNMENT COLLEGE, (AUTONOMOUS)**

**NALGONDA**

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***BOARD OF STUDIES - 2021-22***

**DEPARTMENT OF CHEMISTRY**



# NAGARJUNA GOVERNMENT COLLEGE (A):NALGONDA

Date: 19-08-2021

To,

Principal,  
Nagarjuna Government College(A),  
Nalgonda

Sir,

Sub: Autonomous status – Constitution of the Board of Studies Chemistry,  
Department – request for approval – Reg.

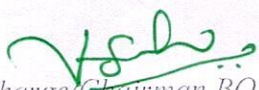
- Ref: 1. No.F.22-1/2007(AC) Dt.3 Apr 2007  
2. OU Lr. NoMR.69/H/2007/Acad, Dt:12-06-07.  
3. GORt. No.467 HE. (CE-1) Dept. Dt.29.6.2007.  
4. MGU Lr.18/MGU/NLG/2020-21 Dated 27-07-2021

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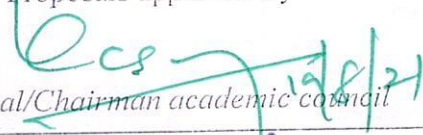
With reference to the subject cited, I am here with submitting the list of committee members for constitution of Board of Studies in Chemistry for the academic year 2021-22 for your approval.

Sl.No.	CATEGORY	NAME & DESIGNATION	CONTACT No
1	Chairman, Board of studies	Sri.V. Srinivasulu	9440838371
2	University Nominee	Dr. Annapoorna R.S. Butti. M.Sc. Ph.D Associate Professor, <i>UCSI</i> , Mahatma Gandhi University, Nalgonda.	8498055022
3	Subject expert from outside the college	L. Kamala , M.Sc. Assistant Professor Government Degree College (women's) Nalgonda.	9848766492
4	Subject expert from outside the college	Dr. A .Dayanand Assistant Professor Government City College, Hyderabad	9492302186
5	Members: All The Faculty members of the Dept.	Smt.K. Manjula Sri. K. Nagireddy Sri. Y. Yadagiri Rao Sri. Chinthha Muthaiah Sri K. Naresh Sri. R. Chandrashekar Dr. P. Balaswamy Dr. B. Bixamaiah	7981051491 9052454283 9959422591 9985046563 9704295903 9951020987 9704346175 9440522563

Submitted by

  
In-Charge/Chairman BOS

Proposals approved by

  
Principal/Chairman academic council

Principal  
Nagarjuna Govt. College  
(Autonomous) NALGONDA.



# NAGARJUNA GOVT. COLLEGE(A), NALGONDA

## DEPARTMENT OF CHEMISTRY

### CONSTITUTED COMMITTEE OF BOARD OF STUDIES: 2021-22

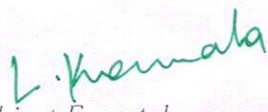
Sl.No.	Designation	Name	Mobile No.
1	Chairman, Board of studies	Sri. V.Srinivasulu Assistant Professor Nagarjuna Government College, Nalgonda.	9440838371
2	University Nominee	Dr. Annapoorna R.S.Butti M.Sc,Ph.D Associate Professor,UCSI. Mahatma Gandhi University, Nalgonda.	8498055022
3	Subject expert from outside the college	Smt.L.Kamala ,M.Sc. Assistant Professor Government Degree College(women's)	9848766492
4	Subject expert from outside the college	Dr.A .Dayanand, M.Sc.,Ph.D Assistant Professor Government City College, Hyderabad	9492302186
5	Members: All the Faculty members of theDept.	Smt.K. Manjula	7981051491
		Sri. K. Nagireddy	9052454283
		Sri. Y. Yadagiri Rao	9959422591
		Sri. Chintha Muthaiah	9985046563
		Sri. K. Naresh	9704295903
		Sri. R. Chandrashekar	9951020987
		Dr. P. Balaswamy	9704346175
Dr. B. Bixamaiah	9440522563		

  
In-Charge/Chairman BOS

  
Principal/Chairman academic council

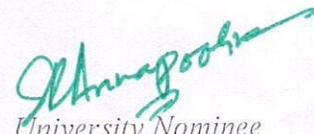
**Principal**

**Nagarjuna Govt. College  
(Autonomous) NALGONDA,**

  
Subject Expert-1

  
Subject Expert-2

**Dr. A. DAYANAND**  
Asst. Prof. of Chemistry  
Govt. City College  
Nayapul, Hyderabad - 500 002

  
University Nominee  
**Dr. ANNAPOORNA R.S. BUTTI**  
Associate Professor, Dept. of Chemistry  
MAHATMA GANDHI UNIVERSITY  
NALGONDA-508254, A.P. INDIA



**NAGARJUNA GOVERNMENT COLLEGE, NALGONDA**  
**(AUTONOMOUS)**

Re. No: 01 / BOS/chem/acad/2021-22

Date: 19-08-2021

To,  
Dr. Annapurna Butti. R.S, M.Sc, Ph.D  
Associate Professor,  
Mahatma Gandhi University, Nalgonda.  
Madam,

Sub: - Nagarjuna Govt. college, Nalgonda (Autonomous)-convening the meeting of Board of studies - Chemistry on 30-08-2021- Intimation-Request-Reg.


Ref: - Lr.No.18/MGU/NLG/2020-21      dated:27-07-2021

-o0o-

I am happy to inform you that you have been nominated as University Nominee of Board of studies, Department of Chemistry of this college for the year 2021-22. The meeting of the Board of studies, Chemistry will be held on 30-08-2021 in the Department of Chemistry at 10.00 am to consider the BOS-2021-22 Agenda.

Hence, you are requested to make it convenient to attend the meeting and extend your cooperation.

  
In-Charge/Chairman BOS  
Department of Chemistry

  
Principal  
Nagarjuna Govt. College  
(Autonomous) NALGONDA.



# NAGARJUNA GOVERNMENT COLLEGE, NALGONDA

(AUTONOMOUS)

Rc. No: 02 / BOS/chem/acad/2021-22

Date: 19-08-2021

To

Smt.L.Kamala

Assistant Professor of Chemistry,

GDC(W), Nalgonda-

Madam,

Sub:- Nagarjuna Govt. college, Nalgonda (Autonomous)-convening the meeting of Board of studies - Chemistry on 30-08-2021-Intimation-Request-Reg.

-o0o-


I am happy to inform you that you have been nominated as a Subject expert for Board of studies, Department of Chemistry of this college for the year 2021-22 by the proceedings of the Principal, Nagarjuna College(A), Nalgonda.

The meeting of the Board of studies, Chemistry will be held on 30-08-2021 in the Department of Chemistry at 10.00 am to consider the BOS-2021-22 Agenda.

Hence, you are requested to make it convenient to attend the meeting and extend your cooperation.

  
In-Charge/Chairman BOS

Department of Chemistry

  
Principal  
Principal  
Nagarjuna Govt. College  
(Autonomous) NALGONDA.



**NAGARJUNA GOVERNMENT COLLEGE, NALGONDA**  
**(AUTONOMOUS)**

Re. No: 03/ BOS/chem/acad/2021-22

Date: 19-08-2021

To

Dr.A. Dayanand, M.Sc,Ph.D

Assistant Professor

Government City College, Hyderabad

Sir,

Sub:- Nagarjuna Govt. college, Nalgonda (Autonomous)-convening the meeting of Board of studies - Chemistry on 30-08-2021- Intimation-Request-Reg.

-o0o-

I am happy to inform you that you have been nominated as a Subject expert for Board of studies, Department of Chemistry of this college for the year 2021-22 by the proceedings of the Principal, Nagarjuna College(A), Nalgonda.

The meeting of the Board of studies, Chemistry will be held on 30-08-2021 in the Department of Chemistry at 10.00 am to consider the BOS-2021-22 Agenda.

Hence, you are requested to make it convenient to attend the meeting and extend your cooperation.



*In-Charge/Chairman BOS*

*Department of Chemistry*



*Principal*



# NAGARJUNA GOVT.COLLEGE, NALGONDA (AUTONOMOUS)

## DEPARTMENT OF CHEMISTRY BOARD OF STUDIES MEETING

The members of Board of studies in Chemistry Department, N.G. College, Nalgonda met under the chairmanship of Sri V. Srinivasulu, Assistant Professor, on 30-08-2021 proposed following issues as agenda for discussion.

### AGENDA

1. To consider and approve the syllabus for B.Sc.- I, II, III years (I, II, III, IV, V&VI semesters) for the academic year 2021-22.
2. To consider and approve the choice-based credit system (CBCS) and Cumulative grade Point average (CGPA) system for I, II and III-year (all semesters) Students for the Academic year 2021-22.
3. To consider and approve the Generic Elective course "**Chemistry of Cosmetics, food processing, drugs and pharmaceuticals**" for the V Semester Students for the Academic year 2021-22
4. To Consider and approve the continuation of Internal Assessment for the Students admitted in to I, II & III-year UG course during 2021-2
5. To consider and approve the new syllabus for the CBCS and cumulative grade Point average (CGPA) System for the I, II- and III-Year Students as per new common core syllabus. As per the guidelines of TSCHE Project /Advanced Course in Chemistry is proposed to introduce from the academic year 2021-22 for VI semester with 4 credits
6. To consider and approve to conduct semester wise practical examinations for I, II- & III-year students for the Year 2021-22
7. To consider and approve the list of examiners for paper setting and evaluation for B.Sc. - I,II & III years (I,II,III,IV,V & VI semesters ) for the academic year 2021-22.
8. To consider and approve the model question papers for B.Sc. I, II and III Years for the academic year 2021-22.
9. To consider and approve the Syllabus and Model question paper of Skill Enhancement Compulsory Course (SEC)
  - i. **Safety Rules in Chemistry Laboratory and Lab Reagents**
  - ii. **Remedial methods for pollution, drinking water and Soil fertility**for III semester, and
  - iii. **Materials and their Applications**
  - iv. **Chemistry of Cosmetics and Food Processing**for IV semester students in Chemistry for the academic year 2021-22.
10. Any other related academic matter.



Members:

Name of members	Signature
Smt.K. Manjula	
Sri. K. Nagireddy	
Sri. Y. Yadagiri Rao	
Sri. Chintha Muthaiah	
Sri. K. Naresh	
Sri. R. Chandrashekar	
Dr. P. Balaswamy	
Dr. B. Bixamaiah	

Subject Expert-1

University Nominee  
**Dr. ANNAPOORNA R.S. BUTTI**  
Associate Professor, Dept. of Chemistry  
MAHATMA GANDHI UNIVERSITY  
NALGONDA-508254. A.P. INDIA.

Subject Expert-2  
**Dr. A. DAYANAND**  
Asst. Prof. of Chemistry  
Govt. City College  
Nayapul, Hyderabad - 500 002  
  
Chairman BOS.

### Resolutions

1. Discussed and approved the syllabus into 4 units for each paper.
2. CBCS and CGPA system approved for UG courses.
3. 'Chemistry of Cosmetics, food processing, drugs and pharmaceuticals' is as General elective in semester-V is approved.
4. Discussed and approved to conduct two Internal Assessments for 20 marks, one student seminar for 5 marks and to give one assignment for 5 marks (total 30 marks) in each semester for I, II & III year students as per the previous year.
5. Discussed and approved the new syllabus for V & VI semesters, As per the guidelines of TSCHE 'Project in Chemistry/Advanced Chemistry' is approved to introduce from this academic year 2021-22 for VI semester with 4 credits
6. Discussed and approved the Semester wise practical examinations for all UG courses in Chemistry.
7. List of the examiners is approved.
8. Model question papers are approved.
9. Syllabus and Model question paper of Skill Enhancement Compulsory Course (SEC) for III & IV semesters of II Year students in Chemistry for the academic year 2021-22 are approved.
10. Internal examinations are to be conducted for 30 marks and semester end exams are to be conducted for 70 marks approved.
11. Continuous Internal Assessment methods adopted to evaluate the progression of the Student.
12. Discussed and approved to design question paper pattern in the following lines for I, II- and III-year students.



### Question Paper Design-THEORY

#### Section -A

5 X 2=10 Marks

To give five very short questions and ask them to answer all questions (at least One Question from each unit)

#### Section-B

4 X 5=20 Marks

To give Six Short questions and ask them to answer any four questions(at least One Question from each unit)

#### Section-C

4 X 10 = 40 Marks

To give 4 Long Questions with internal choice and ask them to answer all question (One Question from each unit)

### Question Paper Design- PRACTICAL

- |                      |          |
|----------------------|----------|
| 1. Principle Writing | 10 Marks |
| 2. Experiment-       | 30 Marks |
| 3. Viva              | 5 Marks  |
| 4. Record-           | 5 Marks  |

Members:

Name of members	Signature
Smt.K. Manjula	
Sri. K. Nagireddy	
Sri. Y. Yadagiri Rao	
Sri. Chintha Muthaiah	
Sri. K. Naresh	
Sri. R. Chandrashekar	
Dr. P. Balaswamy	
Dr. B. Bixamaiah	

Subject Expert-1

Subject Expert-2  
**Dr. A. DAYANAND**  
 Asst. Prof. of Chemistry  
 Govt. City College  
 Nayapul, Hyderabad - 500 002

University Nominee  
 Associate Professor, Dept. of Chemistry  
**Dr. ANNAPOORNA R.S. BUTTI**  
 MAHATMA GANDHI UNIVERSITY  
 NALGONDA-508254. A.P. INDIA.  
 Chairman BOS



**NAGARJUNA GOVERNMENT COLLEGE(A), NALGONDA**  
**PROPOSED SCHEME FOR CHOICE BASE CREDIT SYSTEM**  
**IN B.SC CHEMISTRY 2021-22**

**FIRST YEAR- SEMESTER I**

CODE	COURSE TITLE	COURSE TYPE	HPW	CREDITS
BS 101	Ability Enhancement Compulsory Course AECC-1	ES	2	2
BS 102	English	CC-1A	4	4
BS 103	Second language	CC-2A	4	4
BS 104	Optional I	DSC-1A	4T+3P=7	4+1=5
BS 105	Optional II	DSC-2A	4T+3P=7	4+1=5
BS 106	Optional III- Chemistry - I	DSC-3A	4T	4
	Laboratory Course - I (Qualitative Analysis - Semi Micro Analysis of Mixtures)		3P	1
	Total Credits		31	25

**FIRST YEAR- SEMSTER II**

BS 201	Ability Enhancement Compulsory Course AECC-2	BCS	2	2
BS 202	English	CC-1B	4	4
BS 203	Second language	CC-2B	4	4
BS 204	Optional I	DSC-1B	4T+3P=7	4+1=5
BS 205	Optional II	DSC-2B	4T+3P=7	4+1=5
BS 206	Optional III- Chemistry - II	DSC-3B	4T	4
	Laboratory Course - II (Quantitative Analysis - Titrations)		3P	1
	Total Credits		31	25

**SECOND YEAR- SEMSTER III**

BS 301	Safety Rules in Chemistry Laboratory and Lab Reagents Remedial methods for pollution, drinking water and Soil fertility	SEC-1	2	2
		SEC-2	2	2
BS 302	English	CC-1C	3	3
BS 303	Second language	CC-2C	3	3
BS 304	Optional I	DSC-1C	4T+3P=7	4+1=5
BS 305	Optional II	DSC-2C	4T+3P=7	4+1=5
BS 306	Optional III- Chemistry - III	DSC-3C	4T	4
	Laboratory Course - III (Synthesis of Organic compounds)		3P	1
	Total Credits		31	25

**SECOND YEAR- SEMSTER IV**

BS 401	Materials and their Applications Chemistry of Cosmetics and Food Processing	SEC-3	2	2
		SEC-4	2	2
BS 402	English	CC-1D	3	3
BS 403	Second language	CC-2D	3	3
BS 404	Optional I	DSC-1D	4T+3P=7	4+1=5
BS 405	Optional II	DSC-2D	4T+3P=7	4+1=5
BS 406	Optional III- Chemistry - IV	DSC-3D	4T	4
	Laboratory Course - IV (Qualitative Analysis of Organic Compounds)		3P	1
	Total Credits		31	25



### THIRD YEAR- SEMSTER V

BS 501	Chemistry of Cosmetics, food processing, drugs and pharmaceuticals	GE	4	4
BS 502	English	CC-1E	3	3
BS 503	Second language	CC-2E	3	3
BS 504	Optional I A/B	DSC-1E	4T+3P=7	4+1=5
BS 505	Optional II A/B	DSC-2E	4T+3P=7	4+1=5
BS 506	Optional III- A/B	DSC-3E	4T	4
	A. Spectroscopy and Chromatography		= 7	=5
	B. Green chemistry		3P	1
	Laboratory Course - III (Synthesis and quantitative analysis of Organic compounds,)			
	Total Credits		31	25

### THIRD YEAR-SEMSTER-VI

BS 601	Advanced Chemistry		4T	4
BS 602	English	CC-1F	3	3
BS 603	Second language	CC-2F	3	3
BS 604	Optional I	DSC-1F	4T+3P=7	4+1=5
BS 605	Optional II	DSC-2F	4T+3P=7	4+1=5
BS 606	Optional III- A/B	DSC-3F	4T	4
	A. Medicinal chemistry		= 7	= 5
	B. Agricultural and Fuel Chemistry		3P	1
	Laboratory Course - IV (Qualitative Analysis of Organic Compounds)			
	Total Credits		31	25

\* AECC: Ability Enhancement Compulsory Course, SEC: Skill Enhancement Course, DSC: Discipline Specific Course.

GE: Generic Elective, ES: Environmental Science, BCS: Basic computer skills.

*L. Hanamata*  
Subject Expert-1

*Dr. A. Dayanand*  
Subject Expert-2

**Dr. A. DAYANAND**  
Asst. Prof. of Chemistry  
Govt. City College  
Nayapul, Hyderabad - 500 002

**Dr. ANNAPOORNA R.S. BUTTI**  
Associate Professor, Dept. of Chemist.  
MAHATMA GANDHI UNIVERSITY  
NALGONDA-508254, A.P. INDIA.

*Chairman BCS*

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**B.Sc. I Yr CHEMISTRY**  
**SEMESTER WISE SYLLABUS**

**SEMESTER I**

**Paper – I Chemistry - I**

**Unit-I (Inorganic Chemistry) 15 h (1 hr/week)**

**S1- I-1. Chemical Bonding 8 h**

Ionic solids- lattice and solvation energy, solubility of ionic solids, Fajan's rule, polarity and polarizability of ions. VSPER Theory - Common hybridization- $sp$ ,  $sp^2$ ,  $sp^3$ ,  $sp^3d$ ,  $sp^3d^2$  and  $sp^3d^3$ , shapes of molecules. Molecular orbital theory: Shapes and sign convention of atomic orbitals. Modes of bonds. Criteria for orbital overlap. LCAO concept.  $\pi$  and  $\sigma$  overlapping. Concept of Types of molecular orbitals- bonding, antibonding and non-bonding. MOED of homonuclear diatomics -  $H_2$ ,  $N_2$ ,  $O_2^-$ ,  $O_2^{2-}$ ,  $F_2$  (unhybridized diagrams only) and heteronuclear diatomics  $CO$ ,  $CN^-$ ,  $NO$ ,  $NO^+$  and  $HF$ . Bond order, stability and magnetic properties.

**S1-I-2. P-Block Elements 1 7 h**

Group-13: Structure of diborane and higher Boranes ( $B_4H_{10}$  and  $B_5H_9$ ), Boron nitrogen compounds ( $B_3N_3H_6$  and  $BN$ ), Lewis acid nature of  $BX_3$ . Group - 14: Carbides-Classification - ionic, covalent, interstitial - Structures and reactivity. Industrial applications. Silicones - Classification - straight chain, cyclic and cross-linked. Group - 15: Nitrides - Classification - ionic, covalent and interstitial. Reactivity - hydrolysis. Reactions of hydrazine, hydroxyl amine, phosphazenes.

Unit - II (Organic Chemistry) 15h(1 hr/week)

**S1-O-1: Structural Theory in Organic Chemistry 5 h**

Bond polarization: Factors influencing the polarization of covalent bonds, electro negativity - inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance - Mesomeric effect, application to (a) acidity of phenol. (b) acidity of carboxylic acids and basicity of anilines. Stability of carbo cations, carbanions and free radicals. Hyper conjugation and its application to stability of carbonium ions, free radicals and alkenes.

**S1-O-2: Acyclic Hydrocarbons 6 h**

Alkanes- Methods of preparation: From Grignard reagent, Kolbe synthesis. Chemical reactivity - inert nature, free radical substitution, Halogenation example- reactivity, selectivity and orientation. Alkenes - Preparation of alkenes (with mechanism) (a) by dehydration of alcohols



dehydrohalogenation of alkyl halides (c) by dehalogenation of 1,2 dihalides, Zaitsev's rule. Properties: Anti-addition of halogen and its mechanism. Addition of HX, Markonikov's rule, addition of H<sub>2</sub>O, HOX, H<sub>2</sub>SO<sub>4</sub> with mechanism and addition of HBr in the presence of peroxide (anti - Markonikov's addition). Oxidation (cis - additions) - hydroxylation by KMnO<sub>4</sub>, OsO<sub>4</sub>, anti addition- peracids (via epoxidation), hydroboration, ozonolysis - location of double bond. Dienes - Types of dienes, reactions of conjugated dienes - 1,2 and 1,4 addition of HBr to 1,3 - butadiene and Diels - Alder reaction.

Alkynes- Preparation by dehydrohalogenation of vicinal dihalides, dehalogenation of tetrahalides. Physical Properties: Chemical reactivity - electrophilic addition of X<sub>2</sub>, HX, H<sub>2</sub>O (tautomerism), Oxidation (formation of enediol, 1,2 diones and carboxylic acids) and reduction (Metal-ammonia reduction, catalytic hydrogenation).

### **S1-O-3: Aromatic Hydrocarbons**

4h

Introduction to aromaticity: Huckel's rule - Benzene, Naphthalene and Anthracene. Reactions - General mechanism of electrophilic substitution, mechanism of nitration, sulphonation and halogenation, Friedel Craft's alkylation and acylation. Orientation of aromatic substitution - Definition of ortho, para, and meta directing groups. Ring activating and deactivating groups with examples. Orientation - (i) activating groups: Amino, methoxy and alkyl groups. (ii) Deactivating groups - nitro, nitrile, carbonyl, carboxylic acid, sulphonic acid and halo groups.

### **Unit - III (Physical Chemistry)**

15h (1 hr/week)

#### **S1-P-1: Atomic structure and elementary quantum mechanics**

3 h

Black body radiation, heat capacities of solids, Rayleigh Jeans law, Planck's radiation law, photoelectric effect, Limitations of classical mechanics, Compton effect, de Broglie's hypothesis. Heisenberg's uncertainty principle.

#### **S1-P-2: Gaseous State**

5 h

Deviation of real gases from ideal behavior. van der Waals equation of state. Critical phenomenon. PV isotherms of real gases, continuity of state. Andrew's isotherms of CO<sub>2</sub>. The van der Waal's equation and critical state. Derivation of relationship between critical constants and van der Waal's constants. The law of corresponding states, reduced equation of states. Joule Thomson effect and inversion temperature of a gas. Liquefaction of gases: i) Linde's method based on Joule Thomson effect ii) Claude's method based on adiabatic expansion of a gas.

### S1-P-3: Liquid State and Solutions

4 h

#### Liquid State

Intermolecular forces, structure of liquids (qualitative description). Structural differences between solids, liquids and gases. Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

#### Solutions

3 h

Liquid - liquid mixtures, ideal liquid mixtures, Raoult's and Henry's laws. Non ideal systems. Azeotropes: HCl-H<sub>2</sub>O and C<sub>2</sub>H<sub>5</sub>OH - H<sub>2</sub>O systems. Fractional distillation. Partially miscible liquids: Phenol - Water, Trimethyl amine - Water and Nicotine - Water systems.

#### Unit - IV (General Chemistry)

15h(1 hr/week)

#### S1-G-1. General Principles of Inorganic Qualitative Analysis

6 h

Anion analysis: Theory of sodium carbonate extract, classification and reactions of anions-  $CO_3^{2-}$ ,  $Cl^-$ ,  $Br^-$ ,  $SO_4^{2-}$ ,  $PO_4^{3-}$ ,  $BO_3^{3-}$ ,  $CH_3COO^-$ ,  $NO_3^-$ . Interfering ions. Cation Analysis: Principles<sup>3</sup> involved - Solubility product, common ion effect, general discussion for the separation and identification of group I individual cations ( $Hg^{2+}$ ,  $Ag^+$ ,  $Pb^{2+}$ ) with flow chart and chemical equations. Principle involved in separation of group II & IV cations. General discussion for the separation and identification of group II ( $Hg^{2+}$ ,  $Pb^{2+}$ ,  $Bi^{3+}$ ,  $Cd^{2+}$ ,  $Sb^{3+}$ ), III ( $Al^{3+}$ ,  $Fe^{3+}$ ), IV ( $Mn^{2+}$ ,  $Zn^{2+}$ ) individual cations with flow chart and chemical equations. General discussion for the separation and identification of group V individual cations ( $Ba^{2+}$ ,  $Sr^{2+}$ ,  $Ca^{2+}$ ) with flow chart and chemical equations. Theory of flame test. Identification of Group VI cations ( $Mg^{2+}$ ,  $NH_4^+$ ).

#### S1-G-2. Isomerism

5 h

Isomerism: Definition of isomers. Classification of isomers: Constitutional and Stereoisomers - definition and examples. Constitutional isomers: chain, functional and positional isomers. Stereoisomers: enantiomers and diastereomers - definitions and examples. Representation of stereoisomers - Wedge, Fischer projection, Sawhorse, Newmann formulae.

Conformational analysis : Classification of stereoisomers based on energy. Definition and examples Conformational and configurational isomers. Conformational analysis of ethane, n- butane, 1,2-dichloroethane, 2-chloroethanol. Cyclic compounds: Baeyer's strain theory, Conformational analysis of cyclohexane

Cis-trans isomerism: E-Z-Nomenclature



### S1-G-3: Solid state Chemistry

4 h

Laws of Crystallography: (i) Law of Constancy of interfacial angles (ii) Law of Symmetry- Symmetry elements in crystals (iii) Law of rationality of indices. Definition of space lattice, unit cell. Bravais Lattices and Seven Crystal systems (a brief review). X-ray diffraction by crystals; Derivation of Bragg's equation. Determination of structure of NaCl, KCl and CsCl (Bragg's method and Powder method).

#### References

**General reference:** B.Sc I Year Chemistry : Semester I, Telugu Academy publication, Hyd

#### Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3<sup>rd</sup> edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3<sup>rd</sup> edn Wiley Publishers 2001. Chem.
4. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey,
5. E.A. Keiter and R.L. Keiter 4<sup>th</sup> edn.
6. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press 1989.
7. Inorganic Chemistry by Shriver and Atkins 3<sup>rd</sup> edn Oxford Press 1999.
8. Textbook of Inorganic Chemistry by R Gopalan.

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1. Organic Chemistry by Morrison and Boyd.
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7. Organic Chemistry by Soni.
8. General Organic chemistry by Sachin Kumar Ghosh.
9. Organic Chemistry by C N pillai

#### Unit III

1. Principles of physical chemistry by Prutton and Marron.
2. Text Book of Physical Chemistry by Soni and Dharmahara..
3. Text Book of Physical Chemistry by Puri and Sharma.
4. Text Book of Physical Chemistry by K. L. Kapoor.

5. Physical Chemistry through problems by S.K. Dogra.
6. Text Book of Physical Chemistry by R.P. Verma.
7. Elements of Physical Chemistry by Lewis Glasstone.

#### Unit IV

1. Qualitative analysis by Welcher and Hahn.
2. Vogel's Qualitative Inorganic Analysis by Svehla.
3. Text Book of Organic Chemistry by Morrison And Boyd.
4. Text Book of Organic Chemistry by Graham Solomons.
5. Text Book of Organic Chemistry by Bruice Yuranis Powla.
6. Text Book of Organic Chemistry by Soni.
7. Text Book of Physical Chemistry by Soni And Dharmahara..
8. Text Book of Physical Chemistry by Puri And Sharma.
9. Text Book of Physical Chemistry by K. L. Kapoor.

#### Laboratory Course 45h (3 h / week)

Paper I - Qualitative Analysis - Semi micro analysis of mixtures

Analysis of two anions (one simple, one interfering) and two cations in the given mixture.

Anions:  $CO_3^{2-}$ ,  $SO_3^{2-}$ ,  $S_2O_3^{2-}$ ,  $Cl^-$ ,  $Br^-$ ,  $I^-$ ,  $CH_3COO^-$ ,  $NO_3^-$ ,  $PO_4^{3-}$ ,  $BO_3^{3-}$ ,  $SO_4^{2-}$ ..

Cations:  $Hg_2^{2+}$ ,  $Ag^+$ ,  $Pb^{2+}$

$Hg^{2+}$ ,  $Pb^{2+}$ ,  $Bi^{3+}$ ,  $Cd^{2+}$ ,  $Cu^{2+}$ ,  $As^{3+/5+}$ ,  $Sb^{3+/5+}$ ,  $Sn^{2+/4+}$

$Al^{3+}$ ,  $Cr^{3+}$ ,  $Fe^{3+}$

$Zn^{2+}$ ,  $Ni^{2+}$ ,  $Co^{2+}$ ,  $Mn^{2+}$

$Ba^{2+}$ ,  $Sr^{2+}$ ,  $Ca^{2+}$

$Mg^{2+}$ ,  $NH_4^+$

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**B.Sc I Yr CHEMISTRY  
SEMESTER WISE SYLLABUS**

**SEMESTER II**

**Paper – II Chemistry – II**

**Unit-I (Inorganic Chemistry) 15 h (1 hr/week)**

**S2-I-1 P-block Elements -II 7 h**

**Oxides:** Types of oxides (a) Normal- acidic, basic amphoteric and neutral (b) Mixed sub oxide d) peroxide e) superoxide. Structure of oxides of C, N, P, S and Cl - reactivity, thermal stability, hydrolysis.

**Oxy acids:** Structure and acidic nature of oxyacids of B, C, N, P, S, Cl and I. Redox properties of oxyacids of Nitrogen:  $\text{HNO}_2$  (reaction with  $\text{FeSO}_4$ ,  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ),  $\text{HNO}_3$  (reaction with  $\text{H}_2\text{S}$ , Cu),  $\text{HNO}_4$  (reaction with KBr, Aniline),  $\text{H}_2\text{N}_2\text{O}_2$  (reaction with  $\text{KMnO}_4$ ). Redox properties of oxyacids of Phosphorus:  $\text{H}_3\text{PO}_2$  (reaction with  $\text{HgCl}_2$ ),  $\text{H}_3\text{PO}_3$  (reaction with  $\text{AgNO}_3$ ,  $\text{CuSO}_4$ ). Redox properties of oxyacids of Sulphur:  $\text{H}_2\text{SO}_3$  (reaction with  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ),  $\text{H}_2\text{SO}_4$  (reaction with Zn, Fe, Cu),  $\text{H}_2\text{S}_2\text{O}_3$  (reaction with Cu, Au),  $\text{H}_2\text{SO}_5$  (reaction with KI,  $\text{FeSO}_4$ ),  $\text{H}_2\text{S}_2\text{O}_8$  (reaction with  $\text{FeSO}_4$ , KI). Redox properties of oxy acids of Chlorine.

**Interhalogens-** Classification- general preparation- structures of  $\text{AB}$ ,  $\text{AB}_3$ ,  $\text{AB}_5$  and  $\text{AB}_7$  type and reactivity.

**Poly halides-** Definition and structure of  $\text{ICl}_2^-$ ,  $\text{ICl}_4^-$  and  $\text{I}_3$ .

**Pseudohalogens:** Comparison with halogens.

**S2-I-2: Chemistry of Zero group elements 2 h**

Isolation of noble gases, Structure, bonding and reactivity of Xenon compounds – Oxides, Halides and Oxy-halides. Clathrate compounds and Anomalous behavior of He (II)

**S2-I-3: Chemistry of d-block elements 6 h**

Characteristics of d-block elements with special reference to electronic configuration, variable valence, ability to form complexes, magnetic properties & catalytic properties. Stability of various oxidation states and standard reduction potentials. Comparative treatment of second and third transition series with their 3d analogues. Study of Ti, Cr and Cu triads. Titanium triad – electronic configuration and reactivity of +3 and +4 states – oxides and halides. Chromium triad – reactivity of +3 and +6 states. Copper triad – reactivity of +1, +2 and +3 states.

## Unit - II (Organic Chemistry)

15h(1 hr/week)

### S2-O-1: Halogen compounds

4 h

Classification: alkyl (primary, secondary, tertiary), aryl, aralkyl, allyl, vinyl, benzyl. Chemical reactivity - reduction, formation of  $\text{RMgX}$ , Nucleophilic substitution reactions – classification into  $\text{S}_{\text{N}}1$  and  $\text{S}_{\text{N}}2$ . Mechanism and energy profile diagrams of  $\text{S}_{\text{N}}1$  and  $\text{S}_{\text{N}}2$  reactions. Stereochemistry of  $\text{S}_{\text{N}}2$  (Walden Inversion) 2-bromobutane,  $\text{S}_{\text{N}}1$  (Racemisation) 1- bromo-1-phenylpropane Structure and reactivity – Ease of hydrolysis - comparison of alkyl, vinyl, allyl, aryl, and benzyl halides.

### S2-O-1: Hydroxy compounds and ethers

6 h

Alcohols: Preparation:  $1^\circ$ ,  $2^\circ$  and  $3^\circ$  alcohols using Grignard reagent, Reduction of Carbonyl compounds, carboxylic acids and esters. Physical properties: H-bonding, Boiling point and Solubility. Reactions with Sodium,  $\text{HX}/\text{ZnCl}_2$  (Lucas reagent), esterification, oxidation with PCC, alk.  $\text{KMnO}_4$ , acidic dichromates, conc.  $\text{HNO}_3$  and Oppenauer oxidation (Mechanism).

Phenols: Preparation: (i) from diazonium salts of anilines, (ii) from benzene sulphonic acids and (iii) Cumene hydroperoxide .

Properties: Acidic nature, formation of phenoxide and reaction with  $\text{R-X}$ , electrophilic substitution; halogenations, Reimer Tiemann reaction (Mechanism), Kolbe reaction (Mechanism), Gattermann-Koch reaction, Azo-coupling reaction, Schotten-Boumann reaction, Houben-Hoesch condensation, .

Ethers: Nomenclature, preparation by (a) Williamson's synthesis (b) from alkenes by the action of conc.  $\text{H}_2\text{SO}_4$ . Physical properties – Absence of Hydrogen bonding, insoluble in water, low boiling point. Chemical properties – inert nature, action of conc.  $\text{H}_2\text{SO}_4$  and  $\text{HI}$ .

### S2-O-3 Carbonyl compounds

5 h

Preparation of aldehydes & ketones from acid chloride, 1,3-dithianes, nitriles and from carboxylic acids. Special methods of preparing aromatic aldehydes and ketones by (a) Oxidation of arenes

(b) Hydrolysis of benzal halides Physical properties – absence of Hydrogen bonding. Reactivity of the carbonyl groups in aldehydes and ketones. Chemical reactivity: Addition of (a)  $\text{NaHSO}_3$  (b)  $\text{HCN}$  (c)  $\text{RMgX}$  (d)  $\text{NH}_3$  (e)  $\text{RNH}_2$  (f)  $\text{NH}_2\text{OH}$  (g)  $\text{PhNHNH}_2$  (h) 2,4-DNP (Schiff bases). Addition of  $\text{H}_2\text{O}$  to form hydrate, chloral hydrate (stable), addition of alcohols - hemiacetal and acetal formation. Cannizzaro reaction. Oxidation reactions –  $\text{KMnO}_4$  oxidation and auto oxidation, reduction – catalytic hydrogenation, mechanism of Clemmenson's reduction, Wolf-kishner reduction, Meerwein Ponnoff Verly reduction. Reduction with LAH,  $\text{NaBH}_4$ .



**Unit - III (Physical Chemistry)****15h(1 hr/week)****S2-P-1: Electrochemistry****15 h**

Electrical transport – conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of specific and equivalent conductance with dilution. Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law - its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf's method for attackable electrodes. Applications of conductivity measurements: Determination of degree of dissociation, determination of  $K_a$  of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations. Electrolytic and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells. Electro motive force (EMF) of a cell and its measurement. Computation of EMF. Types of reversible electrodes- the gas electrode, metal-metal ion, metal-insoluble salt and redox electrodes. Electrode reactions, Nernst equation, cell EMF and Single electrode potential, Standard Hydrogen electrode – reference electrodes (calomel electrode) – standard electrode potential, sign conventions, electrochemical series and its significance. Applications of EMF measurements. Calculation of thermodynamic quantities of cell reactions (Gibbs free energy  $G$ , Helmholtz free energy and Equilibrium constant  $K$ ). Determination of pH using hydrogen electrode, glass electrode and quinhydrone electrode. Solubility product of  $AgCl$ . Potentiometric titrations.

**Unit – IV (General Chemistry)****15 h (1 hr/week)****S2-G-1: Theory of Quantitative Analysis****6 h**

*Volumetric Analysis:* Introduction, standard solutions, indicators, end point, titration curves, Types of titrations: i) neutralization titration- principle, theory of acid base indicators, titration curves and selection of indicators- strong acid - strong base, strong acid –weak base, weak acid- strong base and weak acid –weak base. Theory of redox titrations – internal ( $KMnO_4$ ) and external indicators – use of diphenylamine and ferroin indicators. Theory of complexometric titrations – use of EBT, Murexide and Fast sulphone black indicators. Role of pH in complexometric titrations. Precipitation titrations – theory of adsorption indicators.

Gravimetric analysis- Introduction, nucleation, precipitation, growth of precipitate, filtration and washing, drying and incineration of precipitate, coprecipitation and post precipitation. Determination of  $\text{Ni}^{2+}$

### **S2-G-2: Stereoisomerism**

**5 h**

Optical activity: Definition, wave nature of light, plane polarised light, optical rotation and specific rotation, chiral centers. Chiral molecules: definition and criteria - absence of plane, center and  $S_n$  axis of symmetry – asymmetric and dissymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and dissymmetric molecules (trans- 1,2-dichlorocyclopropane). Molecules with constitutionally symmetrical chiral carbons (Tartaric acid) Molecules with constitutionally unsymmetrical chiral carbons (2,3dibromopentane). D, L configuration – examples. R, S – configuration: Cahn-Ingold-Prelog rules, examples for asymmetric and dissymmetric molecules.

### **S2-G-3: Dilute Solutions & Colligative Properties**

**4 h**

Dilute Solutions, Colligative Properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis - laws of osmotic pressure, its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point.

#### **References**

**General reference:** B.Sc I Year Chemistry : Semester II, Telugu Academy publication, Hyd

#### **Unit I**

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3<sup>rd</sup> edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3<sup>rd</sup> edn Wiley Publishers 2001.
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4. Text Book of Physical Chemistry by Puri and Sharma
5. Text Book of Physical Chemistry by K. L. Kapoor
6. Physical Chemistry through problems by S.K. Dogra.
7. Elements of Physical Chemistry by Lewis and Glasstone.
8. Material science by Kakani & Kakani

## Unit IV

1. Vogel's Text Book of Quantitative Analysis by G.H.Jeffery, J.Bassett, J.Mendham and R.C. Denney 5th edn Addison Wesley Longman Inc. 1999.
2. Quantitative Analysis by Day and Underwood Prentice Hall (India) VI Edn..
3. Nano: The Essentials by T. Pradeep, McGraw-Hill Education.
4. Chemistry of nanomaterials: Synthesis, Properties and applications by CNR Rao et.al.
5. Nanostructured Materials and Nanotechnology, edited by Hari Singh Nalwa, Academic Press
6. Practical chemistry by V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati.

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*V. S. Rao*  
**DR. ANNAPOORNA R.S. BUSTI**

Laboratory Course

45hrs (3 h / week)

## Paper II

### Quantitative Analysis Acid - Base titrations

1. Estimation of Carbonate in Washing Soda.
2. Estimation of Bicarbonate in Baking Soda.
3. Estimation of Carbonate and Bicarbonate in the Mixture.
4. Estimation of Alkali content in Antacid using HCl.
5. Estimation of  $NH_4^+$  by back titration

### Redox Titrations

1. Determination of Fe(II) using  $K_2Cr_2O_7$
2. Determination of Fe(II) using  $KMnO_4$  with sodium oxalate as primary standard.
3. Determination of Cu(II) using  $Na_2S_2O_3$  with  $K_2Cr_2O_7$  as primary standard

### Complexometric Titrations

1. Estimation of  $Mg^{2+}$
2. Estimation of  $Cu^{2+}$

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*L. Kanala*  
Subject Expert-1

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III

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**B.Sc II Yr CHEMISTRY SEMESTER WISE SYLLABUS**

**SEMESTER III Paper-III**

**Chemistry - III**

**Unit-I (Inorganic Chemistry)**

**15 h (1 hr/week)**

**S3-I-1: Chemistry of f-block elements:**

**5 h**

Chemistry of Lanthanides: Position in periodic table, Electronic structure, oxidation state, ionic and atomic radii- lanthanide contraction- cause and consequences, anomalous behavior of post lanthanides-complexation- type of donor ligands preferred. Magnetic properties- paramagnetism. Colour and spectra, f-f transitions –occurrence and separation– ion exchange method, solvent extraction.

Chemistry of actinides- general features – electronic configuration, oxidation state, actinide contraction, colour and complex formation. Comparison with lanthanides.

**S3-I-2: Coordination Compounds-I**

**6 h**

Simple inorganic molecules and coordination complexes. Nomenclature – IUPAC rules,

1. Coordination number, coordination geometries of metal ions, types of ligands. 2. Brief review of Werner's theory, Sidgwick's electronic interpretation and EAN rule and their limitations. (Valence bond theory (VBT) – postulates and application to (a) tetrahedral complexes  $[\text{Ni}(\text{NH}_3)_4]^{2+}$ ,  $[\text{NiCl}_4]^{2-}$  and  $[\text{Ni}(\text{CO})_4]$  (b) Square planar complexes  $[\text{Ni}(\text{CN})_4]^{2-}$ ,  $[\text{Cu}(\text{NH}_3)_4]^{2+}$ ,  $[\text{PtCl}_4]^{2-}$  (c) Octahedral complexes  $[\text{Fe}(\text{CN})_6]^{4+}$ ,  $[\text{Fe}(\text{CN})_6]^{3-}$ ,  $[\text{FeF}_6]^{4-}$ ,  $[\text{Co}(\text{NH}_3)_6]^{3+}$ ,  $[\text{CoF}_6]^{3-}$  Limitations of VBT. 3.

Isomerism in coordination compounds, stereo isomerism – (a) geometrical isomerism in (i) square planar metal complexes of the type  $[\text{MA}_2\text{B}_2]$ ,  $[\text{MA}_2\text{BC}]$ ,  $[\text{M}(\text{AB})_2]$ ,  $[\text{MABCD}]$ . (ii) Octahedral metal complexes of the type  $[\text{MA}_4\text{B}_2]$ ,  $[\text{M}(\text{AA})_2\text{B}_2]$ ,  $[\text{MA}_3\text{B}_3]$  using suitable examples, (b) Optical isomerism in (i). tetrahedral complexes  $[\text{MABCD}]$ , (ii). Octahedral complexes  $[\text{M}(\text{AA})_2\text{B}_2]$ ,  $[\text{M}(\text{AA})_3]$  using suitable examples. Structural isomerism: ionization, linkage, coordination ligand isomerism using suitable examples.

**S3-I-3: Metal carbonyls and Organometallic Chemistry**

**4 h**

Metal carbonyls: Preparation and properties of  $\text{Ni}(\text{CO})_4$ . Structural features of  $\text{Ni}(\text{CO})_4$ ,  $\text{Fe}(\text{CO})_5$ ,  $\text{Fe}_2(\text{CO})_9$ ,  $\text{Fe}_3(\text{CO})_{12}$  and  $\text{Cr}(\text{CO})_6$  -18 valence electron rule.

Definition, nomenclature and classification of organometallic compounds. Methods of preparation, properties and applications of alkyl and aryl compounds of Li, Mg & Al.

**Unit - II (Organic Chemistry)****15h(1 hr/week)****S3-O-1: Carboxylic acids and derivatives****5 h**

Preparation: a) Hydrolysis of Nitriles, amides and esters. b) Carbonation of Grignard reagents. Special methods of preparation of Aromatic Acids - Oxidation of Arenes. Physical properties- hydrogen bonding, dimeric association, Chemical properties – Reactions involving H, OH and COOH groups - salt formation, anhydride formation, Acid halide formation, Esterification (mechanism) & Amide formation. Reduction of acid to the corresponding primary alcohol - via ester or acid chloride. Degradation of carboxylic acids by Huns Diecker reaction, Schmidt reaction (Decarboxylation). Arndt – Eistert synthesis, Halogenation by Hell – Volhard - Zelensky reaction. Carboxylic acid Derivatives – Hydrolysis and Amonolysis of acid halides, Acid anhydrides and esters (mechanism of ester hydrolysis by base and acid). Hydrolysis and dehydration of amides.

**S3-O-2: Nitro hydrocarbons****3 h**

Preparation of Nitroalkanes. Reactivity - halogenation, reaction with HNO<sub>2</sub> (Nitrous acid), Nef reaction, reduction. Aromatic Nitrohydrocarbons: Preparation of Nitrobenzene by Nitration. Physical properties, chemical reactivity – Reduction of Nitrobenzenes in different media.

**S3-O-3: Amines, Cyanides and Isocyanides****7 h**

Amines: classification into 1°, 2°, 3° Amines and Quarternary ammonium compounds. Preparative methods – Ammonolysis of alkyl halides, Gabriel synthesis, Hoffman's bromamide reaction (mechanism). Reduction of Amides and Schmidt reaction. Physical properties. Use of amine salts as phase transfer catalysts. Chemical Properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation. Reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines). Electrophilic substitutions of Aromatic amines – Bromination and Nitration, oxidation of aryl and 3° Amines, diazotisation. Diazonium salts: Preparation with mechanism. Synthetic importance – a) Replacement of diazonium group by – OH, X (Cl)– Sandmeyer and Gatterman reaction, by fluorine (Schiemann's reaction), by iodine, CN, NO<sub>2</sub>, H and aryl groups. Coupling Reaction of diazonium salts. i) with phenols ii) with anilines. Reduction to phenyl hydrazines.

**Cyanides and isocyanides:** Structure. Preparation of cyanides from a) Alkyl halides b) from amides c) from aldoximes. Preparation of isocyanides from Alkyl halides and Amines. Properties of cyanides and isocyanides, a) hydrolysis b) addition of Grignard reagent iii) reduction iv) oxidation. Unit III



**Unit-III (Physical Chemistry)**

**15 h (1 hr/week)**

**S3-P-1: Thermodynamics –I**

**10 h**

A brief review of - Energy, work and heat units, mechanical equivalent of heat, definition of system, surroundings. First law of thermodynamics statement- various forms mathematical expression. Thermodynamic quantities- extensive properties and intensive properties, state function and path functions. Energy as a state function and exact differential. Work of expansion and heat absorbed as path function.

Expression for work of expansion, sign convention problems on first law. Heat changes at constant pressure and heat changes at constant volume. Enthalpy. Heat capacities at constant pressure and constant volume. Derivation of  $C_p - C_v = R$ . Isothermal adiabatic processes. Reversible and irreversible processes. Reversible change and maximum work. Derivation of expression for maximum work for isothermal reversible process. Problems. Internal energy of an ideal gas. Joules experiment. Joule-Thompson coefficient. Adiabatic changes in ideal gas, derivation of equation,  $PV^\gamma = \text{constant}$ . P-V curves for isothermal and adiabatic processes. Heat of a reaction at constant volume and at constant pressure, relation between  $\Delta H$  and  $\Delta V$ . Variation of heat of reaction with temperature. Kirchhoff's equation and problems. Limitations of first law and need for second law. Statement of second law of thermodynamics. Cyclic process. Heat engine, Carnot's theorem, Carnot's cycle. Derivation of efficiency of heat engine. Problems. Thermodynamic scale of temperature.

**S3-P-2: Thermodynamics-II**

**5 h**

Entropy: Definition from Carnot's cycle. Entropy as a state function. Entropy as a measure of disorder. Sign of entropy change for spontaneous and non-spontaneous processes & equilibrium processes. Entropy changes in i). Reversible isothermal process, ii). Reversible adiabatic process, iii). Phase change, iv). Reversible change of state of an ideal gas. Problems. Entropy of mixing of ideal gases. Free energy Gibb's function (G) and Helmholtz's function (A) as thermodynamic quantities. Concept of maximum work and network  $\Delta G$  as Criteria for spontaneity.

Derivation of equation  $\Delta G = \Delta H - T\Delta S$ . Significance of the equation. Gibbs equations and Maxwell relations. Variation of G with P, V and T.

**Unit – IV (General Chemistry)****15 h (1 hr/week)****S3-G-1 Evaluation of analytical data****4 h**

Significant figures, accuracy and precision. Errors-classification of errors- determinate and indeterminate errors, absolute and relative errors. Problems based on mean, median, range, standard deviation

**S3-G-2: Carbanions-I****5 h**

Introduction, acidic nature of  $\alpha$ -hydrogens and tautomerism in carbonyl compounds, nitro hydrocarbons, ethyl acetoacetate, diethyl malonate. Terminal alkynes. Stability of carbanions Reactions: Aldol reaction, Perkin reaction, Benzoin condensation, haloform reaction, conversion of smaller alkynes to higher alkynes.

**S3-G-3: Phase Rule****6 h**

Statement and meaning of the terms – Phase, Component and Degrees of freedom, Gibb's Phase rule, phase equilibria of one component system – water system. Phase equilibria of two- component system – Solid-Liquid equilibria, simple eutectic –Pb-Ag system, desilverisation of lead. Solid solutions – compound with congruent melting point – Mg-Zn system and incongruent melting point – NaCl-H<sub>2</sub>O system.

**References**

**General reference:** B.Sc. II Year Chemistry: Semester III, Telugu Academy publication, Hyd

**Unit- I**

1. Analytical chemistry by G. L. David Krupadanam, D. Vijaya Prasad, K. Varaprasada Rao, K.L.N. Reddy and C. Sudhakar
2. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications(1996).
3. Concise Inorganic Chemistry by J.D. Lee 3<sup>rd</sup> edn Van Nostrand Reinhold Company(1977)
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## Unit- II

1. Text book of organic chemistry by Soni. Sultan Chand & Sons; Twenty Ninth edition (2012)
2. General Organic chemistry by Sachin Kumar Ghosh. New Age Publishers Pvt Ltd (2008).
3. Text book of organic chemistry by Morrison and Boyd. Person(2009)
4. Text book of organic chemistry by Graham Solomons. Wiley(2015)
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2. Text Book of Physical Chemistry by Soni and Dharmahara. Sulthan Chand and Sons.(2011)
3. Text Book of Physical Chemistry by Puri and Sharma. S. Nagin chand and Co.(2017)
4. Text Book of Physical Chemistry by K. L. Kapoor. (2012)
5. Colloidal and surface chemistry , M. Satake, Y. Hayashi, Y.Mido, S.A.Iqbal and
6. M.S.sethi, Discovery Publishing Pvt.Ltd (2014)
7. Material science by Kakani & Kakani, New Age International(2016)
8. Physical Chemistry by Ira Levine (Author) McGraw-Hill Education; 6 edition (May 9, 2008)

## Unit IV

1. Text book of organic chemistry by Morrison and Boyd, Person(2009)
2. Text book of organic chemistry by Graham solomons, Wiley(2015)
3. Text book of organic chemistry by Sony, Sultan Chand & Sons; 29<sup>th</sup> edition(2012)
4. Text book of organic chemistry by Bruice yuranis Powla, (2012)
5. General Organic chemistry by Sachin kumar Ghosh, New Age Publishers Pvt Ltd (2008)

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Laboratory Course

Paper III (Organic Synthesis)

45 h (3h/week)

1.Synthesis of Organic compounds:

1. **Acetylation:** Acetylation of salicylic acid, Benzoylation of Aniline.
2. **Aromatic electrophilic substitution:** Nitration: Preparation of nitro benzene and m-dinitro benzene.
3. **Halogenation:** Preparation of p-bromo acetanilide, Preparation of 2,4,6-tribromo phenol
4. **Oxidation:** Preparation of benzoic acid from benzyl chloride.
5. **Esterification:** Preparation of n-butyl acetate from acetic acid.
6. **Methylation:** Preparation of - naphthyl methyl ether.
7. **Condensation:** Preparation of benzilidene aniline and Benzaldehyde and aniline.
8. **Diazotization:** Azocoupling of  $\beta$ -Naphthol.

2.Microwave assisted synthesis of Aspirin – DEMO (demonstration only)













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**B.Sc. II yr CHEMISTRY**  
**SEMESTER WISE SYLLABUS**  
**SEMESTER IV**  
**Paper-IV Chemistry - IV**

**Unit-I (Inorganic Chemistry)**

**15h (1 h/week)**

**S4-I-1: Coordination Compounds –II**

**11 h**

Crystal field theory (CFT)- Postulates of CFT, splitting patterns of d-orbitals in octahedral, tetrahedral, square planer with suitable examples. Crystal field stabilization energies and its calculations for various dn configurations in octahedral complexes. High Spin Low Spin complexes. Colour and Magnetic properties of transition metal complexes. Calculations of magnetic moments spin only formula. Detection of complex formation - basic principles of various methods- change in chemical properties, solubility, colour, pH, conductivity, magnetic susceptibility.

Hard and soft acids bases (HSAB) - Classification, Pearson's concept of hardness and softness, application of HSAB principles – Stability of compounds / complexes, predicting the feasibility of reaction. Thermodynamic and kinetic stability of transition of metal complexes. Stability of metal complexes –stepwise and overall stability constant and their relationship and chelate effect determination of composition of complex by Job's method and mole ratio method.

Applications of coordination compounds: Applications of coordination compounds a) in quantitative and qualitative analysis with suitable examples b) in medicine for removal of toxic metal ions and cancer therapy c) in industry as catalysts polymerization – Ziegler Natta catalyst d) water softening.

**S4-I-2: Bioinorganic Chemistry**

**4 h**

Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and chloride (Cl-). Toxic metal ions As, Hg & Pb Oxygen transport and storage – structure of hemoglobin, binding and transport of oxygen. Fixation of CO<sub>2</sub> in photosynthesis- overview of light and dark reactions in photosynthesis. Structure of chlorophyll and coordination of magnesium. Electron transport in light reactions from water to NADP<sup>+</sup> (Z – scheme).

## Unit - II (Organic Chemistry) 15h(1 hr/week)

### S4-O-1: Carbohydrates

6 h

Introduction: Classification and nomenclature. Monosaccharides: All discussion to be confined to (+) glucose as an example of aldohexoses and (-) fructose as example of ketohexoses. Chemical properties and structural elucidation: Evidences for straight chain pentahydroxy aldehyde structure. Number of optically active, isomers possible for the structure, configuration of glucose based on D-glyceraldehyde as primary standard (No proof for configuration is required). Evidence for cyclic structure of glucose (Pyranose structure, anomeric Carbon and anomers). Proof for the ring size (methylation, hydrolysis and oxidation reactions). (Haworth formula and chair conformational formula). Structure of fructose: Evidence of 2 – ketohexose structure. Same osazone formation from glucose and fructose, Hydrogen bonding in osazones, cyclic structure for fructose (Furanose structure, Haworth formula).

Inter Conversion of Monosaccharides: : Arabinose to D-glucose, D- mannose (kiliani – Fischer method). Epimers, Epimerization- Lobry de bruyn van Ekenstein rearrangement. D-glucose to D-arabinose by Ruff's degradation. Aldohexose (+) (glucose) to ketohexose (-) (fructose) and Ketohexose (Fructose) to aldohexose (Glucose).

### S4-O-2: Amino acids and proteins

5 h

Classification. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples – Glycine, Alanine, Valine and Leucine) by following methods: a) From halogenated Carboxylic acid b) Malonic ester synthesis c) Strecker's synthesis. Physical properties: Optical activity of naturally occurring amino acids. Zwitter ion structure – salt like character, definition of isoelectric point. Chemical properties: General reactions due to amino and carboxyl groups – Lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides. Primary structure of proteins, di peptide synthesis

### S4-O-3: Heterocyclic Compounds

4 h

Introduction and definition: 5 membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole. Importance of ring systems –Numbering. Aromatic character  
Resonance structures: Explanation of feebly acidic character of pyrrole, electrophilic substitution, Halogenation, Nitration and Sulphonation. Reactivity of furan as 1,3-diene, Diels Alder reactions (one example). Sulphonation of thiophene purification of Benzene obtained from coal tar). Preparation of furan, Pyrrole and thiophene Paul-Knorr synthesis. Structure of pyridine, Basicity – Aromaticity –



Comparison with pyrrole – preparation by Hantsch method and properties – Reactivity towards Nucleophilic substitution reaction – chichibabin reaction.

### **Unit III (Physical Chemistry)**

**15h (1 hr/week)**

#### **S4-P-1: Chemical Kinetics**

**11 h**

Introduction to chemical kinetics, rate of reaction, variation of concentration with time, rate laws and rate constant. Specific reaction rate. Factors influencing reaction rates: effect of concentration of reactants, effect of temperature, effect of pressure, effect of reaction medium, effect of radiation, effect of catalyst with simple examples. Order of a reaction.

First order reaction, derivation of equation for rate constant. Characteristics of first order reaction. Units for rate constant. Half- life period, graph of first order reaction, Examples- Decomposition of  $\text{H}_2\text{O}_2$  and decomposition of oxalic acid, Problems.

Pseudo first order reaction, Hydrolysis of methyl acetate, inversion of cane sugar, problems. Second order reaction, derivation of expression for second order rate constant, examples-Saponification of ester,  $2\text{O}_3 \rightarrow 3\text{O}_2$ ,  $\text{C}_2\text{H}_4 + \text{H}_2 \rightarrow \text{C}_2\text{H}_6$ . Characteristics of second order reaction, units for rate constants, half- life period and second order plots. Problems

#### **S4-P-2: Photochemistry**

**4 h**

Introduction to photochemical reactions, Difference between thermal and photochemical reactions, Laws of photo chemistry- Grotthus Draper law, Stark–Einstein’s Law of photochemical equivalence. Quantum yield. Examples of photo chemical reactions with different quantum yields. Photo chemical combinations of  $\text{H}_2\text{--Cl}_2$  and  $\text{H}_2\text{--Br}_2$  reactions, reasons for the high and low quantum yield. Problems based on quantum efficiency. Consequences of light absorption. Singlet and triplet states. Jablonski diagram. Explanation of internal conversion, inter- system crossing, phosphorescence, fluorescence.

### **Unit III (General Chemistry)**

**15h (1 hr/week)**

#### **S4-G-1: Theories of bonding in metals**

**4 h**

Valence bond theory, Explanation of metallic properties and its limitations, Free electron theory, thermal and electrical conductivity of metals, limitations, Band theory, formation of bands, explanation of conductors, semiconductors n-type and p-type, extrinsic & intrinsic semiconductors, and insulators.

**S4-G-2: Carbanions-II****5 h**

Mannich reaction, Michael addition and Knoevenagel condensation Synthetic applications of Aceto acetic ester. Acid hydrolysis and ketonic hydrolysis: Preparation of ketones, monocarboxylic acids and dicarboxylic acids Malonic ester– synthetic applications. Preparation of (i) substituted mono carboxylic acids and (ii) substituted dicarboxylic acids.

**S4-G-3: Colloids & Surface Chemistry****6 h**

Definition of colloids. Classification of colloids. Solids in liquids (sols): preparations and properties – Kinetic, Optical and Electrical stability of colloids. Protective action. Hardy– Schultz law, Gold number. Liquids in liquids (emulsions): Types of emulsions, preparation and emulsifier. Liquids in solids(gels): Classification, preparations and properties, General applications of colloids.

**Adsorption:** Types of adsorption. Factors influencing adsorption. Freundlich adsorption isotherm. Langmuir theory of unilayer adsorption isotherm. Applications.

**References**

**General reference:** B.Sc II Year Chemistry : Semester IV, Telugu Academy publication, Hyd.

**Unit- I**

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications (1996).
2. Concise Inorganic Chemistry by J.D. Lee 3<sup>rd</sup> edn. Van Nostrand Reinhold Company(1977)
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3<sup>rd</sup> edn Wiley Publishers (2001).
4. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey,
5. E.A. Keiter and R.L. Keiter 4<sup>th</sup> edn. (2006)
6. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press(1989).
7. Inorganic Chemistry by Shriver and Atkins 3<sup>rd</sup> edn Oxford Press (1999).
8. Textbook of Inorganic Chemistry by R Gopalan, Universities Press,(2012)

**Unit- II**

1. Text book of organic chemistry by Soni. Sultan Chand & Sons; Twenty Ninth edition (2012)
2. General Organic chemistry by Sachin Kumar Ghosh. New Age Publishers Pvt Ltd (2008)
3. Text book of organic chemistry by Morrison and Boyd. Person(2009)
4. Text book of organic chemistry by Graham Solomons. Wiley(2015)
5. Text book of organic chemistry by Bruce Yuranis Powla. (2012)



6. Text book of organic chemistry by C N pillai CRC Press (2012)
7. Organic Chemistry by L. G. Wade Jr.
8. Organic Chemistry by M. Jones, Jr
9. Organic Chemistry by John McMurry.

### Unit III

1. Principles of physical chemistry by Prutton and Marron. The Macmillan Company; 4<sup>th</sup> edn. (1970)
2. Text Book of Physical Chemistry by Soni and Dharmahara. Sulthan Chand & sons.(2011)
3. Text Book of Physical Chemistry by Puri and Sharma. S. Nagin chand and Co.(2017)
4. Text Book of Physical Chemistry by K. L. Kapoor. (2012)
5. Physical Chemistry through problems by S.K. Dogra. (2015)
6. Text Book of Physical Chemistry by R.P. Verma.
7. Elements of Physical Chemistry by Lewis Glasstone. Macmillan (1966)
8. Industrial Electrochemistry, D. Pletcher, Chapman & Hall, London, 1990

### Unit IV

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications(1996).
2. Concise Inorganic Chemistry by J.D. Lee 3<sup>rd</sup> edn. Van Nostrand Reinhold Company (1977)
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3<sup>rd</sup> edn Wiley Publishers (2001).
4. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey,
5. E.A. Keiter and R.L. Keiter 4<sup>th</sup> edn. (2006)
6. Text book of organic chemistry by Morrison and Boyd, Person (2009)
7. Text book of organic chemistry by Graham solomons, Wiley (2015)
8. Fundamentals of organic synthesis and retrosynthetic analysis by Ratna Kumar Kar, CBA,(2014)
9. Organic synthesis by Dr. Jagadamba Singh and Dr. L.D.S. Yadav, Pragati Prakashan, 2010
10. Stereochemistry of organic compounds by D. Nasipuri, New Academic Science Limited, 2012
11. Organic chemistry by Clayden, Greeves, Warren and Wothers, Oxford University Press, 2001
12. Fundamentals of Asymmetric Synthesis by G. L. David Khupadham, Universities, Press 2014

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Laboratory Course Paper IV-

**Qualitative Analysis of Organic Compounds: 45hrs (3 h/week)**

Qualitative analysis: Identification of organic compounds through the functional group analysis - ignition test, determination of melting points/boiling points, solubility test, functional group tests and preparation of suitable derivatives of the following: Carboxylic acids, phenols, amines, urea, thiourea, carbohydrates, aldehydes, ketones, amides, nitro hydrocarbons, ester and naphthalene.

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## B.Sc. Chemistry II Year Semester-III

### Skill Enhancement Course- I (SEC-I) (2 Credits)

#### Rules in Chemistry Laboratory and Lab Reagents

##### **Unit I: Laboratory Safety Rules and Regulations**      **15 h (1 hr/week)**

General rules and regulations for lab safety: Minimizing Risks of Hazards, Personal Protective Equipment (PPE) - Hair, Dressing for the Laboratory, Eye Protection, Eyewash fountain, Gloves, Laboratory Protocols, Labeling Chemicals, Careful reading of labels Prevention of Inhaling Harmful Chemicals, Guide to Chemical Hazards, Chemical Spills etc., Accidents use of fire extinguisher and first aid kit in the laboratory, safety symbols- Preparation of the charts by the students and display of charts in chemistry labs. Calibration of fractional weights, calibration of glass ware - burette, pipette, standard flask, Normality/Molarity and specific gravity of concentrated acids – Preparation of dilute solutions (Numerical problems). Precautions to be taken in the preparation of dilute acids and bases and bases. Preparation of stock solutions of salts with specific examples. Properties of primary standard salt and preparation of standard solution. Good laboratory practices-maintenance of observation book record.

##### **UNIT 2: Preparation of Lab Reagents**      **15 h (1 hr/week)**

Preparation of indicators and use of indicators in volumetric analysis- acid base titrations, redox titrations, precipitation titrations and complexometric titrations. Role of an indicator in detecting end point (Phenolphthalein, Methyl orange, Methyl-red, Potassium Chromate, Diphenylamine, EBT, Murexide, etc). Preparation of buffers – pH 10 ammonical buffer and acetate buffer solutions. Preparation of commonly used reagents : Ammonium hydroxide solution, Ammonium molybdate reagent, Ammonium hydrogen phosphate solution, Bayer's reagent, Benedict's solution, Bromine water, Dimethyl glyoxime reagent, 2,4-Dinitrophenyl hydrazine reagent, Eriochrome black-T reagent Fehling solution, Ferric chloride solution, Ferrous sulphate solution, Iodine solution, Molisch's reagent, Nessler's reagent, Neutral FeCl<sub>3</sub>, Schiff's reagent, Silver nitrate solution, Sodium carbonate solution , Sodium hydroxide (Caustic soda) solution, Starch solution, Tollen's reagent. (reference work and submission of assignments). Charts preparation depicting course content.

## RECOMMENDED BOOKS

1. Vogel's Text Book of Quantitative Chemical Analysis, 5th edition.
2. Vogel's Text Book of macro and semi micro qualitative inorganic analysis. G. Svehla, 5th edition.
3. Chemistry Reagent Manual Prepared by Chemistry Department, SGTB Khalsa College under
4. DBT's Star College Scheme, University of Delhi (Available: online)
5. American Chemical Society Safety in Academic Chemistry Laboratories 8th edition.

[Course objectives (CO)]: To improve the skills of students in the application of theory and practical knowledge. To fill the gap between theory and practicals. To train the students in understanding laboratory safety rules and to improve the skills in preparation of laboratory reagents.

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## B.Sc. Chemistry II Year Semester III

### Skill Enhancement Course- II (SEC –II) (2 Credits)

#### REMEDIAL METHODS FOR POLLUTION, DRINKING WATER AND SOIL FERTILITY STANDARDS

##### **UNIT I: Remedial Methods for Pollution Prevention and control of air pollution 15h(1hr/week)**

Ozone hole-causes and harm due to ozone depletion. The effect of CFC's in Ozone depletion and their replacements. Global Warming and Greenhouse Effect Precautions to control global warming. Deleterious effect of pollutants - Endangered Monuments- acid rain. Precautions to protect monuments. Sources of Radiation pollution - Chernobyl accident and its Consequences. Radiation effect by the usage of cell phones and protection tips. Deleterious effects of cell phone towers and health hazards. Sources of water pollution-(i). Pollution due to pesticides and inorganic chemicals, (ii). Thermal pollution (iii). Ground water pollution (iv). Eutrophication. Methods for control of water pollution and water recycling. Dumping of plastics in rivers & oceans and their effect on aquatic life. Determination of (i) Dissolved Oxygen and (ii) Chemical Oxygen Demand in polluted water - Illustration through charts (or) demonstration of experiments. Sources of soil pollution (i). Plastic bags, (ii). Industrial and (iii). Agricultural sources. Control of soil pollution. Environmental laws in India. Environmental benefits of planting trees.

##### **UNIT II: Drinking Water and Soil Fertility Standards and Analysis 15 h (1 hr/week)**




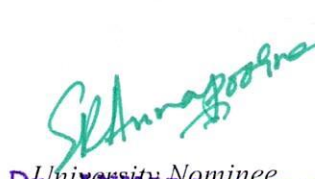

**Water Quality and Common Treatments for Private Drinking Water Systems:** Drinking Water Standards-Primary Drinking Water Standards : Inorganics, Organics and Volatile Organic Chemicals. Secondary Drinking Water Standards-Inorganics and Physical Problems. Water Testing, Mineral Analysis, Microbiological Tests, Pesticide and Other Organic Chemical Tests. Principle involved in Water Treatment Techniques. (i) Reverse osmosis (ii) Disinfection methods such as chlorination, ultraviolet light, ozonation etc (iii) Chemical oxidation and (iv) Ion exchange (water softeners). Visit to nearby drinking water plants and interaction at sites.

**Introduction to Soil Chemistry-** Basic Concepts. Effect of pH on nutrient availability. Macronutrients and their effect on plants -Carbon, Hydrogen, Oxygen, Nitrogen and Phosphorus other macronutrients- Calcium, Magnesium and Sulfur. Micronutrients and their effect on plants. Boron ( $B_4O_7^{2-}$ ), Copper ( $Cu^{2+}$ ), Iron ( $Fe^{2+}$ ,  $Fe^{3+}$ ) Manganese ( $Mn^{2+}$ ) Molybdenum ( $MoO_4^{2-}$ ) Zinc ( $Zn^{2+}$ ) Cobalt ( $Co^{2+}$ ) Chlorine ( $Cl^-$ ) and Others. Determination of soil nitrogen by Kjeldahl method- Illustration through charts (Or) demonstration of experiment. Visit to nearby agricultural farms and interaction with farmers. Discussion with farmers on the use of Soil Analysis Kits.



**References**

1. A Text book for 'Remedial methods for pollution, drinking water and soil fertility standards', First Edition, Authors: Dr Mudvath Ravi, Gopu Srinivas, Putta Venkat Reddy, Vuradi Ravi Kumar, Battini Ushaiah, ISBN No. 978-93-5311-183-0.
2. Remedial methods for pollution, drinking water and soil fertility standards, Author: Dr G. Vanajatha.
3. Remedial methods for pollution, drinking water and soil fertility standards, Telugu version, Authors: Dr N. Yogi Babu, Dr. G. Vanajatha, M. Srilatha.
4. Environmental Pollution, download.nos.org/333courseE/10.pdf
5. CFC Replacements, butane.chem.uiuc.edu/pshapley/Environmental/L21/3.html
6. Effects of Acid Rain on Buildings www.air-quality.org.uk/12.php
7. Acid Rain Effects - Buildings – Chemistry chemistry.elmhurst.edu/vchembook/196buildings.html
8. How to protect national heritage - ways to protect monuments www.youthkiawaaz.com/2011/03/how-to-protect-national-heritage/.
8. Chernobyl nuclear power plant accident - NRC www.nrc.gov/reading-rm/doc-collections/factsheets/chernobyl-bg.pdf
9. Side-effects of harmful radiation from mobile phones and towers pib.nic.in/newsite/printrelease.aspx?relid=116304
10. Cell Phone Radiation Protection - Highly Effective Tips https://www.electricsense.com/775/how-to-protect-yourself-from-cell-phone-radiation/
11. Chemical Waste That Impact on Aquatic Life or Water Quality blog.idrenvironmental.com/chemical-waste-that-impact-on-aquatic-life-or-waterquality
12. Trees and Your Environment - Clean Air Gardening www.cleanairegardening.com/plantingtrees
14. water quality and common treatments for private drinking water . extension.uga.edu/publications/detail.html?number=b939
13. Soil chemistry https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDFdownloads/2.2-soil-chemistry.pdf
14. Soil Analysis-Determination of Available Nitrogen . Amrita VirtualLab vlab.amrita.edu/?sub=2&brch=294&sim=1551&cnt=1
15. Determination of dissolved oxygen (DO) www.cutm.ac.in/pdf/env%20engg%20lab%20manual.pdf
18. Determination of chemical oxygen demand of wastewater www.pharmaguideline.com/quality control/test


  

  
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**B.Sc. Chemistry II Year Semester - IV**  
**Skill Enhancement Course- III (SEC - III) (2 Credits)**

**Materials and their Applications**

**Unit – I: Types of Materials 15 h (1 hr/week)**

Introduction: Materials and their importance. Classification of Materials, Advanced materials and their need. Types of Materials: Metals, ceramics, polymers and composites; Nature of bonding (Type of bond present). Types and applications of metal alloys: Classification- ferrous and non-ferrous alloys. Ferrous alloys -types and their applications. Non-ferrous alloys – Cu, Al, Ti alloys, their applications and super alloys.

**Field Work-** Collection of Metal Alloy Samples.

Types and Applications of Ceramics: Classification of Ceramics based on their application- glasses, clay products, refractories, abrasives, cements, and advanced ceramics. Glasses: Compositions and Characteristics of Some of the Common Commercial Glasses; Properties and applications of glass ceramics - preparation of charts depicting various types of glass and their use. Clay products: Structural clay products and the white wares. Refractories: Compositions of four Common Ceramic Refractory Materials, fireclay, silica, basic refractories ex. MgO and special refractories ex. Alumina and Zirconia Cements: Classification, preparation of cement and the setting process; quick setting cements; applications.

Field Work-Visit to industries and collection of samples of materials

**Unit – II: Types of Polymers and Applications**

**15 h (1 hr/week)**

Classification of Polymeric materials based on application: Coatings, adhesives, films, foams with examples Polymer Additives: Fillers, Plasticizers, Stabilizers, Colorants, Flame Retardants with examples.

Advanced Materials: Types of advanced materials - semiconductors, bio-compatible materials, smart materials, advanced polymeric materials and nano-engineered materials. Biocompatible materials: Definition. Materials used as biomaterials and their properties. Metals and alloys used in bone and joint replacement. Filling and restoration materials – dental cements, dental amalgams, dental adhesives.

Field Work- Visit to Dental Clinics and interaction with Doctors regarding materials used in Dental treatments.

Smart materials: Shape memory alloys- definition and examples (Ni-Ti alloys, Cu based alloys), applications. Conducting polymers: - Introduction, electrically conducting polymers and their uses (polyaniline, polypyrrole, polyacetylene and polythiophene).

### References

1. William D. Callister Materials Science and Engineering An Introduction, John Wiley & Sons, Inc, 2006.
2. Material science by Kakani and Kakani.
3. Sujata V., Bhat., —Biomaterials, Narosa Publication House, New Delhi, 2002.
4. M. V. Gandhi and B. S. Thompson, —Smart Materials and Structures, Chapman and Hall, London, First Edition, 1992.
5. Duerig, T. W., Melton, K. N, Stockel, D. and Wayman, C.M., —Engineering aspects of Shape memory Alloys, Butterworth – Heinemann, 1990.
6. Conducting Polymers, Fundamentals and Applications A Practical Approach Authors: Chandrasekhar, Prasanna Ashwin-Ushas Corp., Inc. Kluwer Academic Publishers. Boston

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**B.Sc. Chemistry II Year Semester IV**  
**Skill Enhancement Course- IV (SEC - IV) (2 Credits)**

**Chemistry of Cosmetics and Food Processing**

**Unit-I: Chemistry of Cosmetics and Perfumes**

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, sunscreen lotions, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to eugenol, geraniol, sandalwood oil, eucalyptus, 2-phenyl ethyl alcohol. Demonstration experiments or illustration of experimental procedures through charts for the preparation of talcum powder, shampoo and vanishing cream. Analysis of deodorants and antiperspirant - Aluminum, Zinc, Boric acid, Chloride and Sulphide.

**Unit-II: Food Processing and Food Adulteration**

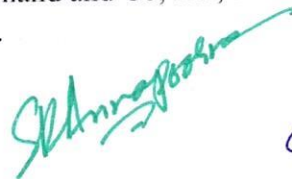
Food processing: Introduction, methods for food processing, additives and preservatives. Food processing- impact on nutrition, analysis of calcium in milk by complexometric titration, spectrophotometric analysis of iron in foods, Spectrophotometric identification and determination of caffeine and benzoic acid in soft drinks. Field Work -Visit to Food Industries. Food adulteration: Adulterants in some common food items and their identification: Pulses, chilli powder, turmeric powder, milk, honey, spices, food grains and wheat flour, coffee powder, tea leaves, vegetable oil, ghee, ice creams, tomato sauce. Field Work-Collection of adulterated food samples, demonstration of a minimum of five experiments for testing adulterants in food items.

**References**

1. E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
2. P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi
3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).
4. Rameen Devi, Food Processing and Impact on Nutrition, Sc J Agric Vet Sci., AugSep 2015; 2(4A):304-311.
5. W.A. Poucher, Perfumes, Cosmetics and Soaps (1993).
6. Srilakshmi, Food Science. Edition: 3rd (2004). 7. Lillian Hoagland Meyer, Food chemistry (2008).
7. Handbook of Analysis and Quality Control for Fruit and Vegetable Products, S. Ranganna, Tata McGraw-Hill Education, 1986 – Food.
8. Fundamental concepts of applied chemistry J.C Ghosh, S. Chand and Co, Ltd, New Delhi.
9. Applied Chemistry K .Bhagavathi Sundhar, MJP publishers.











**Semester V**  
**Generic Elective (GE) Course - I (4 Credits)**  
**(for B.Sc. Non Chemistry/B.A/B.Com Students)**  
**Chemistry of Cosmetics, Food Processing, Drugs and Pharmaceuticals**      **60Hrs**

**Unit-I: Chemistry of Cosmetics and Perfumes** **15 Hrs**

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, sunscreen lotions, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to eugenol, geraniol, sandalwood oil, eucalyptus, 2-phenyl ethyl alcohol.

Demonstration experiments or illustration of experimental procedures through charts for the preparation of talcum powder, shampoo and vanishing cream. Chemistry and Applications of deodorants and antiperspirant - Aluminum, Zinc, Boric acid, Chloride and Sulphide.

**Unit-II: Food Processing and Food Adulteration** **15 Hrs**

**Food processing:** Introduction, methods for food processing, additives and preservatives. Food processing- impact on nutrition.

**Food adulteration:** Adulterants in some common food items and their identification: Pulses, chilli powder, turmeric powder, milk, honey, spices, food grains and wheat flour, coffee powder, tea leaves, vegetable oil, ghee, ice creams, tomato sauce.

**Food Packaging:** Definition and function of packaging-Classification of packaging materials-different types of packaging materials such as glass, wood, metal, paper, wood, plastic etc., - advantages and disadvantages of each packaging material. Packaging materials and systems: corrugated fibre board boxes, shrink bundles and reusable packages. Effect of packaging materials on nutritive values of food.

**Food labelling:** Introduction, need and importance.

**Unit - III: General Characteristics of Drugs** **15Hrs**

**Introduction:** Diseases – causes of diseases, Drug – definition and sources.

ADME of drugs (brief) – Absorption, distribution, drug metabolism (in liver), elimination (brief), Toxicity.

Examples (i) Zintac (Ranitidine, antacid) (ii) Paracetamol (antipyretic) (iii) Benadryl (Cough syrup). Characteristics of an ideal drug.

**Nomenclature of Drugs:** chemical name – generic name – trade name. Trade names for the given generic names – (i) Aspirin (ii) Amoxycillin (iii) Ciprofloxacin (iv) Paracetamol (v) Mebendazole

**Drug formulations:** Definition – need for conversion of drug into pharmaceutical (drug formulations) – Additives – diluents, binders, lubricants, antioxidants, flavourants, sweeteners, colourants, coating agents. Classification of Drug formulations: oral, parenterals and topical dosage forms – advantages and disadvantages.

**(i) Oral Dosage forms:** Tablets (Aspirin – analgesic; Ciprofloxacin - antibacterial). Capsules (Amoxycillin – antibiotic; Omeprazole-antacid). Syrups (B-complex syrup; Benadryl- Cough syrup).



- (ii) Parenterals (Injection forms): Propranolol (antihypertensive), Heparin (anticoagulant)  
 (iii) Topical dosage forms: Creams and Ointments  
 (iv) Antiallergic: Aclometasone (Aclovate), Betamethasone valerate(2%) Multiple purposes,  
 (v) Anti-itching: Doxepin Zonalon), Antifungal: Miconazole (Dactarin, Neomicol), Ketoconazole, (Nizoral Cream), Fluconazole, Anesthetic- Lidocaine, (Lidocaine ointment) and Antiseptic: Boro Plus Cream, For burns -Iodine ointment

#### Unit – IV: Classification of Drugs

15Hrs

Classification of drugs based on therapeutic action-Chemotherapeutic agents, Pharmacodynamic agents and drugs acting on metabolic processes.

Brief explanation for the following:

(i) Chemotherapeutic agents: Antimalarials – Chloroquine; Antibiotic – Amoxicillin; Antitubercular drugs – isoniazide; Antiprotozoals – metronidazole.

#### (ii) Pharmacodynamic agents

(a) Drugs acting on CNS: Diazepam (CNS depressant), General anesthetic (thiopental sodium), antipyretic and analgesic (Ibuprofen)

(b) Drugs acting on PNS: local anaesthetics (Benzocaine)

(c) Drugs acting on cardiovascular system: Metoprolol (antihypertensive agents), Nefidipine antianginal and antihypertensive agent )

(d) Drugs acting on renal system: Diuretics (Acetazolamide)

#### (iii) Drugs acting on metabolic processes

(a) Vitamins: Common name, source, deficiency, vitamin A, B2, B6, C, D, E and K – remedy

(b) Hormones: Function (brief) - deficiency of hormones (Insulin, Testosterone and Oosterone)

#### Recommended Text Books and Reference Books

1. Industrial Chemistry, Vol -I, E. Stocchi, Ellis Horwood Ltd. UK.
2. Engineering Chemistry, P.C. Jain, M. Jain, Dhanpat Rai & Sons, Delhi.
3. Industrial Chemistry, Sharma, B.K. & Gaur, H. , Goel Publishing House, Meerut (1996).
4. Food Processing and Impact on Nutrition, Rameen Devi, Sc J Agric Vet Sci., Aug-Sep 2015: 2(4A):304-311.
5. Perfumes, Cosmetics and Soaps , W.A. Poucher, (1993).
6. A first course in food analysis by A Y Sathe
7. Food Science by N.Potter, CBS publishers
8. Food chemistry, Lillian Hoagland Meyer, (2008).
9. A Handbook of food packaging by F. A. Paine and H.Y. Paine.
10. Fundamental concepts of applied chemistry J.C Ghosh, S. Chand and Co, Ltd, New Delhi.
11. Applied Chemistry K .Bhagavathi Sundhar, MJP publishers.
12. Drugs by G.L.David Krupadanam, D.Vijaya Prasad, K.Varaprasad Rao, K.L.N.Reddy, C.Sudhakar , Universities Press (India) Limited 2007.
13. An Introduction to Medicinal Chemistry by Graham L. Patrick, Oxford University Press, New York. 1995.

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K V

**B.Sc. III yr CHEMISTRY SEMESTER WISE SYLLABUS**

**SEMESTER V**

**Paper-V Chemistry – V      60 hrs**

**Discipline Specific Elective-A**

**UNIT-I**

**S5-E-A-1: Molecular spectroscopy**

**15 hr**

Introduction to electromagnetic radiation, interaction of electromagnetic radiations with molecules, various types of molecular spectra.

**Rotational spectroscopy (Microwave spectroscopy)**

Rotational axis, moment of inertia, classification of molecules (based on moment of inertia), rotational energies, selection rules, determination of bond length of rigid diatomic molecules eg. HCl.

**Infra-red spectroscopy**

Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant. Qualitative relation of force constant to bond energies. An harmonic motion of real molecules and energy levels. Modes of vibrations in polyatomic molecules. Characteristic absorption bands of various functional groups. Finger print nature of infrared spectrum.

**Electronic spectroscopy:**

Bonding and antibonding molecular orbitals, electronic energy levels of molecules ( $\sigma$ ,  $\pi$ ,  $n$ ), types of electronic transitions with suitable examples. Selection rules, Terminology of chromophore, auxochrome, bathochromic and hypso chromic shifts. Absorption characteristics of chromophores: diene, enone and aromatic chromophores. Representation of UV-visible spectra. General features of absorption spectroscopy transmittance, absorbance and molar absorptivity. Beer's law and its limitations.

**UNIT-II**

**15 Hrs**

**S5-E-A-2: Proton Magnetic Resonance Spectroscopy**

**8h**

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals – spin-spin coupling, representation of proton NMR spectrum – Integrations.  $^1\text{H}$  NMR spectrum of – ethyl bromide, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate and acetophenone.



### S5-E-3: Mass Spectrometry

7 h

Electron Impact Mass: Basic principles, Nitrogen rule, types of ions: Molecular ion, fragment ion and isotopic ions, representation of mass spectrum, types of peaks (molecular ion, fragment and isotopic ion peaks). Determination of molecular weight Mass spectrum of ethyl chloride, ethyl bromide and acetophenone.

### UNIT -III

#### S5-E-A-4 Separation techniques- I

15 Hrs

**Solvent Extraction-** Principle, Methods of extraction: Batch extraction, continuous extraction and counter current extraction. Application – Determination of Iron (III).

**Chromatography:** Classification of chromatographic methods, principles of differential migration, adsorption phenomenon, nature of adsorbents, solvent systems.

**Thin layer Chromatography (TLC):** Advantages, preparation of plates, development of the chromatogram, Detection of the spots, factors effecting Rf values and applications.

**Paper Chromatography:** Principle, choice of paper and solvent systems, development of chromatogram – ascending, descending, radial and two-dimensional chromatography and applications.

### UNIT IV

#### S5-E-A-5: Separation techniques II

15 Hrs

**Chromatography: Column Chromatography-** Principle, Types of stationary phases, Column packing – Wet packing technique, Dry packing technique. Selection criteria of mobile phase solvents for eluting polar, non-polar compounds and its applications.

**Ion exchange chromatography:** Principle, cation and anion exchange resins, its application in separation of ions.

**Gas Chromatography:** Theory and instrumentation (Block Diagram), Types of stationary phases and carrier gases (mobile phase).

**High performance liquid chromatography:** Theory and instrumentation, stationary phases and mobile phases. Analysis of paracetamol.

## References

1. Fundamentals of Molecular Spectroscopy, Banwell & McCash
2. Organic spectroscopy, William Kemp, Palgrave Macmillan; 2nd Revised edition
3. Spectroscopy, B K Sharma Krishna Prakashan Media, 1981
4. Elements of Organic Spectroscopy, Y R Sharma.
5. Applications of Absorption Spectroscopy of Organic Compounds (English, Paperback, Dyer R. John)
6. Organic Chemistry, Morrison and Boyd, Pearson Publications.
7. Introduction to Spectroscopy by Donald Pavia, Gary Lampman and George Kriz Saunders College Division, 2001
8. Chemistry text book for B.Sc., published by Telugu Academy, Govt. of Telangana.
9. Analytical Chemistry by David Krupadanam, Universities Press (India) Limited.
10. Principles of Instrumental Analysis, D.A. Skoog, F.J. Holler, T.A. Nieman, Engage earning India Ed.
11. Fundamentals of Analytical Chemistry 6 th Ed., D. A. Skoog, D.M. West, F.J. Holler, Saunders College Publishing, Fort worth (1992).
12. Instrumental Methods of Analysis. 7<sup>th</sup> Ed. Willard, H.H., Merritt, L.L., Dean, J. & Settle, F.A. Wordsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
13. A Textbook of Quantitative Inorganic Analysis 7th Ed., Vogel, A. I. Prentice Hall.
14. Analytical Chemistry 7 th edition by Gary D. Christian (2004).
15. Separation Methods, M.N Sastry, Himalaya Publication (2004).

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K. Narsayya

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S. Srinivasulu Reddy  
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G. Venkatesh  
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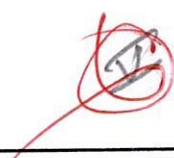
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**B.Sc, Chemistry III Year**  
**Semester-V, Paper- V**  
**Discipline Specific Elective-B (4 Credits)**  
**Green chemistry**

**Unit I:**

**S5-E-B-I: Introduction to Green Chemistry & Principles of Green Chemistry and Designing a Chemical synthesis-I** **04 hrs.**

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry

Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following:

- Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.
- Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard × exposure; waste or pollution prevention hierarchy.

**Unit II:**

**S5-E-B-II: Principles of Green Chemistry and Designing a Chemical synthesis -II**  
**30hrs.**

- Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorinated biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents.
- Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.
- Selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups.
- Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.
- Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD “What you don’t have cannot harm you”, greener alternative to Bhopal Gas Tragedy

(safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.

- Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.

**Unit III:**

**S5-E-B-III: Examples of Green Synthesis/ Reactions and some real-world cases 15 hrs.**

1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)
2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction
3. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)
4. Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO<sub>2</sub> for precision cleaning and dry cleaning of garments.
5. Designing of Environmentally safe marine antifoulant.
6. Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments.
7. An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.
8. Healthier fats and oil by Green Chemistry: Enzymatic interesterification for production of no Trans- Fats and Oils
9. Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting

**Unit IV**

**S5-E-B-IV: Future Trends in Green Chemistry**

**15 hr**

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis (C2 S3 ); Green chemistry in sustainable development.



**Reference Books:**

1. Ahluwalia, V.K. & Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers (2005).
2. Anastas, P.T. & Warner, J.K.: Green Chemistry - Theory and Practical, Oxford University Press
3. (1998).
4. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001).
5. Cann, M.C. & Connely, M.E. Real-World cases in Green Chemistry, American Chemical Society,
6. Washington (2000).
7. Ryan, M.A. & Tinnesand, M. Introduction to Green Chemistry, American Chemical Society,
8. Washington (2002).
9. Lancaster, M. Green Chemistry: An Introductory Text RSC Publishing, 2nd Edition, 2010.

*Ahluwalia*

*Kidwai*

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*M. Ryan*

*M. Warner*

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## Laboratory Course

Experiments in Physical Chemistry-

45hrs (3 h/w)

### 1. Distribution law

- A) Determination of distribution coefficient of iodine between water and carbon Tetrachloride  
determination of molecular status and partition coefficient of benzoic acid in Toluene and water.  
B) Determination of distribution coefficient of acetic acid between n-butanol and water.

### 2. Electrochemistry

- a) Determination of cell constant of conductivity cell.  
b) Determination Of dissociation constant ( $K_a$ ) Of acetic acid by conductivity measurements.

### 3. Colorimetry

Verification of Beer's law using  $KMnO_4$  and determination of the concentration of the given solution.

### 4. Adsorption

Adsorption of acetic acid on animal charcoal, Verification of Freundlich adsorption isotherm.

### 5. Physical constants

Surface tension and viscosity of liquids. (Demonstration Experiment)

### 6. Kinetics

- a) Determination of specific reaction rate of the hydrolysis of methyl acetate catalyzed by hydrogen ion at room temperature.  
b) Determination of rate of decomposition of hydrogen peroxide catalyzed by  $FeCl_3$ .

### 7. Electrochemistry

#### Potentiometry

Determination of redox potential of  $Fe^{2+}/Fe^{3+}$  by potentiometric titration of ferrous ammonium sulphate vs. potassium dichromate.


Precipitation titration of  $KCl$  vs.  $AgNO_3$  -Determination of given concentration of silver nitrate.


#### pH metry:

pH metric titration of strong acid ( $HCl$ ) vs. strong base- Determination of the concentration of the given acid.



  
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**B.Sc. III yr CHEMISTRY**  
**SEMESTER WISE SYLLABUS**

**SEMESTER VI**

**Advanced Chemistry – VII**

**Unit-I (Inorganic Chemistry)**

**15h (1 h/week)**

**S6-I-1: Reaction mechanism**

**8h**

Labile and inert complexes, Thermodynamic and kinetic stability based on VBT & CFT: ligand substitution reactions –  $S_N1$  and  $S_N2$  in Octahedral complexes; substitution reactions of square planar complexes – Trans effect and applications of trans effect. Reactions of tetrahedral complexes-Hydrolysis of silicone halides and phosphorous oxides.

**S6-I-2: Boranes ad Carboranes: 2 h**

Definition of clusters. Structures of boranes and carboranes- Wade's rules, closo, nido arachno Boranes and carboranes.

**S6-I-3: Symmetry of molecules 5 h**

Symmetry operations and symmetry elements in molecules. Definition of Axis of symmetry types of  $C_n$ , Plane of symmetry ( $\sigma_h$ ,  $\sigma_v$ ,  $\sigma_d$ ) Center of symmetry and improper rotational axis of symmetry ( $S_n$ ). Explanation with examples.

**S6-I-4: Non – aqueous solvents 4 h**

Classification and characteristics of a solvent. Reactions in liquid ammonia – physical properties, auto-ionisation, examples of ammono acids and ammono bases. Reactions in liquid ammonia – precipitation, neutralization, solvolysis, solvation - solutions of metals in ammonia, complex formation, redox reactions. Reactions in HF – autoionisation, reactions in HF – precipitation, acid – base reactions, protonation.

**Unit –II (Organic Chemistry)**

**15 h (1h/week)**

**S6-O-1: Pericyclic Reactions**

**5 h**

Concerted reactions, Molecular orbitals of ethene, 1,3-butadiene and allyl radical. Symmetry properties, HOMO, LUMO, Thermal and photochemical pericyclic reactions. Types of pericyclic reactions – electrocyclic, cycloaddition and sigmatropic reactions – one example each and their explanation by FMO theory.

**S6-O-2: Synthetic Strategies**      **5 h**

Terminology – Target molecule (TM), Disconnection approach – Retrosynthesis, Synthons, Synthetic equivalent (SE), Functional group interconversion (FGI), Linear, Convergent synthesis. Retrosynthetic analysis of the following molecules: 1) acetophenone 2) cyclohexene and 3) phenylethylbromide.

**S6-O-3: Asymmetric synthesis**      **5 h**

Definition and classification of stereoselective reactions: substrate, product stereoselective reactions, enantio and diastereo selective reactions. Stereospecific reaction – definition – example – dehalogenation of 1,2-dibromides induced by iodide ion. Enantio selective reactions – definition – example – Reduction of Ethyl acetoacetate by Yeast. Diastereoselective reaction- definition-example: Acid catalyzed dehydration of 1-phenylpropanal and Grignard addition to 2- phenyl propanal. Definition and explanation of enantiomeric excess and diastereomeric excess.

**Unit –III (Physical Chemistry)**

**15 h (1h/week)**

**S6-0-P-1: Polymers**

**15 hrs.**

Definition of polymers — natural polymers and synthetic polymers examples classification as plastics, fibers, elastomers.

Thermosetting. thermoplastic polymers. branched, cross linked and co-polymers.

Definition of polymerization -addition and condensation polymerization with examples.

Explanation: chain polymerization step polymerization, co polymerization and coordination polymerization. Kinetics of free radical polymerization. Tacticity, atacticity, stereo specific synthesis- Zeigler- Natta catalyst.

Molecular weight definition number average, weight average molecular weight. Determination

Of molecular weight of polymers using viscosity method, Osmometric method. Problems.

Preparation and industrial applications of polyethylene, poly vinyl chloride (PVC), nylon- 66, teflon, polyacrylonitrile and terelene. Introduction to biodegradability and examples of biodegradable polymers.

**Unit –IV (General Chemistry)**

**15 h (1h/week)**

**Unit IV: Electroanalytical methods**

**S6-G-I:** Types of Electroanalytical Methods.

**Interfacial methods** – a) Potentiometry: Principle, Electrochemical cell, Electrodes- (i) Indicator and (ii) Reference electrodes – Normal Hydrogen Electrode, Quinhydrone Electrode, Saturated Calomel Electrode. Numerical Problems. Application of Potentiometry – Assay of Sulphanilamide



b) Voltammetry – three electrode assembly; Introduction to types of Volta metric techniques, micro electrodes, Over potential and Polarization.

**Bulk methods** – Conductometry, Conductivity Cell, Specific Conductivity, Equivalent Conductivity. Numerical Problems. Applications of conductometry. Estimation of  $\text{Cl}^-$  using  $\text{AgNO}_3$ . Determination of Aspirin with  $\text{KOH}$ .

**References:**

**Recommended Text Books and Reference books**

1. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paull. Gaus 3 rd edn Wiley Publishers (2001).
2. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4 th edn. (2006)
3. Inorganic Chemistry by Shriver and Atkins 3 rd edn Oxford Press (1999).
4. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications (1996).
5. Symmetry and Spectroscopy of Molecules, K. Veera Reddy, Second Edition, New Age International (P) Limited Publishers
6. Textbook of Inorganic Chemistry by R Gopalan, Universities Press,(2012)
7. Text book of organic chemistry by Morrison and Boyd, Pearson Publishers (2009)
8. Text book of organic chemistry by Graham Solomons, Wiley(2015)
- 9.Fundamentals of organic synthesis and retrosynrthetic analysts by RAMO Kumar Kat-. NCBA,(2014)
10. Organic synthesis by Dr. Jagadamba <and Dr. I...DA. Taday, Preget. Prakashart. 2010
- 11.Stereo chemistry Of organic compounds by b. Nasipuri New Academie Science Limited, 2012
12. Organic chemistry by Claydes4 Greeves, Warten and Wothers, Oxford University Prey, 2001 13. Fundamental asymmetric Synthesis by G. L. DMA\* Krupadanarn, Linivetsitiast Press(2014)
14. Polymer Chemistry, Arora and M Singh
15. Introductory Polymer Chemistry by G S Ivlisra
16. Textbook of Polymer Science, F. W. Billmeyer Jr, John Wiley & sons
17. Polymer Science, V. R. Gowarikar, ISL V. Viswanathan & J. Sreecihar, Wiley Eastern
18. Contemporary Polymer Chemistry. Alcock & F. W. Lambe, Prentice Hall
19. Materials Science and Engineering an Introduction by William D. Canister, Jr. John Wiley & Sons.
20. Principles of Instrumental Analysis, D.A. Skoog, F.J Holler, T..A. Nieman, Engage earning India E
- 21.Fundamentals of Analytical Chemistry 6 th Ed., D. A. Skoog, D.M. West. F.j. a0110(4, Saunders College Publishing.. Fort worth (1992).
22. Physical Chemistry by Atkins and De Pai,414,,8 th Edn. 2, Physioal. Chemistry by Puri, Sharma, and Pattania, 2017

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**B.Sc. Chemistry III Year**

**Semester-VI, Paper-VI**

**Elective-A (3 Credits)**

**Medicinal Chemistry**

**60Hrs**

**S6-E-A-I: Unit- I: Introduction and Terminology**

**15Hrs**

**Diseases:** Common diseases, infective diseases—insect borne, air-borne, water-borne and hereditary diseases.

**Terminology in Medicinal Chemistry:** Drug, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics, metabolites, anti metabolites and therapeutic index.

**Drugs:** Nomenclature: Chemical name, Generic name and Trade names with examples; Classification: Classification based on structures and therapeutic activity with examples.

**ADME:** a) Absorption: Definition, absorption of drugs across the membrane – active and passive absorption, routes of administration of drugs. b) Distribution: definition and effect of plasma protein binding. c) Metabolism: definition, phase I and phase II reactions.

d) Elimination: definition and renal elimination.

**S6-E-A-II: Unit-II: Enzymes and Receptors**

**15Hrs**

**Enzymes:** Introduction. Mechanism and factors affecting enzyme action, Specificity of enzyme action (including stereo specificity), Enzyme inhibitors and their importance. Types of inhibition - reversible, irreversible and their subtypes with examples.

**Receptors:** Introduction, Drug action-receptor theory, Mechanism of drug action, concept of agonists and antagonists with examples. Drug receptor interactions involved in drug receptor complex. binding role of – OH group, -NH<sub>2</sub> group, quaternary ammonium salts and double bond.

Structure – activity relationships of drug molecules, explanation with sulfonamides.

**S6-E-A-III: Unit- III: Synthesis and Therapeutic Activity of Drugs**

**15Hrs**

Introduction, synthesis and therapeutic activity of:

**Chemotherapeutics:** Sulphanilamide, dapsone, Penicillin-G (semi synthesis), Chloroquine, Isoniazid, Cisplatin and AZT.

**Drugs to treat metabolic disorders:** Anti diabetic - Tolbutamide; Anti-inflammatory –Ibuprofen; Cardiovascular- Glyceryl trinitrate; Antipyretic (paracetamol, aspirin) and Antacid- Omeprazole.

**Drugs acting on nervous system:** Anesthetics-definition, Classification-local and general. Volatile- Nitrous oxide, chloroform uses and disadvantages. Local anesthetics – benzocaine.



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**S6-E-A-IV: Unit- IV: Molecular Messengers and Health Promoting Drugs**

**15Hrs**

**Molecular Messengers:** Introduction to hormones and neurotransmitters, Thyroid hormones, Antithyroid drug-Carbimazol. Adrenaline: Adrenergic drugs- salbutamol, atenelol. Serotonin: SSRIs- fluoxetine. Dopamine: Antiparkinson drug- Levodopa.

**Health promoting drugs:** Introduction, sources, Deficiency disorders and remedy of Vitamins A,B, C, D, E K and micronutrients – Na, K, Ca, Cu, Zn and I .

**Reference books**

1. G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, New York. 2013.
2. Thomas No Grady, Medicinal Chemistry, Oxford Univ. Press, New York.2005
3. David William and Thomas Lemke, Foye's Principles of Medicinal Chemistry, Lippincott Williams & Wilkins, 2008.
4. Ashutosh Kar Medicinal Chemistry, New Age International, 2005.
5. O.D.Tyagi & M.Yadav Synthetic Drugs by, Anmol Publications,1998.
6. Medicinal Chemistry by Alka L. Gupta, Pragati Prakashan.
7. G.L. David Krupadanam, D.Vijaya Prasad, K.Varaprasad Rao, K. L. N. Reddy, C. Sudhakar, Drugs, Universities Press (India) Ltd. 2012.

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B.Sc. Chemistry III Year  
Semester –VI, Paper-VI  
Discipline Specific Elective-B (4 Credits)  
Agricultural and Fuel Chemistry

60 Hrs

**Unit I: – Pesticides**

15Hrs

**S6-E-B-I: Introduction.** Definition, classification of pesticides based on use (target). Toxicity and chemical structure with examples. Adverse effects of pesticides and its impact on environmental pollution.

Synthesis, manufacture and uses of representative pesticides: Organochlorines (Cypermethrin); Organophosphates (Parathion); Carbamates (Carbaryl); Quinones(Chloranil), Anilides(Alachlor).  
**Pesticide formulations:** Dusts, Granules, Wettable powders, Emulsions and Aerosols.

**Biopesticides :** Introduction: Potential pesticidal plants of India, Role of Neem in plant protection-constituents, Azadirachtin and its role in pest control, Structure and mode of action of Pyrethrins( pyrethrin-I) and Pyrethroids (permethrin) and nicotinoids (Imidacloprid).

**Unit II: – Fertilizers**

15Hrs

**S6-E-B-II: Introduction:** (need of fertilizers), functions of essential plant nutrients (N, P, K), Classification formula and uses of fertilizers:

**Nitrogenous fertilizers:** Ammonium nitrate, Urea, Calcium Cyanamide, Calcium Ammonium Nitrate, Sodium Nitrate, Ammonium Chloride and their uses.

**Phosphate fertilizers:** Normal super phosphate, Triple Super Phosphate, Ammonium Phosphate and their uses.

**Potassium fertilizers:** Potassium chloride, potassium nitrate, potassium sulphate and uses. Complex fertilizers: Diammonium Phosphate and mixed fertilizers their uses. Manufacture of urea and Super phosphate of lime and their reactions in the soil.

**Biofertilizers –** Introduction, definition, classification, Rhizobium, Azatobactor, Azospirillum, Azolla, Blue Green Algae, Vermicomposting and uses.

**Organic farming:** The principal methods, crop rotation, green manures and compost, biological pest control, and mechanical cultivation and uses.

**Unit III: Energy Sources and Coal**

15Hrs.

**S6-E-B-III:** Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

**Coal:** Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar based chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

**Unit IV: Petroleum and its products, petrochemicals and non petroleum fuels**

15Hrs.

**S6-E-B-IV:**

**Petroleum and its products**

**Petroleum:** Origin, Composition of crude petroleum and classification. Properties- flash point and its determination, Knocking and antiknocking compounds; Octane number, and Cetane number. Distillation of crude petroleum, Fractional Distillation - Principle and process, refining, Fractions and uses. Cracking -Thermal and catalytic cracking, Reforming



**Petroleum products** – Petrol, Diesel, LPG, Kerosene, Tar and their applications.

**Petrochemicals:** Vinyl acetate, Propylene oxide, Isoprene and their uses.

**Lubricants:** Classification of lubricants- Solid, semisolid and liquids; Properties (viscosity, flash point, fire point, cloud point, pour point) and their determination. Functions of lubricants. Mechanism of lubrication.

**Non-petroleum fuels:** Natural Gas-CNG, LNG, Clean Fuels-H<sub>2</sub> gas, ethanol, Fuel from waste - bio-gas, Fuel from biomass -bio-ethanol, biodiesel, Synthetic fuels- syngas based.

#### Recommended Text Books and Reference books

1. Chemistry of pesticides, N. N. Melnikov, Springer-Verlag- Technology & Engineering (2012).
2. Pesticide Synthesis Handbook, Thomas A. Unger, Elsevier, (2000).
3. Pesticides, R. Cremlyn, John Wiley, 1980.
4. Manures and Fertilisers, K. Kolay, Published by Atlantic (2007).
5. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).
6. A Text Book of Engineering Chemistry Paperback – 2017 by Shashi Chawla
7. Industrial Chemistry, Vol-I, Stocchi, E, Ellis Horwood Ltd. UK (1990).
8. Jain, P.C. and Jain, M. Engineering Chemistry Dhanpat Rai & Sons, Delhi.
9. Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Sons, Delhi.

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*Srinivas*

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Semester - VI  
Laboratory course  
Paper VI Experiments in Physical Chemistry-II

45h (3 h/w)

1. Kinetics

- Determination of specific reaction rate of the hydrolysis of methyl acetate catalyzed by hydrogen ion at room temperature.
- Determination of rate of decomposition of hydrogen peroxide catalyzed by  $\text{FeCl}_3$ .

2. Electrochemistry

A. Potentiometry:

- Determination of redox potential of  $\text{Fe}^{2+}/\text{Fe}^{3+}$  by potentiometric titration of ferrous ammonium sulphate vs. potassium dichromate.
- Precipitation titration of  $\text{KCl}$  vs.  $\text{AgNO}_3$  -Determination of given concentration of silver nitrate.

B. pH metry:

- pH metric titration of strong acid ( $\text{HCl}$ ) vs. strong base- Determination of the concentration of the given acid.
- pH metric titration of weak acid(acetic acid) with strong base(  $\text{NaOH}$ ).- Determination of acid dissociation constant ( $K_a$ ) of weak acid.

3. Conductometry:

- Determination of overall order: Saponification of ethyl acetate with  $\text{NaOH}$  by conductance measurements.

Reference books:

- Senior practical physical chemistry. B. D. Khosla, V.C. Garg, Adarsh Gulati
- Advanced Practical Physical chemistry: J.B.Yadav
- Practical Physical Chemistry: B. Vishwanathan and P.S. Raghavan.
- Practical in Physical Chemistry: P.S. Sindhu

*H. N. S. S.*

*Y. R. Rao*

*Ch. R. S. S.*

*S. S. S.*

*S. S. S.*

*C. S. S.*

*L. Kamala*

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**Model question papers**  
Faculty of Science  
B.Sc. I,II&III Year (I To VI semesters)  
CHEMISTRY- I TO VIII (NEW CBCS)

Time: 2½ Hrs.

Max.Marks: 70

SECTION – A

Answer All of the following questions:

(5 x 2 = 10)

1. Unit-I
2. Unit-II
3. Unit-III
4. Unit-IV
5. from Any Unit

SECTION – B

Answer any FOUR of the following questions:

(4 x 5 = 20)

6. Unit-I
7. Unit-II
8. Unit-III
9. Unit-IV
10. Unit-I or Unit-II
11. Unit-III or Unit-IV

SECTION – C

Answer ALL of the following questions:

(4 x 10 = 40)

12. (a). Unit-I
- (b). Unit-I

(OR)

- (c). Unit-I
- (d). Unit-I

13. (a). Unit-II
- (b). Unit-II

(OR)

- (c) Unit-II.
- (d) Unit-II

14. (a). Unit-III
- (b). Unit-III

(OR)

- (c) Unit-III.
- (d). Unit-III

15. (a). Unit-IV
- (b). Unit-IV

(OR)

- (c). Unit-IV
- (d). Unit-IV

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## Model question papers

Faculty of Science

B.Sc. II Year (III & IV semesters)

### Skill Enhancement Course- (NEW CBCS)-INTERNAL EXAMINATIONS

1. ANSWER ANY FIVE QUESTIONS

5X2=10

1. Unit-I
2. Unit-I
3. Unit-I
4. Unit-I
5. Unit-I
6. Unit-II
7. Unit-II
8. Unit-II
9. Unit-II
10. Unit-II

B.Sc. II Year (III & IV semesters)

### Skill Enhancement Course- (NEW CBCS)-EXTERNAL EXAMINATIONS

1. ANSWER ANY FOUR QUESTIONS

2x20=40 marks

1. Unit-I
2. Unit-I
3. Unit-II
4. Unit-II

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