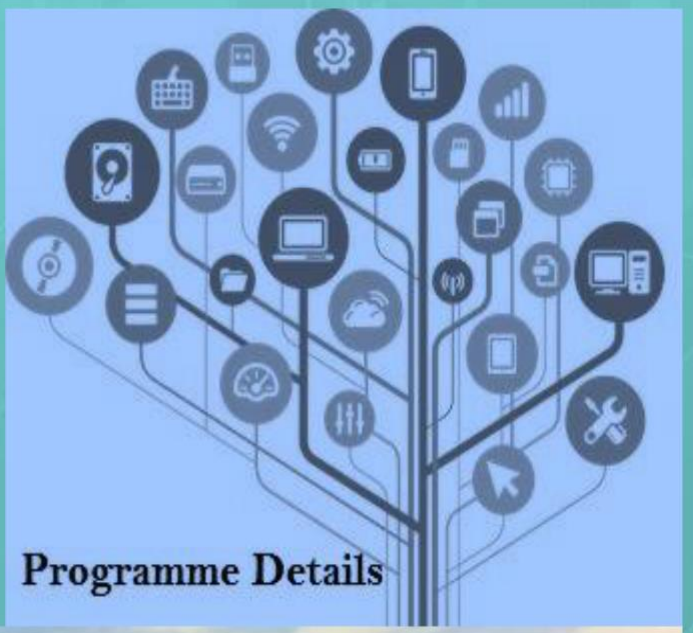
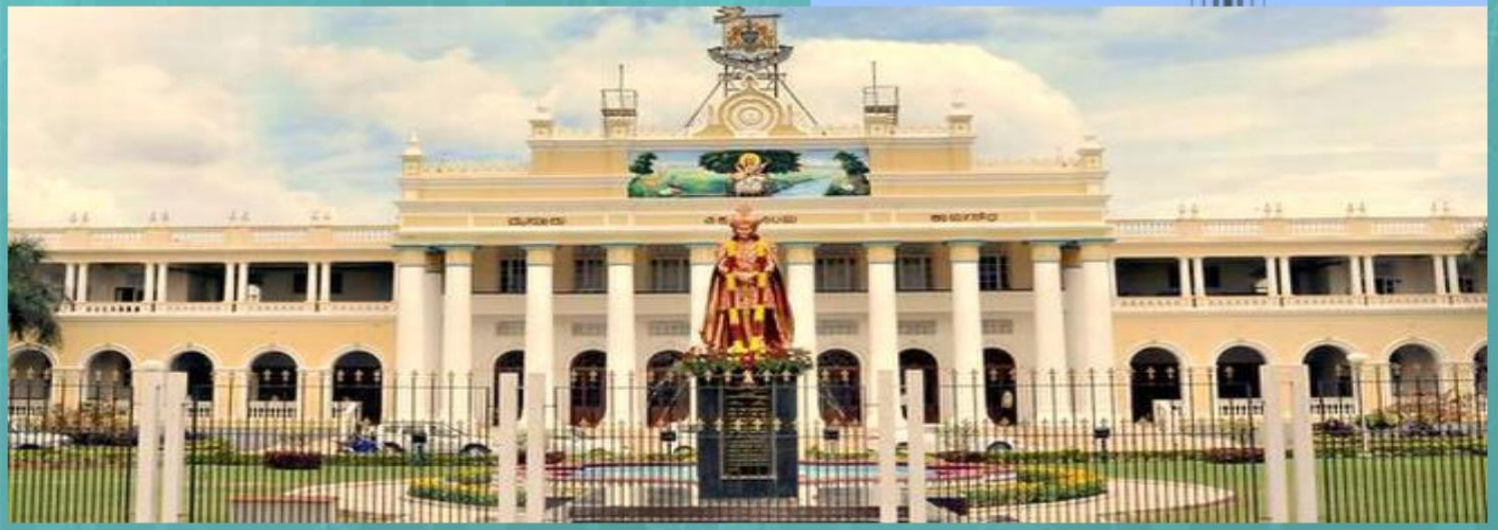
University of Mysore

(Estd.1916)

M.Sc. Organic Chemistry

Choice Based Credit System (CBCS)





SYLLABUS FOR M. Sc. DEGREE PROGRAMME FOR CHOICE BASED CREDIT SYSTEM AND CONTINUOUS ASSESMENT GRADING PATTERN (CBCS-CAGP)

ORGANIC CHEMISTRY

2018-19

Programme Outcomes

The M.Sc., programme in Organic Chemistry is highly sought programme among Chemical sciences in the University. On successful completion of this programme each student will:

- Have a strong foundation in understanding the basic inorganic, physical, organic, bioorganic, and drug reactions that occurs in applied chemical systems at molecular level.
- Further, the student will be able to learn cutting edge technology in the field of organic chemistry, chemical biology, medicinal chemistry, and pharmaceutical chemistry.
- Develop practical skills along with their theory components, which will help in their research programme both in academic institutions and in R & D programmes of industries.
- Inculcate skills for teaching in academic institutions for undergraduate and postgraduate students.
- Develop confidence in taking competitive examination in the field of life science both in India and abroad so that they can pursue higher education.

Programme Specific Outcomes

- Generation of Chemist who has a sound knowledge in the basics of organic and medicinal chemistry.
- Emerging a chemist who fit to teach/research in the area of chemistry and chemical biology
- Skilled teachers be produced in the area of chemical sciences
- Generation of skilled persons to work in pharmaceutical industry
- Generation of sound knowledge in socio-medical subjects related to drugs formulations and drugs abuse.
- Alcohol awareness and toxicity knowledge person emergence.
- Drug discovery and development personnel are generated.

Pedagogies employed in the M.Sc., programme

- Class room teaching will be using black board and chalk, power point presentation and information and communications technology.
- One on one interaction or with small student numbers during tutorial classes.
- Individual student performs experiments as per the protocol in practical classes.
- Student seminar/research paper presentation in each semester.
- Students will be tested for their writing abilities to answer precise and essay type questions.
- Every semester the students will be subjected to viva voce examinations by external examiners.
- Project work on a small research problem.
- Literature review in the form of Dissertation.
- Invited talks from eminent scientists.
- Black board and chalk piece based conventional method of teaching and modern methods like power point presentation, hands on training, and information and communications technology was used in class room teaching.
- Molecular models and Chemical structure drawing software's was used to teach molecular symmetry, stereochemistry, 3D view of chemicals.
- For teaching solids, crystal models (MX and MX_2 types) can be utilized.
- The structure based molecular docking software was used to understand the drug-biomolecule interaction
- Each student performs experiments as per the protocol in practical classes.
- For the preparation of new compounds, each student can adopt new experimental setup, and also exposed to different analytical instruments for qualitative and quantitative

analysis. In addition to this, students will acquire a skill to handle instruments independently.

- Students will be presenting seminar topic/research paper in each semester.
- The writing abilities in presentation of precise answer and essay type questions will be tested.
- Every semester, each student will be subjected to viva voce examinations by external examiners.
- Every student will work for their project on a small research problem.
- Rigorous training will be giving for every student to interpret spectral data in the respective course including their dissertation.
- Arrange the invited talk/lecture series by eminent scholars from different intuitions.
- Conduct the national/ international conferences to upgrade the subject knowledge.

Programme Structure (LTP)

THE SKELETAL SCHEME OF PATTERN FOR CHOICE BASED CREDIT SYSTEM

Semesters	Hard Core		Soft Core		Open Elective
I	T	3+0+0	T	3+0+0=3	
	T	3+0+0	P	0+0+2=2	
	T	3+0+0	P	0+0+2=2	
	T	3+0+0	P	0+0+2=2	
II	T	3+0+0	T	3+0+0=3	
	T	3+0+0	P	0+0+2=2	
	T	3+0+0	P	0+0+2=2	
	T	3+0+0	P	0+0+2=2	
III	T	3+0+0	T	3+0+0=3	
	T	3+0+0	P	0+0+2=2	4+0+0=4
	T	3+0+0	P	0+0+2=2	
IV	T	3+0+0	P	0+0+2=2	
	T	3+0+0	P	0+0+2=2	
	Diss.	4+0+0			
Credits	**43**		**29**		

Total Credits 76

GENERAL INSTRUCTIONS

Scheme of Instructions

1. A Masters Degree programme is of 4 semesters-two years duration. A candidate can avail a maximum of 8 semesters – 4 years (in one stretch) to complete Masters Degree (including blank semesters, if any). Whenever a candidate opts for blank semesters, he/she has to study the prevailing courses offered by the department when he/she continues his/her studies.

2. A candidate has to earn a minimum of 76 credits, for successful completion of a Master Degree. The 76 credits shall be earned by the candidate by studying Hardcore, Soft Core and Open Elective.

3. **Minimum for Pass:** In case a candidate secures less than 30% in C1 and C2 put together, the candidate is said to have DROPPED the course, and such a candidate is not allowed to appear for C3.

4. In case a candidate secures less than 30% in C3, or secures more than 30% in C3 but less than 50% in C1, C2 and C3 put together, the candidate is said to have not completed the course and he/she may either opt to DROP the course or to utilize PENDING option.

5. **Credits (Minimum) Matrix:** A candidate has to study a minimum of 20 credits in Soft Core (sum total of 4 semesters) and 04 credits in Open Elective (III Semester) for the successful completion of the Masters degree programme.

6. All other rules and regulations hold good which are governed by the University from time to time.

Definitions

1. In the Choice Based Credit System – Continuous Assessment Grading Pattern (CBCSCAGP), programme means a course and a course means a paper.

2. Composite course means which includes both Theory and

SCHEME OF STUDY AND EXAMINATION

First semester
HARD CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCIHCT 1.1	Inorganic Chemistry – I	3	3	100	15	15	70
OCOHCT 1.2	Stereochemistry & reaction mechanism	3	3	100	15	15	70
OCPHCT 1.3	Physical Chemistry – I	3	3	100	15	15	70
OCGHCT 1.4	Chemical Spectroscopy	3	3	100	15	15	70

SOFT CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCOSCT 1.51	Carbohydrates, Peptides & Nucleic acids	3	3	100	15	15	70
OCOSCT 1.52	Lipids, Anthocyanins & Porphyrins	3	3	100	15	15	70
OCISCP 1.53	Inorganic Chemistry Practical-I	4	2	100	15	15	70
OCOSCP 1.54	Organic Chemistry Practical-I	4	2	100	15	15	70
OCPSCP 1.55	Physical Chemistry Practical-I	4	2	100	15	15	70

SCHEME OF STUDY AND EXAMINATION

Second semester

HARD CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCIHCT 2.1	Inorganic Chemistry – II	3	3	100	15	15	70
OCOHCT 2.2	Reagents in Organic Synthesis	3	3	100	15	15	70
OCPHCT2 .3	Physical Chemistry – II	3	3	100	15	15	70
OCAHCT2 .4	Advanced Separation techniques	3	3	100	15	15	70

SOFT CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCOSCT 2.51	Vitamins, steroids & terpinoids	3	3	100	15	15	70
OCOSCT 2.52	Industrial Chemicals	3	3	100	15	15	70
OCASCP 2.53	Analytical Chemistry Practical-I	4	2	100	15	15	70
OCOSCP 2.54	Organic Chemistry Practical-II	4	2	100	15	15	70
OCPSCP 2.55	Physical Chemistry Practical-II	4	2	100	15	15	70

SCHEME OF STUDY AND EXAMINATION

Third semester

HARD CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCOHCT 3.1	Synthetic Organic Chemistry	3	3	100	15	15	70
OCOHCT 3.2	Bonding, Photochemistry, pericyclic reaction	3	3	100	15	15	70
OCOHCT 3.3	Green chemistry, molecular rearrangements and heterocyclic chemistry	3	3	100	15	15	70

SOFT CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCOSCT 3.41	Dyes, Insecticides and polymer chemistry	3	3	100	15	15	70
OCOSCT 3.42	Enzymes Functions and their kinetics	3	3	100	15	15	70
OCOSCP 3.43	Organic Chemistry Practical-III	4	2	100	15	15	70
OCOSCP 3.44	Organic Chemistry Practical-IV	4	2	100	15	15	70
OPEN ELECTIVE							
OCOOET 3.51	Applications of synthetic products	3	3	100	15	15	70
OCOOET 3.52	Natural and synthetic products	3	3	100	15	15	70

SCHEME OF STUDY AND EXAMINATION

Forth semester

HARD CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCOHCT 4.1	Organometallic compounds & Organononmetallic compounds	3	3	100	15	15	70
OCOHCT 4.2	Advanced Medicinal chemistry	3	3	100	15	15	70
OCOHCD 4.3	Dissertation	8	4	100	15	15	70

SOFT
CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCOSCP 4.41	Organic Chemistry Practical-V	4	2	100	15	15	70
OCOSCP 4.42	Organic Chemistry Practical-VI	4	2	100	15	15	70

Note:

1. Practical papers are only for organic chemistry students which are compulsory.
2. Examination duration for C3 component for theory papers is 3 hrs and practical papers is 6 hrs.

SCHEME OF STUDY AND EXAMINATION

First semester

HARD CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCIHCT 1.1	Inorganic Chemistry – I	3	3	100	15	15	70
OCOHCT 1.2	Stereochemistry & reaction mechanism	3	3	100	15	15	70
OCPHCT 1.3	Physical Chemistry – I	3	3	100	15	15	70
OCGHCT 1.4	Chemical Spectroscopy	3	3	100	15	15	70

SOFT CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCOSCT 1.51	Carbohydrates, Peptides & Nucleic acids	3	3	100	15	15	70
OCOSCT 1.52	Lipids, Anthocyanins & Porphyrins	3	3	100	15	15	70
OCISCP 1.53	Inorganic Chemistry Practical-I	4	2	100	15	15	70
OCOSCP 1.54	Organic Chemistry Practical-I	4	2	100	15	15	70
OCPSCP 1.55	Physical Chemistry Practical-I	4	2	100	15	15	70

SCHEME OF STUDY AND EXAMINATION

Second semester

HARD CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCIHCT 2.1	Inorganic Chemistry – II	3	3	100	15	15	70
OCOHCT 2.2	Reagents in Organic Synthesis	3	3	100	15	15	70
OCPHCT2 .3	Physical Chemistry – II	3	3	100	15	15	70
OCAHCT2 .4	Advanced Separation techniques	3	3	100	15	15	70

SOFT CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCOSCT 2.51	Vitamins, steroids & terpinoids	3	3	100	15	15	70
OCOSCT 2.52	Industrial Chemicals	3	3	100	15	15	70
OCASCP 2.53	Analytical Chemistry Practical-I	4	2	100	15	15	70
OCOSCP 2.54	Organic Chemistry Practical-II	4	2	100	15	15	70
OCPSCP 2.55	Physical Chemistry Practical-II	4	2	100	15	15	70

SCHEME OF STUDY AND EXAMINATION

Third semester

HARD CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCOHCT 3.1	Synthetic Organic Chemistry	3	3	100	15	15	70
OCOHCT 3.2	Bonding, Photochemistry, pericyclic reaction	3	3	100	15	15	70
OCOHCT 3.3	Green chemistry, molecular rearrangements and heterocyclic chemistry	3	3	100	15	15	70

SOFT CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCOSCT 3.41	Dyes, Insecticides and polymer chemistry	3	3	100	15	15	70
OCOSCT 3.42	Enzymes Functions and their kinetics	3	3	100	15	15	70
OCOSCP 3.43	Organic Chemistry Practical-III	4	2	100	15	15	70
OCOSCP 3.44	Organic Chemistry Practical-IV	4	2	100	15	15	70
OPEN ELECTIVE							
OCOOET 3.51	Applications of synthetic products	3	3	100	15	15	70
OCOOET 3.52	Natural and synthetic products	3	3	100	15	15	70

SCHEME OF STUDY AND EXAMINATION

Forth semester

HARD CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCOHCT 4.1	Organometallic compounds & Organononmetallic compounds	3	3	100	15	15	70
OCOHCT 4.2	Advanced Medicinal chemistry	3	3	100	15	15	70
OCOHCD 4.3	Dissertation	8	4	100	15	15	70

SOFT CORE

Courses	Title	Contact Hour/Week	Credit	Max Marks	Internal Assessments		Semester End Examination
					C1	C2	C3
OCOSCP 4.41	Organic Chemistry Practical-V	4	2	100	15	15	70
OCOSCP 4.42	Organic Chemistry Practical-VI	4	2	100	15	15	70

Note:

1. Practical papers are only for organic chemistry students which are compulsory.
2. Examination duration for C3 component for theory papers is 3 hrs and practical papers is 6 hrs.

SCHEME OF EXAMINATION FOR C1, C2 AND C3 COMPONENTS

Preamble

In view of the CBCS syllabus, following is the model distribution of marks for C1, C2 and C3 Components. At a glance, the model includes both HC/SC/OE as well as Non-composite courses' assessment of marks.

The following is the scheme which will be followed for the assessment of marks for HC/SC/OE as well as Non-composite courses irrespective of the credits

associated with each course. 30% of the marks will be assessed for the internals (C1 and C2) and remaining 70% will be for the Semester End Examinations (C3). Each course carries 100 marks and hence 30 marks will be allotted to internals and remaining 70 marks will be for Semester end Examinations. Out of 30 marks for internals, 15 marks will be allotted to each C1 and C2 components. The distribution of marks for C1 and C2 varies with HC and SC courses.

Each course (HC/SC/OE) consists of three components namely C1, C2 and C3. C1 and

C2 are designated as Internal Assessment (IA) and C3 as Semester End Examination. Each course (HC/SC/OE) carries **100 Marks** and hence the allotment of marks to C1, C2 and C3 Components will be 15, 15 and 70 marks respectively. i.e.,

C1 Component	: 15 Marks	Internal Assessment Marks
C2 Component	: 15 Marks	
C3 Component	: 70 Marks	Semester End Examination
Total	: 100 Marks	

The above will be followed in common for all the HC/ SC (Non-composite)/OE courses in all the four semesters.

1. HARD CORE (03 CREDIT COURSES)

1.1. Distribution of Marks for C1 and C2 Components:

IA consists of 15 marks; it will be divided into three parts *viz*., ***Internal Test, Home Assignment and Seminar***. Internal tests will be conducted during the 8th week of the semester for C1 and 16th week of the semester for C2. Home Assignment will be concerned for C1 Component and Seminar for C2 Component only. Hence, a teacher may give only one assignment (or in their personal interest one more may be given). Since each course has three units, the marks shall be divided equally. Allotment of marks for

C1 and C2 is as follows: Out of 15 Marks for IA for C1, Internal test will be conducted for 30 Marks (10 Marks from each unit and reduced to 10 Marks) and Home Assignment will be given for 05 Marks (Each Home Assignment from every unit will be assessed for 05 Marks and finally reduced to 05 Marks). IA for C2 will be distributed as follows: Internal test will be conducted for 30 Marks (10 Marks from each unit and reduced to 10 Marks) and Seminar will be assigned for 05 Marks for the favor of IA. Please note that actual Seminar will be assessed for 20 Marks and finally 05 Marks will be distributed to each theory HC course. i.e.,

C1		**C2**	
Internal Test	: 30 Marks (10+10+10) **Reduced to 10 Marks**	Internal Test	: 30 Marks (10+10+10) **Reduced to 10 Marks**
Home Assignment	: 15 Marks (05+05+05) **Reduced to 05 Marks**	Seminar	: 15 Marks (05+05+05) **Distributed 05 Marks to each HC course**
Total	**15 Marks**	**Total**	**15 Marks**

2. SOFT CORE (03 CREDIT COURSES)

C1		**C2**	
Internal Test	: 30 Marks (10+10+10) **Reduced to 10 Marks**	Internal Test	: 30 Marks (10+10+10) **Reduced to 10 Marks**
Home Assignment	: 15 Marks (05+05+05) **Reduced to 05 Marks**	Home Assignment	: 15 Marks (05+05+05) **Distributed 05 Marks to each SC**
Total	**15 Marks**	**Total**	**15 Marks**

3. OPEN ELECTIVE (04 CREDIT COURSES)

C1		**C2**	
Internal Test	: 40 Marks (10+10+10+10) **Reduced to 10 Marks**	Internal Test	: 40 Marks (10+10+10+10) **Reduced to 10 Marks**
Home Assignment	: 20 Marks (05+05+05+05) **Reduced to 05 Marks**	Home Assignment	: 20 Marks (05+05+05+05) **Distributed 05 Marks to each OE**
Total	**15 Marks**	**Total**	**15 Marks**

1.2. Distribution of Marks for C3 Component (Semester End Examination)

The question paper is of 3 hr duration with Max. Marks 70. The following question paper pattern will be followed for all the theory courses (HC/SC/OE). Question paper will have FIVE main questions. All the questions will cover all the units of the course with equal marks distribution. Q. No. 1 is of Medium/ Short Answer Type questions which will have nine questions and each question carries two marks. A student has to answer any seven questions. Q. No. 2 to 5 carries 14 marks each and a student has to answer all the four questions (*No Choice*). Each main question will have three sub- sections a, b, c. An examiner may set the questions like (4+4+6) or (5+5+4) or as his/her wish. However, sub-section 'c' will have an internal choice. i.e.,

Model Question Paper Pattern

Max. Duration: 3 Hr Max.

Marks: 70

Note: *Answer all the questions. Each question carries 14 marks.*

1. Nine Medium/ Short Answer Type Questions and any seven should be answered.

   Each question carries TWO marks. **[7 x 2 = 14]**

2. **2. to 5.** All the four questions have to be answered (*No Choice*). Each question carries FOURTEEN marks. An examiner may set the questions like (4+4+6) or (5+5+4) or as his/her wish. However, sub-section c will have an internal choice. (*Two marks questions shall be avoided for 2 to 5*) **[4 x 14 = 56]**

   a.

   b.

   c.

   or

   c.

4. PRACTICALS

The following scheme will be applicable for SC in all the four semesters (SC for organic chemistry students only).

Each practical (SC) consists of three components namely C1, C2 and C3. C1 and C2 are designated as Internal Assessment (IA) and C3 as Semester End Examination. Each practical (SC) carries **100 Marks** and hence the allotment of marks to C1, C2 and C3 Components will be 15, 15 and 70 marks respectively. i.e.,

C1 Component	: 15 Marks	Internal Assessment Marks
C2 Component	: 15 Marks	
C3 Component	: 70 Marks	Semester End Examination
Total	: 100 Marks	

4.1. Distribution of Marks for C1 and C2 Components

IA consists of **15 Marks**; it will be divided into three parts *viz.*, ***Internal Test, Continuous Assessment and Record***. Continuous assessment refers to the daily assessment of each student based on his/her attendance, skill, results obtained etc. Thus, 05 marks are allotted for Continuous Assessment. Internal tests will be conducted for 05 Marks during the 8th week of the semester for C1 and 16th week of the semester for C2. Finally, remaining 05 Marks will be for the record. i.e.,

C1		**C2**	
Internal Test	: 05 Marks	Internal Test	: 05 Marks
Continuous Assignment	: 05 Marks	Continuous Assignment	: 05 Marks
Record	: 05 Marks	Record	: 05 Marks
Total	**: 15 Marks**	**Total**	**: 15 Marks**

4.2. Distribution of Marks for C3 Component (Semester End Examination)

The end examination will be conducted for **70 Marks/course** with a maximum duration of 6 hours. Two experiments will be given to each student which carries 30 Marks each.

Each student will be subjected to Viva-Voce Examination for which 10 Marks is allotted. i.e.,

Two Experiments	: 30+30 Marks
Viva-Voce	: 10 Marks
Total	**: 70 Marks**

5. DISSERTATION/ PROJECT WORK (04 CREDIT COURSE)

Each student is expected to undergo Dissertation/ Project Work under the guidance of the faculty of the department during the IV Semester.

5.1. Distribution of Marks for C1 and C2 Components

IA consists of **15 Marks**; it will be divided into three parts viz., ***Attendance, Continuous Assessment and Work Progress***. Continuous assessment refers to the daily assessment of each student based on his or her skill, results obtained, literature survey etc. C1 will be assessed during the 8th week of the semester and C2 during the 16th week of the semester. Hence, the concerned guide will prepare the marks list based on the above said parameters for both C1 and C2 Components.

5.2. Distribution of Marks for C3 Component (Semester End Examination)

The end examination will be conducted for **70 Marks**. Every student is suppose to prepare a hard copy of the findings of the work in the form of dissertation and submitted for evaluation. This part will be assessed for 50 Marks. Each student will be subjected to Viva-Voce Examination for which 20 Marks is allotted. i.e.,

Evaluation of Dissertation	: 50 Marks
Viva-Voce	: 20 Marks
Total	**: 70 Marks**

OCIHCT 1.1 - INORGANIC CHEMISTRY–I

Course outcome:

This course conveys to deal with the phenomenon of understanding of metal complexes, and their composition using advanced spectroscopic techniques.

Pedagogy:

To introduce the basic concept in metal coordination chemistry

Understanding the application of symmetry and spectroscopic methods with a special reference with inorganic compounds

Course contents:

Chemical Periodicity: Review of periodic properties

Structures and energetics of ionic crystals: Introduction, MX (NaCl, CsCl, ZnS) and MX_2 (fluorite, rutile, β-crystobalite and cadmium iodide) types. The perovskite and spinel structures. Thermodynamics of ionic crystal formation. Lattice energy, Born-Haber cycle, Born-Lande equation. Applications of lattice energetics. Radius ratio rules

Structures and energetics of inorganic molecules: Introduction, Energetics of hybridization. VSEPR model for explaining structure of AB, AB_2E, AB_3E, AB_2E_2, ABE_3,

AB_2E_3, AB_4E_2, AB_5E and AB_6 molecules. M.O. treatment of homonuclear and heteronuclear diatomic molecules. M.O. treatment involving delocalized π-bonding (CO_3^{2-}, NO_3^-, NO_2^- ,CO_2 and N_3^-), M.O. correlation diagrams (Walsh) for triatomic molecules.

Modern concept of acids and bases: Lux-Flood and Usanovich concepts, solvent system and leveling effect. Hard-Soft Acids and Bases, Classification and Theoretical backgrounds.

Non-aqueous solvents: Classification of solvents, Properties of solvents (dielectric constant, donor and acceptor properties) protic solvents (anhydrous H_2SO_4 and HF) aprotic solvents

(liquid SO_2, BrF_3 and N_2O_4). Solutions of metals in liquid ammonia, hydrated electron. Super acids.

Inner transition elements: Spectral and magnetic properties, redox chemistry.

Applications: Lanthanides as shift reagents, high temperature super conductors. Chemistry of trans-uranium elements.

Molecular symmetry and group theory: Symmetry elements and symmetry operations. Concept of a group, definition of a point group. Classification of molecules into point groups. Subgroups. Schoenflies and Hermann-Maugin symbols for point groups. Multiplication tables (C_n, C_{2V} and C_{3V}). Matrix notation for the symmetry elements. Classes and similarity transformation.

Representation of groups: The Great Orthogonality theorem and its consequences. Character tables (C_s, C_i, C_2, C_2v, C_{2h} and C_3v). Symmetry and dipole moment.

Applications of group theory: Group theory and hybrid orbital. Group theory to Crystal field theory and Molecular orbital theory (octahedral and tetrahedral complexes). Determining the symmetry groups of normal modes (both linear and non-linear molecules).

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1. Basic Inorganic Chemistry – 3rd edition. F.A. Cotton, G. Wilkinson and P.L. Gaus, John Wiley and Sons (2002).

2. Inorganic Chemistry, 3rd edition. James E. Huheey, Harper and Row Publishers (1983).

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7. Concepts and Models of Inorganic Chemistry 3rd edition. B.E. Douglas, D.H. McDaniel and Alexander, Wiley (2001).

8. Chemical Applications of group theory, - F.A. Cotton, Wiley Eastern Ltd., 2nd Edition, New Delhi, (1971).

9. Group theory and Symmetry in Chemistry, -G. Raj, A. Bhagi and V. Jain, Krishna Prakashan Media (P) Ltd., Meerut, (1998).

10. Chemical Applications of Group Theory, 3rd edition, F.A. Cotton, John Wiley and Sons (2006).

11. Molecular Symmetry and Group Theory – Robert L Carter, John Wiley and Sons (2005).

12. Symmetry in Chemistry - H. Jaffe and M. Orchin, John Wiley, New York (1965).

13. Group Theory and its Chemical Applications - P.K. Bhattacharya, Himalaya Publications, New Delhi (1998).

OCOHCT 1.2 - STEREOCHEMISTRY AND REACTION MECHANISM

Course outcome:

This course conveys to deal with the phenomenon of understanding the basic nature of organic compounds with a special reference to stereo view, isomerism and chirality.

This course deals with the understating of basic organic reaction mechanism.

Pedagogy:

To introduce the basic concept in organic stereochemistry

To introduce the basic concept in organic reaction mechanism.

Course content:

Stereoisomerism: Projection formulae [fly, wedge, Fischer, Newman and saw horse].

Optical isomerism: Conditions for optical isomerism, optical isomerism due to chiral centers and molecular dissymmetry, allenes and biphenyls, criteria for optical purity. enantiomorphs, diastereoisomers, racemic mixtures and their resolution, configurational notations of simple molecules, DL and RS configurational notations.

Geometrical isomerism: Isomorphism due to C=C, C=N and N=N bonds, E,Z conventions, determination of configuration by physical and chemical methods.

Conformational analysis: Elementary account of conformational equilibria of ethane, butane and cyclohexane, Conformation of cyclic compounds such as cyclopentane, cyclohexane, cyclohexanone derivatives and decalins. Conformational analysis of 1,2-; 1,3-; 1,4- disubstituted cyclohexane derivatives, D-glucose. Effect of conformation on the course of rate of reactions.

Stereoselectivity: Stereoselective reactions, diastereoselective reactions, stereospecific reactions, regioselective & regiospecific reactions.

Addition reactions: Addition to C-C multiple bonds involving electrophiles, nucleophiles and free radicals. Markownikoff's rule and antiMarkownikoff's rule, Hydroboration.

Typical additions to carbonyl compounds: Addition of hydride, water, alcohol, thioalcohol, bisulphite, HCN, Grignard reagents and amino compounds to carbonyl compounds.

Aldol and related reactions: Keto-enol tautomerism, mechanism and synthetic applications of aldol condensations, Claisen reaction, Schmidt reaction, Perkin reaction, Knoevenogel, benzoin, Stobbe and Darzen's glysidic ester condensation, Cannizaro reaction, Tishchenko reaction, Michael addition, Robinson's annulation reactions.

Mechanism of ester formation and their hydrolysis, formation and hydrolysis of amides, decarboxylation mechanisms.

Electrophilic substitution reactions – Kinetics, mechanism and stereochemical factor affecting the rate of S_E1 & S_E2

Aromatic electrophilic substitution reactions: Mechanism of nitration, halogenation, sulphonation, Friedel-Crafts alkylation and acylation, Mannich reaction, chloromethylation, Vilsmeier Haack reaction, Diazonium coupling, Gattermann–Koch reaction, Mercuration reaction.

Aromatic nucleophilic substitution reactions: S_N^1, S_N^2 and benzyne mechanism, Bucherer reaction, von Richter reaction.

Elimination reactions: Mechanism and stereochemistry of eliminations–E1, E2, E1cb mechanism, *cis*-elimination, Hofmann and Saytzeff eliminations, competition between elimination and substitution, Chugaev reaction.

Substitution reactions – Kinetics, mechanism and stereochemical factor affecting the rate of S_N1, S_N2, S_{RN}^i, S_N^i, S_N1', S_N2', S_N1i, reactions, Neighbouring group participation.

References

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2. E. L. Elliel and S. H. Wilen, Stereochemistry of Organic Compounds, John Wiley and Sons, New York. 1994.
3. Introduction to stereochemistry – K. Mislow.
4. R. K. Bansal, Organic Reaction Mechanism, Wiley Eastern Limited, New Delhi, 1993.
5. J. March, Advanced Organic Chemistry, Wiley Interscience, 1994.
6. E. S. Gould, Mechanism and Structure in Organic Chemistry, Halt, Rinhart & Winston, New York, 964.
7. A Guide book to mechanism in Organic Chemistry – Petersykes
8. Stereochemistry and mechanism through solved problems – P. S. Kalsi.
9. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
10. D. Nasipuri, Stereochemistry of Organic Compounds, 2nd edition, Wiley Eastern Limited, New Delhi, 1991.

11. S. K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd, 1998.

OCPHCT 1.3 - PHYSICAL CHEMISTRY–I

Course outcome:

This course conveys to deal with the phenomenon of colloidal, physical, kinetic, and pressure dependent chemical observations in the applied chemistry.

Pedagogy:

To introduce the basic concept in physical chemistry

Course content:

Concepts of entropy and free energy: A brief resume of laws of thermodynamics (First and second laws). Entropy as a measure of unavailable energy. Entropy change during spontaneous process. Helmholtz and Gibbs free energies. Thermodynamic criteria of equilibrium and spontaneity. Variation of free energy with temperature and pressure. Maxwell's relations. Third law of thermodynamics - calculation of absolute entropies. Nernst heat theorem & its applications.

Partial molar properties: Partial molar volumes and their determination by intercept method and from density measurements. Chemical potential and its significance. Variation of chemical potential with temperature and pressure. Formulation of the Gibbs – Duhem equation. Derivation of Duhem-Margules equation.

Fugacity: Concept of fugacity, Determination of fugacity of gases. Variation of fugacity with temperature and pressure. Activity and activity coefficients. Variation of activity with temperature and pressure. Determination of activity co-efficients by vapour pressure, depression in freezing point, solubility measurements by electrical methods.

Thermodynamics of dilute solutions: Raoult's law, Henry's law. Ideal and non-ideal solutions.

Chemical Kinetics: Determination of order of reactions, complex reactions - parallel, consecutive and reversible reactions. Chain reactions - Branched chain reactions- general rate expression, explosion limits.

Theories of reaction rates: Collision theory and its limitations, Activated complex theory (postulates -derivation) and its applications to reactions in solution. Energy of activation,

other activation parameters - determinations and their significance. Lindemann theory of unimolecular reactions. Qualitative account of its modifications (no derivation).

Potential energy surfaces: Features and construction, theoretical calculations of Ea.

Reactions in solution: Ionic reactions - salt and solvent effects. Effect of pressure on the rates of reactions. Cage effect with an example. Oscillatory reactions.

Fast reactions- Study of fast reactions by continuous and stopped flow techniques, relaxation methods (T-jump and P-jump methods), flash photolysis, pulse and shock tube methods.

Electrochemistry of solutions: Arrhenius theory of strong and weak electrolytes and its limitations. Factor effecting electrolytic conductance, Debye-Huckel theory - concept of ionic atmosphere. Debye-Huckel-Onsager equation of conductivity and its validity. Debye-Huckel limiting law (DHL), its modification for appreciable concentrations. A brief survey of Helmholtz-Perrin, Guoy-Chapman and Stern electrical double layer (no derivation). Determination of transference number by emf and Hittorf's methods. True and apparent transference numbers. Abnormal transference numbers, effect of temperature on transference numbers. Liquid junction potential-determination and minimization.

Irreversible electrode process: Introduction, reversible and irreversible electrodes, reversible and irreversible cells. Polarization, over voltage - concentration over voltage, activation over voltage and ohmic over voltage. Experimental determination of over voltage. Equations for concentration over potential, stationary and non-stationary surface. Polarography- Half wave potential, application in qualitative and quantitative analysis. Butler-Volmer equation, Tafel

equation. Hydrogen oxygen over voltage. Effect of temperature, current density and *p*H on over voltage.

Reference

1. Physical Chemistry by P.W. Atkins, ELBS, 5th edition, Oxford University Press (1995).
2. Text Book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., 2nd edition (1974).
3. Elements of Physical Chemistry by Lewis and Glasstone.
4. Fundamentals of physical chemistry – Maron and Lando (Collier Macmillan) 1974.
5. Thermodynamics for Chemists by S. Glasstone, Affiliated East-West Press, New Delhi, (1965).
6. Chemical Thermodynamics by I.M. Klotz, W.A. Benzamin Inc. New York, Amsterdam (1964).
7. Chemical Kinetics by K.J. Laidler.
8. Chemical Kinetics by Frost and Pearson.
9. Kinetics and Mechanism of Chemical Transformation by J. Rajaram and J.C. Kuriacose.
10. Chemical Kinetics by L.K. Jain.
11. Chemical Kinetics by Benson.
12. Text Book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., 2nd edition (1974).
13. Elements of Physical Chemistry by Lewis and Glasstone.
14. Physical Chemistry by P.W. Atkins, ELBS, 4th edition, Oxford University Press (1990).

15. Physical Chemistry – G.M. Barrow, McGraw Hill International Service (1988).

16. Introduction to Electrochemistry by S. Glasstone.

17. Electrochemistry –Principles and Applications by E.G. Potter.

18. Electrochemistry by Reiger, Prentice Hall (1987).

19. Modern Electrochemistry Vol. I and II by J.O.M. Bockris and A.K.N. Reddy, Pentium Press, New York (1970).

OCGHCT 1.4 - CHEMICAL SPECTROSCOPY

Course outcome:

This course deal with the application of spectroscopic methods to determine the organic and drug compounds integrity and structure.

Pedagogy:

To introduce the concept of spectroscopic tools employed to elucidate the structure of organic compounds.

Course content:

UV-Visible spectroscopy: Modes of electronic excitations, simple chromophoric groups– systems of extended conjugation, aromatic systems. Types of auxochromes–functions of auxochromes, absorption and intensity shift. Types of transition probability, types of absorption bonds, solvent effects and choice of solvent. Effect of polarity on various type of bonds, Woodwards empherical rules for predicting the wavelength of maximum absorption: - Olefins, conjugated dienes, cyclic trienes and polyenes, α,β-unsaturated aldehydes and ketones, benzene and substituted benzene rings.

IR spectroscopy: Principles, Hook's law, characteristic group frequencies and skeletal frequencies. Finger print region. Identification of functional groups: Alkenes, alkynes, aromatics, carbonyl compounds (aldehydes and ketones, esters and lactones), halogen compounds, sulphur and phosphorous compounds, amides, lactams, amino acids, and imines. Factors affecting group frequencies and band shapes, conjugation, resonance and inductance, hydrogen bonding and ring strain, tautomerism, cis-trans isomerism. Applications of IR spectra to co-ordinatation compounds, organotransition metal complexes (N,N-dimethyl acetamides, urea, DMSO, NO_3^-, SO_4^{--}, NO_2^-). Introduction to Raman spectroscopy and its applications.

Nuclear magnetic resonance spectroscopy: General introduction and defination, magnetic properties of nuclei (magnetic moment, g factor) and theory of nuclear resonance. Larmor precession frequency, resonance condition and relaxation processes.

Chemical shift: Standards employed in NMR, factors affecting chemical shift, electronegativity, shielding and deshielding mechanism, Vander waals deshielding, H-bonding, diamagnetic and paramagnetic anisotropics. Spin-spin coupling, chemical shift values and correlation for protons bonded to carbon and other nuclei. Instrumentation and sample handling.

Equivalence and magnetic equivalence proton exchange reactions, effects of chiral center, complex spin-spin interaction, stereochemistry, hindered rotation, Karplus curve-variation of coupling constants with dihedral angles. Simplification of complex spectra: isotopic substitution, increasing magnetic field strength, double resonance, spin decoupling, constant shift reagents, solvent effect, Fourier-transfer technique, variable temperature profile, nuclear overhauser effect (NOE). ^1H NMR and ^{13}C NMR spectroscopy, Multiplicity-proton decoupling, noise decoupling, off resonance decoupling, selective proton decoupling. Applications of NMR: Structural diagnosis, conformational analysis, keto-enol tautomerism, hydrogen bonding. Two dimensional NMR spectroscopy: COSY, NOESY, MRI.

Mass spectrometry: Principles, instrumentation, different methods of ionization, EI, CI, FD and FAB, ion separators: single focusing separator with magnetic diffraction, focusing analyzer, time-of–flight separator and quadrupole analyzer. Mass spectra: molecular ion, base peak, meta-stable peak, nitrogen rule and McLafforty rearrangement. Mass spectral fragmentation of organic compounds and common functional groups: normal and branched alkanes, alkenes, cycloalkanes, benzene and its derivatives, alcohols, phenols, aldehydes and ketones, carboxylic acids, and their derivatives, amines, nitrocompounds. Determination of molecular formula by accurate molecular weight and isotopic abundance methods. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

LC-MS, LC-MS/MS, GC-MS: Principles and applications

Composite problems: Problems involving the application of the above spectroscopic techniques for structural elucidation of organic molecules.

References

1. Spectroscopy by B. P. Straughan and S. Walker, John Wiley & Sons Inc., New York, Vol. 2, 1976.

2. Organic spectroscopy by William Kemp, ELBS Society, MacMillan, 1987.

3. Application of absorption spectroscopy of organic compounds by John R. Dyer, Prentic-Hall of India Private Ltd., New Delhi, 1974.

4. Organic spectroscopy by V. R. Dhani, Tata McGrow-Hall publishing company Ltd., New Delhi, 1995.

5. Spectrometric identification of organic compounds, 4^{th} edition, Robert M. Silverstein, G. Clayton Bassler and Terence C. Morrill, John Wiley & Sons Inc., New York, Vol. 1, 1981.

6. Interpretation of carbon-13 NMR spectra, F. W. Wehrli and T. Wirthlin, Heyden, London, 1976.

OCOSCT 1.51 - CARBOHYDRATES, PEPTIDES & NUCLEIC ACIDS

Course outcome:

This course conveys to deal with the phenomenon of understanding of the composition of the major cellular components such as carbohydrates, peptides & nucleic acids.

Pedagogy:

To introduce the basic concept in biological macromolecules like carbohydrates, peptides & nucleic acids.

Course content:

Monosaccharides: Introduction, general reactions, ring size determination of monosaccharides, configuration and conformations of monosacharides, anomeric effect, Hudson's rules, epimerization and mutarotation. Synthesis and biological importance of glycosides, amino sugars, anhydrosugars.

Dissaccharides: Structure, synthesis and biological aspects of sucrose, maltose and lactose. Industrial applications of sucrose.

Polysaccharides: General methods of structure elucidation.

Amino acids: General structure, essential amino acids physiological properties, isoelectric points, buffers {phosphate and acetate buffers) and two methods of synthesis (Gabriel phthalimide synthesis and Strecker synthesis).

Peptides: Peptide bond, structure determination: Amino acid residue analysis, C and N-terminal determination, selective cleavage of peptide bonds (two chemical and biochemical methods); Peptide synthesis: - Protection of amino group (Boc, Cbz, Fmoc-), carboxyl group as alkyl and aryl esters and activation of carboxylic groups, solution and solid phase techniques, use of DCC and Merrifield's resin, Racemization during peptide synthesis,

synthesis of oxytocin, insulin, vasopressin and gramicidin, brief account of MSH, ACTH and HOBT.

Proteins: Primary, secondary, tertiary and quaternary structures of proteins. Denaturation and renaturation of proteins. Biological importance of proteins.

Nucleic acids: Introduction, structure and synthesis of nucleosides and nucleotides, protecting groups for hydroxy group in sugar, amino group in the base and phosphate functions. Methods of formation of internucleotide bonds: DCC, phosphodiester approach, phosphite triester and phosphoramide methods. Solid phase synthesis of oligonucleotides.

Structure of RNA and DNA, Crick-Watson model, role of nucleic acids in the biosynthesis of proteins. Genetic code, replication of DNA,

References

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2. K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, 1st edition, New Delhi, 1993.
3. Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.
4. Encyclopedia of Chemical technology – Kirck-Othmer series
5. Harper's review of biochemistry – P. W. Martin, P. A. Mayer & V. W. Rodfwell, 5th edition, Maurzen Asian Edition, California, 1981.

OCOSCT 1.52 - LIPIDS, ANTHOCYANINS & PORPHYRINS

Course outcome:

This course introduces the understanding the chemistry of major biomolecules such as lipids, anthocyanins & porphyrins.

Pedagogy:

To introduce the basic concept in biological macromolecules like lipids, anthocyanins & porphyrins.

Course content:

Fats and oils: Isolation, purification, structure and biological importance.

Essential oils: Source, constituents, isolation & uses.

Phospholipids: Isolation, structure and biological significance of lecithin and cephalin

Sphingolipids: Examples with structure and biological importance.

Prostaglandins: Classification, source, nomenclature, structural elucidation of PGE1, PGE2 and their biological significance.

Anthocyanines: Introduction, General nature, structure of anthocyanidines, general methods of synthesizing the anthocyanidines, Flavones , iso flavones, tannins, biosynthesis of flavonoids

Porphyrins: Synthesis of porphyrins. Introduction, structure, synthesis and biological functions of haemin. Vitamin B_{12} : structure and as coenzyme in molecular rearrangement reactions; Chlorophyll: structure and biological importance.

References

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.

2. K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, 1st edition, New Delhi, 1993.

3. Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.

OCISCP 1.53 - INORGANIC CHEMISTRY PRACTICAL-I

Course outcome:

This course trains the students to perform the analysis of natural ore, alloy, or any inorganic compounds of particular interest of study.

Pedagogy:

To introduce hands on training in the field of inorganic compounds analysis.

Course contents:

1. Determination of iron in haematite using cerium(IV) solution (0.02M) as the titrant, and gravimetric estimation of insoluble residue.
2. Estimation of calcium and magnesium carbonates in dolomite using EDTA titration, and gravimetric analysis of insoluble residue.
3. Determination of manganese dioxide in pyrolusite using permanganate titration.
4. Quantitative analysis of copper-nickel in alloy/mixture:
    i. Copper volumetrically using KIO_3.
    ii. Nickel gravimetrically using DMG
5. Determination of lead and tin in a mixture: Analysis of solder using EDTA titration.
6. Quantitative analysis of chloride and iodide in a mixture:
    i. Iodide volumetrically using KIO_3
    ii. Total halide gravimetrically
7. Gravimetric analysis of molybdenum with 8-hydroxyquinoline.
8. Quantitative analysis of copper(II) and iron(II) in a mixture:

i. Copper gravimetrically as CuSCN

ii. Iron volumetrically using cerium(IV) solution

9. Spectrophotometric determinations of:

    i. Titanium using hydrogen peroxide

    ii. Chromium using diphenyl carbazide in industrial effluents

    iii. Iron using thiocyanate/1,10-phenanthroline method in commercial samples

    iv. Nickel using dimethylglyoxime in steel solution.

10. Micro-titrimetric estimation of :

    i. Iron using cerium(IV)

    ii. Calcium and magnesium using EDTA

11. Quantitative estimation of copper(II), calcium(II) and chloride in a mixture.

12. Circular paper chromatographic separation of: (Demonstration)

    i. Iron and nickel

    ii. Copper and nickel

References

1. Vogel's Text Book of Quantitative Chemical Analysis – 5^{th} edition, J. Basset, R.C. Denney, G.H. Jeffery and J. Mendhom.

2. A Text Book of Quantitative Inorganic Analysis by A.I. Vogel, 3^{rd} edition.

3. Spectrophotometric Determination of Elements by Z. Marczenko.

4. Vogel's Qualitative Inorganic Analysis – Svelha.

5. Macro and Semimicro Inorganic Qualitative Analysis by A.I. Vogel.

6. Semimicro Qualitative Analysis by F.J. Welcher and R.B. Halin.

7. Quantitative Chemical Analysis by Daniel C. Harris, 7^{th} edition, (2006).

OCOSCP 1.54 - ORGANIC CHEMISTRY PRACTICAL-I

Course outcome:

This course trains the students to perform the synthesis of organic compounds that are needed to society.

Pedagogy:

To introduce hands on training in the field of organic synthesis.

Organic Preparations: Preparations involving oxidation, reduction, dehydration, nitration, diazotization, cyclization, condensation, addition reactions. Report the yield and cost per Kg of the product synthesized and the cost from the catalogue.

1. Preparation of aniline from nitrobenzene (Reduction).
2. Preparation of p-nitroacetanilide from acetanilide.
3. Preparation of n-butyl bromide from n-butanol.
4. Preparation of p-iodonitrobenzene from p-nitroaniline.
5. Preparation of osazone derivative.
6. Preparation of penta-O-acetyl-D-glucose from glucose.
7. Preparation of *cis* and *trans* cinnamic acid.
8. Preparation of phenoxy acetic acid.
9. Preparation of hippruic acid from glycine.
10. Preparation of p-nitrobenzoic acid from p-nitrotoluene (Oxidation).
11. Preparation of 7-hydroxy-4-methyl coumarin.
12. Preparation of m-nitrobenzoic acid from methyl benzoate.

13. Preparation of aspirin.

14. Preparation of Tetrahydrocarbazole from cyclohexanone (Fischer indole synthesis).

References

1. Manual of Organic Chemistry - Dey and Seetharaman.
2. Modern Experimental Organic Chemistry by John H. Miller and E.F. Neugil, p 289.
3. An Introduction to Practical Organic Chemistry - Robert, Wingrove etc
4. A Text Book of Practical Organic Chemistry – A.I. Vogel, Vol.III
5. Practical Organic Chemistry - Mann & Saunders 6. Semimicro Qualitative Organic Analysis by Cheronis, Entrikin and Hodnet .

OCPSCP 1.55 - PHYSICAL CHEMISTRY PRACTICAL-I

Course outcome:

This course trains the students to obtain the physical nature, and chemical reactivity of organic compounds

Pedagogy:

To introduce hands on training in field of physical chenmsitry.

1. Study of kinetics of hydrolysis of an ester using HCl/H_2SO_4 at two different temperatures, determination of rate constants and energy of activation.
2. Study of kinetics of reaction between $K_2S_2O_8$ and KI, first order, determination of rate constants at two different temperatures and E_a.
3. To study the kinetics of saponification of ethyl acetate by conductivity method, determination of rate constant.
4. Conductometric titration of a mixture of HCl and CH_3COOH against NaOH.
5. Conductometric titration of sodium sulphate against barium chloride.
6. Determination of equivalent conductance at infinite dilution of a strong electrolytes and verification of Onsager equation.
7. Potentiometric titration of KI *vs* $KMnO_4$ solution.
8. Determination of dissociation constant of a weak acid by potentiometric method.
9. Potentiometric titration of $AgNO_3$ *vs* KCl.

10. To obtain the absorption spectra of coloured complexes, verification of Beer's law and estimation of metal ions in solution using a spectrophotometer.

11. Spectrophotometric titration of $FeSO_4$ against $KMnO_4$.

12. Determination of heat of solution of benzoic acid by variable temperature method (graphical method).

13. Kinetics of photodegradation of indigocarmine (IC) using ZnO/TiO_2 as photocatalyst and study the effect of [ZnO/TiO_2] and [IC] on the rate of photodegradation.

14. Determination of the molecular weight of a polymer material by viscosity measurements (cellulose acetate/methyl acrylate).

15. Analysis of a binary mixture (Gylcerol & Water) by measurement of refractive index.

16. Determination of degree of association of benzoic acid in benzene by distribution method.

Reference

1. Practical Physical Chemistry – A.J. Findlay.

2. Experimental Physical Chemistry – F. Daniels *et al*.

3. Selected Experiments in Physical Chemistry – Latham.

4. Experiments in Physical Chemistry – James and Prichard.

5. Experiments in Physical Chemistry – Shoemaker.

6. Advanced Physico-Chemical Experiments – J. Rose.

7. Practical Physical Chemistry – S.R. Palit.

8. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
9. Experiments in Physical Chemistry – Palmer.
10. Experiments in Chemistry – D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994).
11. Experimental Physical Chemistry – R.C. Das and B. Behera, Tata Mc Graw Hill.

OCIHCT 2.1 - INORGANIC CHEMISTRY–II

Course outcome:

This course conveys to deal with the phenomenon of understanding the basic nature of inorganic compounds and their electronic composition.

Pedagogy:

To introduce the basic concept in inorganic compounds electronic nature and its reactivity, in particular reference to coordination compounds.

Course content:

Preparation of coordination compounds: Introduction, Preparative methods – simple addition reactions, substitution reactions, oxidation-reduction reactions, thermal dissociation reactions. Geometries of metal complexes of higher coordination numbers (2-12).

Stability of coordination compounds: Introduction, trends in stepwise stability constants, factors influencing the stability of metal complexes with reference to the nature of metal ion and ligands, the Irving-William series, chelate effect.

Determination of stability constants: Theoretical aspects of determination of stability constants of metal complexes by spectrophotometric and polarographic methods.

Crystal field theory: Salient features of CFT, d-orbital splitting in octahedral, tetrahedral, square planar and tetragonal complexes, Jahn-Teller distortions, measurement of 10 Dq and factors affecting it. Evidences for metal-ligand covalency.

Molecular Orbital Theory: MOT to octahedral, tetrahedral and square planar complexes without and with pi-bonding.

Electronic spectra: Introduction, selection rules and intensities, electronic spectra of octahedral and tetrahedral complexes, Term symbols for dn ions, Orgel and Tanabe Sugano diagrams, charge-transfer spectra.

Magnetic properties: Introduction, magnetic susceptibility and its measurements, spin and orbital contributions to the magnetic moment, the effects of temperature on μeff, spin-cross over, ferromagnetism, anti-ferromagnetism and ferrimagnetism.

Reaction and Mechanisms: Introduction. Substitution reactions - Inert and labile compounds, mechanisms of substitution. Kinetic consequences of Reaction pathways - Dissociation, interchange and association. Experimental evidence in octahedral substitution - Dissociation, associative mechanisms, the conjugate base mechanism, the kinetic chelate effect. Substitution reactions of square-planar complexes - kinetics and stereochemistry of squareplanar substitutions, evidence for associative reactions, explanations of the trans effect.

Electron-transfer processes: Inner-sphere mechanism and outer-sphere mechanism,

conditions for high and low oxidation numbers. Photochemistry of Coordination Compounds: Overview and General Concepts.

Inorganic fibers: Introduction, properties, classification, asbestos fibers, optical fibers,

carbon fibers, Applications.

Zeolites: Introduction, types of zeolites, manufacture of synthetic zeolites and applications.

Mineral fertilizers: **Phosphorous containing fertilizers -** Economic importance, importance of superphosphate, ammonium phosphates and their synthesis.

Nitrogen containing fertilizers - Importance and synthesis of ammonium sulfate, ammonium nitrate and urea.

Potassium containing fertilizers - Economic importance and manufacture of potassium sulfate.

Inorganic pigments: General information and economic importance.

White pigments – titanium dioxide pigments, zinc oxide pigments.

Colored pigments – Iron oxide, chromium oxide, mixed-metal oxide pigments and ceramic colorants.

Corrosion protection pigments, luster pigments, luminescent pigments, magnetic pigments.

Ceramics: Raw materials used in ceramics and ceramic insulators.

References

1. Physical Inorganic Chemistry - A Coordination Chemistry Approach- S.F.A. Kettle, Spektrum, Oxford, (1996).

2. Inorganic Chemistry - 2nd edition, C.E. Housecroft and A.G. Sharpe, Pearson Education Ltd., (2005).

3. Inorganic Chemistry - 3rd edition, G.L. Miessler and D.A. Tarr, Pearson Education, (2004).

4. Inorganic Chemistry - 2nd edition, D.F. Shriver, P.W. Atkins and C.H. Langford, Oxford University Press, (1994).

5. Inorganic Chemistry- 3rd edition, James E. Huheey, Harper and Row Publishers, (1983).

6. Basic Inorganic Chemistry- 3rd edition, F.A. Cotton, G. Wilkinson and P.L. Gaus, John Wiley and Sons, (2002).

7. Inorganic Chemistry Principles of Structure and Reactivity: James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi, Delhi University, New Delhi (2006)**.**

8. Chemistry of the Elements – N.N. Greenwood and A. Earnshaw, Pergamon Press (1985).

9. Industrial Inorganic Chemistry – 2nd edition. K.H. Buchel, H.H. Moretto and P. Woditsh, Wiley - VCH (2000).

OCOHCT2.2 - REAGENTS IN ORGANIC SYNTHESIS

Course outcome:

This course conveys to deal with the phenomenon of understanding the chemistry and its mechanism of oxidants and reluctants used in organic functional group transformations.

Pedagogy:

To introduce the basic concept in organic reactions, in particular with oxidation and reduction reagents.

Course content:

Oxidation: Oxidation with chromium and manganese reagents (CrO3, K2Cr2O7, PCC, PDC, Sarret reagent, Jones reagent, MnO2, KMnO4), oxygen (singlet and triplet), ozone, peroxides and peracids, lead tetraacetate, periodic acid, OsO4, SeO2, NBS, chloramine-T, Sommelet oxidation, Oppenauer oxidation, Fenton's reagent, Sharpless epoxidation.

Reduction: Catalytic hydrogenation (homogeneous and heterogeneous) – catalysts (Pt, Pd, Ra-C, Ni, Ru, Rh), solvents and reduction of functional groups, catalytic hydrogen transfer reactions. Wilkinson catalyst, LiAlH4, NaBH4, DIBAL- H, Sodium cyanoborohydride, dissolving metal reactions (Birch reduction). Leukart reaction (reductive amination), diborane as reducing agent, Meerwein-Ponndorf-Verley reduction, Wolff-Kishner reduction, Clemensen reduction, tributyl tinhydride, stannous chloride, Bakers yeast, Organoboron compounds: Introduction and preparations. Hydroboration and its applications. Reactions of organoboranes: isomerization reactions, protonolysis, carbonylation, cyanidation. Reaction of nonallylic boron stabilized carbanions: alkylation reactions, acylation reaction, Reactions with aldehydes or ketones (E and Z-alkenes). Palladium reagents: Suzuki coupling, Heck reaction, Negishi reaction.

Reagents in organic synthesis: Use of following reagents in organic synthesis and

functional group transformations: Lithium diisopropylamide (LDA), Gilmann reagent, dicyclohexyl carbodimide (DCC), dichlorodicyanoquinone (DDQ), Silane reagents-trialkylsilyl halides, trimethylsilyl cyanide, trimethyl silane, phase transfer catalyst, crown ethers, cyclodextrins, Ziegler-Natta catalyst, diazomethane, Woodward and Prevost hydroxylation, Stork enamine reaction, phosphorous ylides - Wittig and related reactions, sulphur ylides – reactions with aldehydes and ketones, 1,3-dithiane anions - Umpolung reaction, Peterson reaction. Functional group transformations: Nitro to keto group (Neff reaction), alcohol to aldehyde.

References

1. H. Pine, Hendrickson, Cram and Hammond, Organic Chemistry, Mc Graw Hill, New York, 1987.
2. I.L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
3. R.K. Bansal, Organic Reaction Mechanism, Wiley Eastern Limited, New Delhi, 1993.
4. J. March, Advanced Organic Chemistry, Wiley Interscience, 1994.
5. F.A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
6. S.K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd, 1998.

OCPHCT2.3 - PHYSICAL CHEMISTRY–II

Course outcome:

This course enables the students to understand the nature and reactivity of nano materials

Pedagogy:

To introduce the basic concept in nano-science and technology

Course content:

Chemistry of Nanomaterials: Introduction, nanoparticles, nanotobes (carbon nanotubes, SWNT and MWNT), nano wires, nano fibers and nano gel. Fullerenes and other bulk balls. Graphine and its applications. Quantum dots.

Synthesis: Chemical vapour deposition (CVD), sol-gel, silica-gel, solvothermal, hydrothermal methods, microwave, electrochemical, laser abalation, biologiocal and bacterial methods. Characterization (X- ray, IR, UV and SEM).

Applications of Nanomaterials: Renewable energy (nano solar cells), coloured glasses (gold and silver ruby glasses), chemical sensors, biosensors, SAM, electrical and electronics (RAM). Chemical and photocatalytic applications. Lithography, drug delivery targeting and medical applications, micro-electrochemical machines (MEMS). Inorganic and organic nano porous gel.

Semiconductors: Band theory, energy bands, intrinsic and extrinsic semiconductors. Conductivity: electrons and holes, temperature dependence on conductivity, Optical properties: absorption spectrum, photoconductivity, photovoltaic effect and luminescence. Junction properties: metal-metal junctions, metal-semiconductor junctions, p-n junctions, transistors, industrial applications of semiconductors: Mixed oxides, spinels and other magnetic materials.

Superconductors: Meissner effect, type I and II super conductors, isotope effect, basic concepts of BCS theory, manifestations of the energy gap, Josephson devices.

Quantum Chemistry: A brief resume of black body radiation, and atomic spectra-Bohr's theory of hydrogen atom. Photoelectric and Compton effects, de-Broglie concept, uncertainty principle. Operators - algebra of operators, commutative and non-commutative operators, linear operator, Laplacian operator, Hermitian operator, Hamiltonian operator, turn over rule. Wave equation for stretched strings, Schrodinger wave equation for particles, Eigen values and Eigen functions, postulates of quantum mechanics. Application of Schrodinger equation to a free particle and to a particle trapped in a potential field (one dimension and three dimensions). Degeneracy, Wave equation for H-atom, separation and solution of R, ϕ and θ equations. Application of Schrodinger equation to rigid rotator and harmonic oscillator.

Reference

1. Hand Book of Nanotechnology, Bharat Bhushan, Springer Publisher.
2. Nanotechnology, Richard Booker and Earl Boysen, Wiley.
3. Nanometerials, A.K. Bandopadhyay, New Age International, 2nd edition.
4. Nanotechnology - Importance and Applications, M. H. Fulekar, Ink International publishing.
5. Solid State Chemistry – N.B. Hannay.
6. Introduction to Solids – Azaroff.
7. Solid State Chemistry and its applications – A.R. West.
8. Principles of the Solid State – H.V. Keer.
9. Basic Solid State Chemistry, 2nd edition, Anthony R. West.

10. Solid State Chemistry: An Introduction, 3rd edition, Lesley E. Smart and Elaine A. Moore.

11. Introduction to Solid state Physics—C. Kittel, 5th edition, Wiley Eastern, Limited.

12. C.N.R. Rao and J. Gopalakrishna "New Directions in solid state chemistry" Cambridge University Press, Cambridge (1999).

13. Quantum Chemistry – A.K. Chandra. 2nd edition, Tata McGraw Hill Publishing Co. Ltd., (1983).

14. Quantum Chemistry – Eyring, Walter and Kimball. John Wiley and Sons, Inc., New York.

15. Quantum Chemistry – I.N. Levine. Pearson Education, New Delhi, (2000).

16. Theoretical Chemistry – S. Glasstone. East West Press, New Delhi, (1973).

17. Quantum Chemistry – R.K. Prasad, New Age International Publishers, (1996).

18. Valence Theory – Tedder, Murel and Kettle.

19. Quantum Chemistry – D.A. McQuarrie.

OCAHCT2.4 - ADVANCED SEPARATION TECHNIQUES

Course outcome:

This course teaches the understanding of separation techniques of micro/macro molecules using chemical and as well as spectroscopy based equipments

Pedagogy:

To introduce the basic concept in analytical chemistry.

Course content:

Errors and treatment of analytical data: Limitations of analytical methods – Error: determinate and indeterminate errors, minimization of errors. Accuracy and precision, distribution of random errors, the normal error curve. Statistical treatment of finite samples - measures of central tendency and variability: mean, median, range, standard deviation and variance. Student's t-test, confidence interval of mean. Testing for significance - comparison of two means and two standard deviations. Comparison of an experimental mean and a true mean. Criteria for the rejection of an observation - Q-test. Propagation of errors: determinate errors and indeterminate errors.

Fundamentals of chromatography: General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase-nature of adsorbents, factors influencing the adsorbents, nature and types of mobile phases and stationary phases.

Column chromatography: Theories – plate theory, rate theory, band broadening-eddy diffusion, longitudinal diffusion and resistance to mass transfer, column efficiency, Van

Deemter's equation and its modern version, optimization column performance, interrelationships-capacity factor, selectivity factor, column resolution, distribution constant and applications of conventional column chromatography, advantages and limitations.

Thin layer chromatography (TLC): Definition, mechanism, efficiency of TLC plates, methodology –selection of stationary and mobile phases, preparation of micro and macro plates, development, spray reagents, identification and detection, reproducibility of Rf values, qualitative and quantitative analysis.

High performance liquid chromatography (HPLC)*:* Apparatus, pumps, column packing, characteristics of liquid chromatographic detectors-UV, IR, refractometer and fluorescence detectors, advantages and applications.

Gas chromatography (GC): Principle, instrumentations, columns, study of detectors – thermal conductivity, flame ionization, electron capture and mass spectrometry, factors affecting separation, retention volume, retention time, applications.

Ion exchange chromatography (IEC): Definitions, principle, requirements for ion-exchange resin and its synthesis, types of ion-exchange resins, basic features of ion-exchange reactions, resin properties-ion-exchange capacity, resin selectivity and factors affecting the selectivity, applications of IEC in preparative, purification and recovery processes.

Solvent extraction*:* definition, types, principle and efficiency of extraction, sequence of extraction process, factors affecting extraction-pH and oxidation state, masking and salting out agents, techniques-batch and continuous extraction, applications.

Paper chromatography: Definations, theory and principle, techniques, one, two dimensional and circular PC, preparation of sample, choice of solvents, location of spots, spray reagents. Applications - Separation of amino acids and carbohydrates.

Gel permiation chromatography: size exclusion chromatography (Gel filtration) with special reference to separation of protein, carbohydrates and nucleic acids. Preparation of medium, column, determination of void volume, sample application, detectors.

Affinity chromatography: Chromatographic matrix, ligand selection, linkage of ligands, absorbant derivatives. LC/MS, LC/MS-MS, GC/MS, GC/MS-MS for organic compound analysis.

Electrophoresis: Introduction, two dimensional gel electrophoresis (ascending, descending), coomassie blue staining and silver staining, zone electrophoresis, capillary electrophoresis, isoelectric focusing.

Centrifugation: Introduction, high speeds centrifuges, ultracentrifuge, sedimentation coefficients, density gradient, sedimentation equlibrium, analytical centrifugation.

Reference

1. Analytical Chemistry, G.D. Christian, 5th ed., John Wiley & Sons, Inc, India, 2001.
2. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Pearson Education Pvt. Ltd., New Delhi, 2004.
3. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
4. Instrumental Methods of Analysis, Hobart H. Willard, Lynne L. Merritt, Jr., John A. Dean & Frank A. Settle, Jr., 6th edition, CBS Publishers & Distributors, Delhi, 1986.
5. Modern Analytical Chemistry, D. Harvey, McGraw-Hill International Edition, Singapore, 2000.
6. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West and F.J. Holler, 6th edition, Saunders College Publishing, New York, 1992

OCOSCT 2.51 NATURAL PRODUCTS

Course outcome:

This course trains the students to elucidate and understands the chemistry of vitamins, terpenoids, alkaloids, and steroids.

Pedagogy:

To introduce the basic understanding of the chemistry of vitamins, terpenoids, alkaloids, and steroids.

Course content:

Vitamins: Introduction, constitution, synthesis and biological significance of thiamine, riboflavin, pyridoxine, biotin, ascorbic acid, vitamin A_1 & A_2, E_1 and E_2 , B_{12} and K groups.

Alkaloids: Introduction, classification, isolation and general methods of structural elucidation of alkaloids. Biological importance of alkaloids. Synthesis and reaction of nicotin, papavarine, quinine, reserpine, and morphine.

Steroids: Introduction, Structural elucidation of cholesterol, bile acids, Ergosterol and its irradiation products. Sex hormones and corticosteroids: Synthesis of estrone, progesterone, androsterone, testosterone. Barton reaction for the synthesis of aldosterone. Brief discussion of homosteroids, norsteroids and oral contraceptives. Biological significance of anabolic steroids.

Terpenoids: Introduction, classification and general methods of structural elucidation.

Chemistry of pinene, camphor, caryophyllene, santonin, abietic acid and vetivone. Biological importance of terpenoids.

Carotenoids: Methods of isolation. Structure elucidation and synthesis of β-carotenes. Structural relationship of α-,β-, and γ-carotenes.

References

1. I. L. Finar, Organic chemistry, ELBS Longman, Vol. I and II, 1984.
2. Introduction to Alkoloids-G. A. Swan.
3. The Alkoloids- K. W. Bently.
4. Steroids-L. Fiescher and M. Fiescher.
5. Steroids-Shoppe.

OCOSCT 2.52 INDUSTRIAL CHEMICALS

Course outcome:

This course trains the students to understand the chemical composition, nature and abundance, and chemistry of industrial chemicals.

Pedagogy:

To introduce the basic understanding of the chemistry of chemical composition, nature and abundance of industrial chemicals.

Course content:

Perfumery: Introduction, Compounds used in perfumery and their classification, methods of preparation and importance of phenyl ethanol, Yara yara, Ionone musk ketone, musk ambrette, musk xylene, phenyl acetic acid and its esters, benzyl acetate, synthetic musks and jasmine.

Flavours: Introduction, classification, Chemical basis for flavour, flavours in diary products, flavours formed by heating or cooking-caramelisation & Maillard reaction, flavour degradation by oxidation-rancidity, molecular structure & odour/taste, sweetness, acidity & sourness, saltness, bitterness, synthetic chemicals, Natural flavouring materials & classification. Flavouring materials-Acidulants, sweeteners, potentiators, enhancers & sodium-restricted food flavourings. Organic chemicals used in flavorings & food colorants. Essential oils: Source, constituents, isolation & uses.

Cosmetics: Detailed study of formulations and manufacturing of cream and lotions, lipstick and nail polish, shampoos, hair dyes and tooth pastes. A formulary of cosmetic preparation-Godwin.

Oils, soaps and Detergents: Refining of edible oils, manufacturing of soaps, detergents- classification-anionic, cationic, non-ionic and amphoteric detergents, comparison of soaps and detergents, detergent builders and additives, liquid soaps. Manufacturing of fatty acids and glycerol, greases from fatty acids, turkey red oil. Paints, varnishes and inks-constitutions, examples of preparation and applications.

Food Analysis: Moisture, ash, crude protein, crude fiber, fat, carbohydrate, calcium, potassium, sodium and phosphates, food adultration-common adulteration in food, contamination of food stuffs, microscopic examination of food for adulterants, pesticide analysis in food products.

Rubber: Natural and synthetic rubbers, structure elucidation of natural rubber. Polymer degradation reactions: Thermal, oxidative and radiative processes. Synthesis and properties of Buna-S and butyl rubbers.

Conducting Polymers: Polyanilines

Polymer Characterizations: Isolation and purification of polymers-Fractional precipitation, partial dissolution, gradient elution and Gel permeation chromatography. Principles of determination of molecular weights-End group analysis, viscosity, light scattering, osmometry, cryoscopy, ebulliometry and ultracentrifugation method. Thermal characterization- Isothermal gravimetric analysis, Thermogravimetry , Differential Thermal Analysis and Differential Scanning Calorimetry. Mechanical properties-Tensile, Impact and Flexural strengths. Flammability and Limiting Oxygen Index.

Characterization and structural analysis of polymers - IR, NMR, ESR, X-Ray Diffraction and Scanning Electron Microscopic Methods.

References

1. Text book of polymer Science. F.W. Billmeyer, Jr., John Wiley. London (1994).

2. Polymer Science. V. R. Gowrikar, N. V. Vishwanathan and J. Srreedhar, Wiley Eastern, New Delhi (1990).

3. Fundamentals of Polymer Science and Engineering. A. Kumar and S.K. Gupta. Tata –McGraw Hill New Delhi (1978).

4. Polymer Characterization, D. Campbell and J. R. White, Chapman and Hall, New York.

5. Fundamental Principles of Polymer materials, R. L. Rosen, John Wiley and Sons, New York.

6. Infrared spectroscopy by R. T. Conley, Allyn and Bacon, Inc.

7. Functional monomers and polymers by K. Takemoto, Y. Inaki and P. M. Ottenbrite, Marcel dekker, Inc., New York, 1987.

8. Progress in Inorganic Chemistry, by Stephen J. Lippard, John Wiley and Sons, Inc.,New York, vol. **20**, 1976..

9. Synthetic organic chemistry, G R Chatwal, Himalaya publishing house.

OCASCP 2.53 ANALYTICAL CHEMISTRY PRACTICAL-I

Course outcome:

This course conveys to deal with the detection of impurities in pharmaceutical, food, and agro industries.

Pedagogy:

To introduce the hands on training in analytical R&D equipments.

Course content:

1. Determination of percentage of chloride in a sample by precipitation, titration – Mohr, Volhard, and Fajan's methods.
2. Determination of calcium in calcium gluconate.calcium carbonate tablets/injections and of calcium in milk powder by EDTA titration.
3. Determination of ascorbic acid in Vitamin-C tablets by titration with $KBrO_3$ and of Vitamin-C in citrus fruit juice by iodimetric titration.
4. Determination of Iron in pharmaceuticals by visual and potentiometric titration using cerium(IV) sulphate.
5. Determination of total acidity of vinegar and wines by acid-base titration.
6. Determination of replaceable hydrogen and relative molecular mass of a weak organic acid by titration with NaOH.
7. Determination of aspirin in their tablet preparations by residual acid-base titrimetry.
8. Assay of chlorpromazine tablets by non-aqueous acid-base titration.
9. Determination of carbonate and bicarbonate in a mixture by *p*H-metric titration and comparison with visual acid-base titration.
10. Determination of benzoic acid in food products by titration with methanolic KOH in chloroform medium using thymol blue as indicator.
11. Analysis of water/waste water for acidity by visual, *p*H metric and conductometric titrations.
12. Analysis of water/waste water for alkalinity by visual, *p*H metric and conductometric titrations.

13. Determination of carbonate and hydroxide-analysis of a commercial washing soda by visual and *p*H-titrimetry.

14. Flame emission spectrometric determination of sodium and potassium in river/lake water.

References

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8^{th}edition, 2005, Saunders College Publishing, New York.

2. Analytical Chemistry, G.D. Christian, 5^{th} edition, 2001 John Wiley & Sons, Inc, India.

3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6^{th} edition, 1993, Prentice Hall, Inc. New Delhi.

4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6^{th} edition, Third Indian Reprint, 2003, Pearson Education Pvt. Ltd., New Delhi.

5. Analytical Chemistry Principles, John H. Kennedy, 2^{nd} edition, Saunders College Publishing, California, 1990.

6. Practical Clinical biochemistry methods and interpretations, R. Chawla, J.P. Bothers Medical Publishers (P) Ltd., 1995.

7. Laboratory manual in biochemistry, J. Jayaraman, New Age International Publishers, New Delhi, 1981.

8. Practical Clinical Biochemistry by Harold Varley and Arnold. Heinmann, 4th edition.

OCOSCP 2.54 ORGANIC CHEMISTRY PRACTICAL-II

Course outcome:

This course enables the students to understand the separation, analysis and testing of organic compounds and drugs in micro and macro scale.

Pedagogy:

To introduce the hands on training in the separation of many organic compounds in micro and macro scale.

Course content:

Qualitative analysis: Separation of binary mixtures, identification of functional groups and preparation of suitable solid derivatives.

References

1. Manual of Organic Chemistry - Dey and Seetharaman.
2. Modern Experimental Organic Chemistry by John H. Miller and E.F. Neugil, p 289.
3. An Introduction to Practical Organic Chemistry - Robert, Wingrove etc.
4. A Text Book of Practical Organic Chemistry – A.I. Vogel, Vol.III
5. Practical Organic Chemistry - Mann & Saunders

PHYSICAL CHEMISTRY PRACTICAL-II

Course outcome:

This course will allow the student to know more about the reaction mechanism, reactivity, and stability of the organic compounds.

Pedagogy:

To provides the hands on training in determination of reaction pathway, redox-potential of organic and physical reactions.

Course content:

1. Study of kinetics of reaction between CAT and indigocarmine spectrophotometrically and determination of rate constant.
2. Kinetics of reaction between sodium formate and iodine, determination of energy of activation.
3. Determination of energy of activation for the bromide-bromate reaction.
4. Determination of dissociation constant and mean ionic activity coefficient of weak electrolytes by conductivity method.
5. Conductometric titration of oxalic acid against NaOH and NH_4OH.
6. pH titration of (a) CH_3COOH vs. NaOH and determination of K_a.
7. Potentiometric titration of a mixture of halides (KCl+KI) against $AgNO_3$.
8. Determination of redox potential of Fe^{2+} ions by potentiometric method.
9. Determination of activity of 0.1 M HCl by EMF method.

10. Determination of partial molar volume of NaCl-H_2O/KCl- H_2O/KNO_3/ H_2O systems.
11. G.M. Counter – determination of G.M. plateau and dead time.
12. Verification of inverse square law using gamma emitter.
13. Determine the concentration of KI potentiometrically by calibration method.
14. To study the kinetics of reaction between acetone and iodine - determination of order of reaction w.r.t. iodine and acetone.
15. To determine the eutectic point of a two component system (Naphthalene-*m*- dinitrobenzene system).
16. Coulometric titration I_2 vs $Na_2S_2O_3$.

References

1. Practical Physical Chemistry – A.J. Findlay.
2. Experimental Physical Chemistry – F. Daniels *et al*.
3. Selected Experiments in Physical Chemistry – Latham.
4. Experiments in Physical Chemistry – James and Prichard.
5. Experiments in Physical Chemistry – Shoemaker.
6. Advanced Physico-Chemical Experiments – J. Rose.
7. Practical Physical Chemistry – S.R. Palit.
8. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
9. Experiments in Physical Chemistry – Palmer.

10. Experiments in Chemistry – D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994).

11. Experimental Physical Chemistry – R.C. Das. and B. Behera, Tata Mc Graw Hill.

OCOHCT 3.1 SYNTHETIC ORGANIC CHEMISTRY

Course outcome:

This course conveys to deal with the phenomenon of understanding of structure, stereochemistry, and stereo specific compounds generation chemistry.

Pedagogy:

To introduce the basic concept in synthetic organic chemistry.

To introduce the synthesis of organic compounds via asymmetric method.

Course content:

Structure and reactivity of organic compounds: Acids and Bases, functional group effects on acidity and basicity, hydrogen bonding, resonance, inductive and hyperconjugation effects.

Meaning and importance of reaction mechanism, Classification of reactions

Determination of reaction mechanism by kinetic and non-kinetic methods: ***Kinetic methods***: Mechanistic implications from rate laws, the transition state theory, ambiguities in interpreting kinetic data, solvent effect, ionic effect, isotopic effect, solvent isotopic effect, substituent effect, steric effect, linear free energy relationships–Hammett equation and Taft treatment.

Non-kinetic methods: Energy profile diagram, identification of products, testing possible intermediates, trapping of intermediates, cross over experiments, isotopic labeling, stereochemical studies, limitations of reactions.

Reaction Intermediates: Formation, structure, stability, detection and reactions of carbocations (classical and non-classical), carbanions, free radicals, carbenes, nitrenes, nitrile oxides, nitrile imines, nitrile ylides and arynes.

Retrosynthesis: Introduction to disconnection approach: Basic principles and terminologies used in disconnection approach. One group C-X and two group C-X discoonections. Functional group interconversions. Synthons and synthetic equivalents. Retrosynthetic analysis and synthesis of ethyl aceto acetate, acetyl acetone, benzofurans, p-methoxy actophenone, saccharin, α-bisabolene, nuciferal, tetralone, ibuprofen, Cantheridin and penicillin-V.

Asymmetric synthesis:

Definition, importance, mechanism, energy consideration, advantages and limitations, methods of determination of enantiomeric excess.

I. **Topocity - Prochirality**- Substrate selectivity - Diastereoselectivity and enantio-selectivity-Substrate controlled methods-use of chiral substrates - examples

II. **Auxiliary controlled methods**- Use of chiral auxiliaries-Chiral enolates-alkylation of chiral imines - Asymmetric Diels - Alder reaction

Reagent controlled methods- Use of chiral reagents - Asymmetric oxidation –Sharpless epoxidation - Asymmetric reduction - Use of lithium aluminium hydride and borate reagents.

Synthesis and applications of oxazaborolidines, IPC-BBN, IPC_2BH, (S)-BINAP-DIAMINE and (R)-BINAL-H. Use of (R,R)-DIPAMP, (S,S)-CHIRAPHOS, (R,R)-DIOP, SAMP, RAMP, S-Proline, S-PBMgCl, (-)-$BOAlCl_2$, (+) and (-)-DET.

References

1. H. Pine, Hendrickson, Cram and Hammond, Organic Chemistry, Mac Grow Hill,

New York, 1987.

2. Organic Chemistry - Morrison and Boyd

3. I.L. Finar, Organic Chemistry, ELBS Longmann, Vol. 1 & II, 1984.

4. J. March, Advanced Organic Chemistry, Wiley Interscience, 1994.

5. E.S. Gould, Mechanism and Structure in Organic Chemistry, Halt, Rinhart & Winston, New York, 1964.

6. F.A. Carey and Sundberg. Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York. 1990.

7. Principles of Organic Synthesis - ROC Norman and Coxon.

8. S.K. Ghosh, Advanced General Organic Chemistry, Book and Allied (P) Ltd. 1998.

OCOHCT 3.2 - BONDING, PHOTOCHEMISTRY AND PERICYCLIC REACTION

Course outcome:

This course conveys to deal with the understanding of organic synthesis by thermal and photo induced state.

Pedagogy:

To introduce the basic concept in synthesis of organic molecules induced by thermal and light.

Course content:

Bonding in organic systems: Theories of bonding- Valence and molecular orbital approaches. Huckel molecular orbital theory and its application to simple π-systems: ethylene, allyl, cyclopropyl, butadienyl, cyclopentadienyl, pentadienyl, hexatrienyl, cyclohexatrienyl, heptatrienyl, cycloheptatrienyl systems. Calculation of the total π-energy, delocalization energy, bond order and M.O. coefficients of the systems.

Aromaticity: Aromaticity and Huckel's rule-HMO theory, benzenoid and non-benzenoid aromatic compounds, Tropones, Tropolones, Pyrilium cation, ferrocene. Alternant and non-alternant hydrocarbons, aromaticity of charged rings (3-8 membered), non-aromatic, anti-aromatic and homo aromatic systems, methods for their determination: X-ray, UV and NMR techniques. Annulunes and hetero annulenes (10-18).

Photochemistry: General consideration: Activation in thermal and photochemical reactions. Light absorption and excitation. Singlet and triplet states. Morse curve, Franck-Condon principle.

Deexcitation: Physical process, Jablonski diagram. Photosensitization (donor acceptor concept, resonance and collision transfer). Chemical process, quantum efficiency, quantum and chemical yields.

Photochemistry of functional groups:

i. ***Olefins*****:** *Cis-trans* isomerism, [2+2] cycloaddition, rearrangements. Reaction of conjugated olefins; di-π-methane rearrangement.

ii. ***Ketones*****:** Excited state of C=O. Norrish type-I and type-II cleavages. Paterno-Buchi reaction. α,β-unsaturated ketones. [2+2] addition, *cis-trans* isomerisation. Rearrangements of cyclohexadienones.

iii. ***Aromatic compounds*****:** Photorearrangement of benzene and its derivatives, cycloaddition of benzene.

iv. ***Photochemical oxidations and reductions*****:** Cycloaddition of singlet molecular oxygen. Oxidative coupling of aromatic compounds, photoreduction by hydrogen absorptions.

Photodegradation: Photocatalyst –ZnO, TiO2, principle, application of ZnO/TiO2 in the phodegradation of dyes (IC), pesticides (DDT, HCCH0 and in industrial affluents. Effect of photodegradation on COD values.

Pericyclic reactions: Classification of pericyclic reactions. Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system.

Electrocyclic reactions: Woodward-Hofmann rules for electrocyclic reactions, FMO theory of electrocyclic reactions, correlation diagram for cyclobutadiene and cyclohexadiene systems.

Cycloaddition reactions: [2+2], [3+2] and [4+2] cycloadditions, analysis by FMO and correlation diagram method. Cycloadditions - antarafacial and suprafacial additions, [2+2] additions of ketenes.

1,3-dipolar cycloadditions: involving nitrile oxide, nitrile imine, nitrile ylide cycloaddition. Intra and intermolecular 3+2 cycloaddition and their application in organic synthesis.

[4+2] cycloaddition reactions: Deil's-Alder reaction, hetero Diel's-Alder reaction and their applications.

Sigmatropic rearrangements - Classification, stereochemistry and mechanisms. suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties. [3,3]- and [5,5]-sigmatropic rearrangement, Claisen, Cope and aza-Cope rearrangements.

References

1. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
2. Dupey and Chapmann, Molecular reactions and Photochemistry, Prentic Hall-International, Tokyo, 1972.
3. Introduction to physical organic chemistry – Kosower
4. Molecular orbital calculations – J. D. Roberts
5. N. J. Turro, Modern molecular photochemistry, The Benzamin Cummings Publishing Co. Ltd, Menlo Park, 1978.
6. K. Yates, Huckel's Molecular Orbital Theory, Academic Press, New York, 1978.
7. T. L. Gilchrist & R. C. Storr, Organic reaction and orbital symmetry, Cambridge Univ. Press, London, 1979.
8. D. C. Neckers, Mechanistic Organic Photochemistry, Reinhold, New York, 1967.

OCOHCT 3.3 - GREEN CHEMISTRY, MOLECULAR REARRANGEMENTS AND HETEROCYCLIC CHEMISTRY

Course outcome:

This course helps the student to understand the green chemical procedure to prepare drugs.

This course teaches to improve the manufacture of drugs by increasing the overall yield, more economic method, and low cost procedures.

This course teaches to understand the chemistry of dyes, insecticides & polymer chemistry.

Pedagogy:

To introduce the basic concept in green chemistry with a special emphasis on drug molecules.

To introduce the basic concept of dyes, insecticides & polymer chemistry.

Course content:

Molecular rearrangements: Introduction,

Carbon to carbon migrations: Pinacol-pinacolone, Wagner-Meerwein, Benzidine, Demyanov, Benzylic acid, Favorskii, Arndt-Eistert synthesis, Fries rearrangement, Stevens rearrangement.

Carbon-to nitrogen migrations: Hofmann, Curtius, Lossen, Schmidt and Beckmann rearrangement.

Miscellaneous rearrangement: Sommelet-Hauser, Wittig, Smiles, Neber, Rupe, Jap-Klingermann rearrangement, Meisenheimer rearrangements, Bayer-Villeger rearrangement. Allylic rearrangements.

Nomenclature of heterocyclic systems; Structure, reactivity, synthesis and reactions of furan, pyrrole, thiophene, indole, pyridine, quinoline, isoquinoline, pyrazole, imidazole, pyrimidines and purines.

Synthesis and synthetic applications of azirines & aziridines, azetidines, oxazolines, isoxazolines, isoxazole, triazole and azepines and benzodiazepines.

Green chemistry: Definition and principles, planning a green synthesis in a chemical laboratory, Green preparation-Aqueous phase reactions, solid state (solvent less) reactions, photochemical reactions, Phase transfer catalyst catalyzed reactions, enzymatic transformations & reactions in ionic liquids.

Microwave induced organic synthesis: Introduction, reaction vessel and reaction medium, concept, specific effect, atom efficiency, % atom utilization, advantages and limitations, N-alkylation and alkylation of active methylene compounds with aldehydes, synthesis of Ibuprofen by BHC and BOOTS approaches, Diels-Alder reaction, Leuckardt reductive amination of ketones, oxidation of alcohols and sulfides. Organic process research, process development, process optimization. Basics of environmental health safety, basics of intellectual property rights.

OCOSCT 3.41 DYES, INSECTICIDES & POLYMER CHEMISTRY

Dyes: Introduction, modern theories of colour and chemical constitution. A general study of the following: Direct azo dyes (congored, rosanthrene O, procion dyes), acid azo dyes (ponceau2R, Naphthol blue black 6B), basic azo dyes (chrysoidin G, bismark brown), developed dyes, mordent dyes, vat dyes, disperse dyes, fibre reactive dyes, sulphur dyes and solvent dyes. Fluoroscent brightening agents (tinopal B.V), cyanine dyes (classification,

application in photography, quinoline blue and sensitol), chemistry of colour developer, and instant colour processes. Synthesis and applications of malachite green, rhodamine-B, phenolphthalein and methyl orange.

Triphenylmethane dyes: crystal violet, pararosaniline, aurin, chromeviolet. Application of dyes: i. photography and ii. Biological studies.

Insecticides: Introduction, classification, mode of action and synthesis of chlorinated insecticides (DDT, chlordane, heptachlor and hexachlorocyclohexane), Naturally occurring insecticides-pyrethroids-natural pyrethrins-isolation and structures, synthetic pyrethroids, allethrin, cypermethrin, phenvalerate.

Organophosphorous insecticides: Malathion, parathion, DDVP, diazenon. Carbamate insecticides: Sevin, carbofluron, aldicab, beygon.

Insect Pheromones: Introduction, classification, use in insect pest control. Synthesis of disparlure, faranol, grandisol, brevicomin and bomykol.

Fungicides: Introduction, Inorganic & organic fungicides, Systemic fungicides-types & examples. **Herbicides:** Introduction, study of sulfonyl ureas, heterocyclic sulfonamides. heterocyclic amines, dihydropyrano[2,3*b*]pyridylimidazolinones,pyrrolopyridy limidazolinones, 1,2,4-triazine-3,5 diones, hydroxyoxazolidinones & hydroxypyrrolidinones, pyridine herbicides &1,3,4-oxadiazoles. Mechanism of action and toxicities of insecticides, fungicides and herbicides.

Polymers: Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization, linear, branched and network polymers. Classification and nomenclature of polymers. Properties of polymers (brief explanation of molecular weight, glass transition temperature - Tg , solubility and visco-elasticity). Methods of polymerization-addition and condensation polymerization, ionic and free-radical polymerization processes, polymerization with complex catalysts (Ziegler-Natta catalysis), co-polymerization and their mechanisms. Techniques of polymerization - bulk, emulsion etc.

Stereospecific Polymers: Preparation and significance- classification of polymers based on physical properties - Thermoplastics - Thermosetting plastics - Fibers and elastomers - General applications.

Preparation of Polymers: Preparation of Polymers based on different types of monomers - Industrial applications-olefin polymers - Diene polymers- nylons - Glyptal resins - Urea- formaldehyde, phenol - formaldehyde and melamine resins - Epoxy resins - Ion exchange resins, polycarbonates and its applications.

References

1. A Text Book of Fertilizers, Ranjan Kumar Basak.
2. Agronomy - Theory & Digest, Bidhan Chandra, Krishi Vishwavidyalaya, Mohanpur.
3. Fundamentals of Agronomy, S.S.Cheema, K.Dhaliwal, T.S. Shota, Punjab Agricultural University.
4. Principles and Practices of Agronomy, Shri.S.S.Singh, Allahabad Agricultural Institute.
5. Fertilizers, Organic Manures & Biofertilizers–A Product Quality Guide for Major & Micronutrients, HLS Tandon, Fertilizer Development and Consultation Organisation,New Delhi.
6. Handbook on Fertilizer Technology, Bham Swaminathan & Manish Goswami, TheFertilizer Association of India, New Delhi.
7. Outlines of Chemical Technology, Charles E. Dryden, Affiliated East-West Press, New Delhi.

8. Synthesis and Chemistry of Agrochemicals, Vol I & II, ACS, Wahington.

9. Chemistry of Pesticides, K H Buchel.

10. Advances in Pesticide Formulation Technology, ACS.

11. Chemicals for Crop Protection and Pest Managements, M B Green, G.S. Hartley West, Pergamon.

12. Chemistry of Insecticides and Fungicides, Sree Ramulu, Oxfo

13. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.

14. K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, 1st edition, New Delhi, 1993.

15. Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.

16. Encyclopedia of Chemical technology – Kirck-Othmer series

OCOSCT 3.42 - ENZYMES FUNCTIONS AND THEIR KINETICS

Course outcome:

This course conveys to deal with the understanding of functional and kinetic property of enzymes

Pedagogy:

To introduce the basic concept in enzyme chemistry

Course content:

Enzymes: Introduction, nomenclature, classification with examples and their functions.

The mechanistic role of the following co-enzymes in the living systems:

i. Thiamine pyrophosphate (TPP) in oxidative and non-oxidative decarboxylation of □-keto acids and formation of ketols

ii. Pyridoxal phosphate:- transamination, decarboxylation, dealdolization and elimination reactions of amino acids

iii. Lipoic acid in the transfer of acyl group and oxidation reactions

iv. Co-enzyme A: generation and ternsfer of acyl groups

v. Biotin – in the addition of carboxyl groups to saturated carbon atoms and in transcarboxylation reactions; tetrahydrofolic acid – in one carbon transfer reactions at all oxidation levels except that of CO_2; Nicotenamide and flavin coenzymes – in biological oxidation-reduction reactions.

Biogenesis of fatty acids, terpenoids (mono and sesquiterpenoids), steroids, aminoacids, alkaloids.

Enzyme kinetics: Effect of substrate concentration, Effect of pH, effect of catalysts and inhibitors (substrate, zeoliter, Cr^{3+}, Fe^{2+} ZnO, U.V light) and effect of temperature. A brief kinetic and mechanistic applications of glucose oxidase and L-amino oxidase in the oxidation of glucose and L-amino acids. Biological significance of Donnan membrane phenomenon. Micelles and involvement during digestion and absorption of dietary lipids. Diffusion of solutes across bio-membranes and its application in the mechanism of respiratory Exchange. “Salting In” and “Salting out” of proteins. Osmotic behaviour of cells and osmo-regulation and its application in the evolution of excretory systems of organisms. Significance of visulity in biological systems-mechanism of muscle contraction, detection of in trastrand disulfide bonds in proteins, polymerization of DNA and nature of blood flow tarongu different vessels. Effect of temperature solute concentration (amino acids) in surface tension. Biological significance of surface tension, stability of Alveoli in lungs, interfacial tension in living cells (Danielle and Davson model). In metabolism studies; Radio immuno assay (cabeling of antigens) Immune radiometry.

Pharmocokinetics: Plasma concentration time curve, drug dissolution rate, phyiso-chemical factors effecting bioavailability. Pharmocokinetics applied to one component open model. Calculation of elimination rate constant and metabolism constant apparent volume of drug distribution and kinetics of drug clearance. Protein binding of drugs, Bioavailability and bio equivalence. Factors affecting bioavailability route of drug administration and kinetics of protein binding.

Chemical biology: What is life? Its chemical definition in the perspective of modern scientific progress. **Origin of life**: spontaneous generation of life and its failure; abiotic origin of life: Urey-Miller’s experiment, Oparin-Haldane concept of origin of life, panaspermic origin of life and genetic code (life material has come from extra- terrestrial

source through meteorites. What is the first important polymer in the evolution of life? RNA based origin of life.

Water: the major constituent of life, its physical and chemical nature that makes it versatile as a solvent. Is life possible without water?

References

1. Thermodynamics for chemists by S. Glasstone, Affiliated East-west press, New Delhi, (1965).
2. Chemical Thrmodynamics by I.M. Klotz, W.A. Benzamin Inc. New York, Amsterdam, (1964).
3. Basic Physical Chemistry by W.J. Moore, Prentice Hall of India Pvt. Ltd., New Delhi, (1986).
4. Text book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., (II edition), (1974).
5. Theoretical chemistry by S. Glasstone.
6. Statistical themodynamics by B.C. Meclelland, Chapman and Hall, London (1973).
7. Elementary statistical thermodynamics by N.D. Smith Plenum Press, NY (1982).
8. Elements of classical and statistical thermodynamics by L.K. Nash, Addison-Wesley (1970).
9. Statistical thermodynamics by I.M. Klotz.
10. Introduction to Statistical Thermodynamics by M. Dole, Prantice-Hall, (1962).

OCOSCP 3.43 ORGANIC CHEMISTRY PRACTICAL-III

Course outcome:

This course conveys to have knowledge and expertization in the preparation of organic compounds of pharmaceutical interest.

Pedagogy:

To introduce the hands on training in organic synthesis.

Course content:

Multi step synthesis

1. Preparation of benzyl alcohol and benzoic acid via Cannizzaro reaction.
2. Oxidation of cyclohexanol to adipic acid via cyclohexanone
3. Esterification: Preparation of benzoccaine from p-nitrotoluene
4. Diazotization (Sandmeyer's reaction): Preparation of p-chlorobenzoic acid from p-toluidine
5. Molecular rearrangement: Preparation of o-chlorobenzoic acid from phthalic anhydride
6. Preparation benzilic acid from benzaldehyde
7. Preparation of o-hydroxy benzophenone from phenyl benzoate via Fries rearrangement
8. Prepartion of benzanilide from benzophenone oxime via Beckmann rearrangement.
9. Synthesis of m-chloroiodobenzene from m-dinitrobenzene.

10. Preparation of benzyl alcohol and benzoic acid via Cannizarro's reaction.

References

1. Manual of Organic Chemistry - Dey and Seetharaman.
2. Modern Experimental Organic Chemistry by John H. Miller and E.F. Neugil, p 289.
3. An Introduction to Practical Organic Chemistry - Robert, Wingrove etc
4. A Text Book of Practical Organic Chemistry – A.I. Vogel, Vol.III
5. Practical Organic Chemistry - Mann & Saunders

OCOSCP 3.44 ORGANIC CHEMISTRY PRACTICAL–IV

Course outcome:

This course conveys to deal with the phenomenon of isolation and purification of naturally occurring biomolecules.

Pedagogy:

To introduce the hands on training in natural compounds isolation, purification, and analysis.

Course content:

Isolation of natural products

1. Fractional crystallization: separation of mixture of naphthalene and biphenyl
2. Fractional distillation: Separation of mixture of hexane and toluene.
3. Thin layer chromatography: Separation of plant pigment
4. Column chromatography: Separation of mixture of o & p-nitro anilines
5. Paper chromatography: Separation of amino acids
6. Isolation of piperine from pepper
7. Isolation of caffeine from tea
8. Isolation of cysteine from hair
9. Isolation of hesperidiene from orange peal
10. Isolation of azeleic acid from castor oil

11. Isolation and spectroscopic characterization of Lycopene

12. Isolation of lipids from egg yolks

13. Extraction of nicotine from Tobacco Leaves

References

1. Manual of Organic Chemistry – Dey and Seetharaman

2. Natural Products Chemistry by Raphel Ikhan

OPEN ELECTIVE

OCO OET 3.51 APPLICATIONS OF SYNTHETIC PRODUCTS

Course outcome:

This course conveys the students to understand the spectroscopic and analytical tools to identify and purify the organic compounds

Pedagogy:

To introduce the basic concept in spectroscopic and analytical tools to identify and purify the organic compounds

Course content:

Acids and bases, electrophiles and nucleophiles, hybridization in carbon compounds, inductive effect, resonance effect, hydrogen bonding {types of hydrogen bonding, hydrogen bonding in HF, water, alcohols, acids, nitrophenols) bond angle and bond length.

Purification: Crystallization, sublimation, fractional crystallization, distillation techniques (simple distillation, steam distillation, distillation under reduced pressure, fractional distillation).

Separation techniques: Solvent extraction, continuous extraction, chromatography (principles of TLC, PC, column, GC, ion exchange chromatography) and electrophoresis

Characterization: Detection of elements, estimation of carbon, hydrogen, halogens, sulphur, nitrogen and phosphourous. Detection of functional groups (hydroxyl, carboxyl, keto, ester, amino, nitro, amide, thiol, ether etc) in the unknown samples. Basic principles for the determination of hydroxyl, carboxyl, keto, ester, amino, nitro groups. Estimation of sugars, aminoacids and proteins.

Basics of organic reactions: Meaning and importance of reaction mechanism, classification and examples for each classes.

Structural determination of organic compounds by: UV spectroscopy: Absorption maxima for simple organic molecules

IR spectroscopy: Absorption frequencies for functional groups in simple organic molecules

NMR-spectroscopy: Chemical shift (δ-scale), spin-spin coupling, coupling constants, applications to simple molecules. [For all spectroscopic methods, simple molecules like ethyl alcohol, methyl cyanide, ethane, propane, ethylene, benzene, methyl amine, aniline, acetone, acetophenone and other simple molecules are considered].

Dyes: Colour and constitution, classification, dyeing method and their industrial importance.

Drugs: Basic concepts, classification, sources, the requirement of an ideal drug

Synthetic drugs: Structure and medicinal properties: Sulphanilamide – an example of sulpha drug-paracetamol, aspirin, oil of wintergreen; Mephensin – a muscle relaxant;

Ibuprofen – an anti-inflammatory drug; L-dopa – cures. Parkinson's disease; Chloroquine – an antimalarial drug; Chlorpromazine – an antipsychotic agent; Phenobarbital – a barbiturate; Omeprazole – an drug; Ciprofloxacin – an antibacterial drug; Formulation of drugs – introduction and classification.

Polymers: Introduction, biodegradable and non-biodegradable polymers and their industrial importance, plastics (uses and effects on enviornment), natural and synthetic rubbers, polyamides and poly esters like nylon, decron, terelyne. Thermoplastics - poly carbonates, poly acrylates in lens applications, polyurethanes and conducting polymers.

References

1.I.L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.

2.K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, 1st edition, New Delhi, 1993.

3.Harper's Biochemistry, Ed. R. Harper, 22nd edition, Prentice Hall Press, New York, 1990.

OCO OET 3.52 - NATURAL AND SYNTHETIC PRODUCTS

Course outcome:

This course brings the students to gain knowledge in the area of chemical nature of natural and synthetic bioactive compounds

Pedagogy:

To introduce the basic concept in the chemistry of biomolecules.

Course content:

Fats and oils: Isolation, purification, structure and biological importance.

Essential oils: Source, constituents, isolation & uses.

Phospholipids: Isolation, structure and biological significance of lecithin and cephalin

Sphingolipids: Examples with structure and biological importance.

Prostaglandins: Classification, source, structure, nomenclature and its significance.

Terpenoids: Introduction, classification, source, structure of biologically important terpenoids (antihelmentic, anticancer terpenoids, etc)

Steroids: Structure and biological significance of cholesterol, bile acids, androgen, estrone, progesterone and anabolic steroids.

Flavonoids and Isoflavonoids: Occurrence, nomenclature, structure and their biological importance.

Porphyrins: Introduction, structure and biological functions of haemin. Vitamin B_{12} : structure and as coenzyme in molecular rearrangement reactions; Chlorophyll: structure and biological importance.

Carotenoids: Methods of isolation, structure and their biological importance..

Alkaloids: Introduction, source, structure and biological significance of vinca alkaloids, chincona alkaloids, LSD, reserpine, morphine, codeine, strychnine, brucine, nicotine, yohimbine,

Vitamins: structure and biological functions of vitamin A, C, D, E, K, biotin, pyridoxine, thiamine.

Soaps and detergents: Production and their cleansing action. Liquid crystals and their applications. Surfactants

Cosmetics: Detailed study of formulations and manufacturing of cream and lotions, lipstick and nail polish, shampoos, hair dyes and tooth pastes. Flavours: Natural flavouring materials and classification

Sweeteners: Natural and synthetic sweeteners.

Insecticides: Introduction, classification, applications and their effect on environment. **Pheromones:** Introduction, Sources, biological importance.

Explosives: Introduction, RDX, Gun powder, TNT.

References

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2. Essentials of physiological chemistry – Anderson, John Wiley & Sons, New York, 1953.

3. K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, 1st edition, New Delhi, 1993.

4. Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.

5. Encyclopedia of Chemical technology – Kirck-Othmer series

6. Harper's review of biochemistry – P. W. Martin, P. A. Mayer & V. W. Rodfwell, 15th edition, Maurzen Asian Edition, California, 1981.

FORTH SEMESTER

OCOHCT 4.1 - ORGANOMETALLIC COMPOUNDS & ORGANONONMETALLIC COMPOUNDS

Course outcome:

This course conveys to deal with the chemistry of organ metallic and non-metallic compounds and their use in preparing the organic compounds.

Pedagogy:

To introduce the basic concept in organo metallic chemistry.

Course content:

Chemistry of organometallic compounds: Synthesis and reactions of organolithium (n-BuLi, PhLi}, organocadmium, organomagnesium (Grignard reagent), organoselenium and organotellurium.

Organoaluminium reagents: Preparation, site selective and stereoselctive additions of nucleophiles mediated by organoaluminum reagents, reaction with acid chlorides, allyl vinyl ethers, 1,2-addition to imines and application in the synthesis of natural products.

Organocopper reagents: Gilman reagent, preparation, reactions with aldehydes, ketones and imines. Application in the synthesis of brevicomin.

Organozinc reagents: Preparation - oxidative addition and transmetallation, addition reactions of alkyl, aryl, allylic and propargylic zinc reagents, diastereoselective and enantioselective addition reaction with aldehydes, Reformatsky reaction.

Organosamarium reagents: Reactions promoted by samarium diiodide and dicyclopentadienyl samarium – Barbier type reaction, Reformatsky type reactions, ketyl-alkene coupling reactions, pinacolic coupling reactions, acyl anion reactions.

Organotin reagents: tributyltin hydride, Barton decarboxylation reaction, Barton deoxygenation reaction (Barton McCombie reaction), Stille coupling, Stille-Kelley coupling reactions, , Keck stereoselective allylation and other applications.

Organoboron compounds: Introduction and preparations. Hydroboration and its applications. Reactions of organoboranes: isomerization reactions, oxidation, protonolysis, carbonylation, cyanidation. Reaction of nonallylic boron stabilized carbanions: Alkylation reactions, Acylation reaction, Reactions with aldehydes or ketones (E and Z-alkenes).

Organosulphur compounds: Introduction. Preparations, reactions, mechanism and synthetic applications of important sulphur containing reagents like dithiane, sulphur ylides etc.

Organosilicon compounds: Introduction, preparations and reactions, Peterson reaction. **Organophosphorous compounds**: Nomenclature, synthesis and reactions of trialkyl phosphine, triarylphosphine, trialkyl phosphite, triaryl phosphite, trialkyl phosphate, triaryl phosphates. Wittig reaction and Wittig-Horner reactions: - mechanisms and synthetic uses. Arbasov reaction, transesterification. Organofluorine compounds.

References

1. J. March, Advanced Organic Chemistry, Willey Interscience, 1994.

2. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.

3. Comprehensive Organic Chemistry, Pergamon Press, New York, Vol 1, 1996,

4. H. Pine, Hendrickson, Cram and Hammond, Organic Chemistry, Mac Grow Hill, New York, 1987.

5. I. I. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984

6. Comprehensive Organic Synthesis – B. M. Trost and I. Fleming series, Pergamon Press, New York, 1991.

7. S. K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd, 1998

8. Heterocyclic Chemistry –Joule & Smith

9. Heterocyclic chemistry – Achaeson

10. Basic Principles of heterocyclic chemistry – L. A. Pacquette

OCOHCT 4.2 - ADVANCED MEDICINAL CHEMISTRY

Course outcome:

This course teaches the students to learn more on drugs chemistry that are currently being used in medicine against caner, flu, and other communicable diseases

Pedagogy:

To introduce the basic concept in medicinal chemistry

Course content:

Medicinal Chemistry-Chemotherapy: Definition, History, and Evolution of Chemother Classification of drugs on the basis of therapeutic action, pharmacophonic, API (active pharmaceutical ingredient) chiral drugs, development of new drugs, procedures followed in drug design, concept of lead and lead-compounds and lead modifications, molecular modeling, concept of pro-drug and soft drug, factor affecting bioactivity. Theories of drug activity, occupancy-theory, rate theory, induced-fit theory. Quantitative structure-activity relationship, history and development of QSAR, concept of drug receptors, elementary treatment of drug receptor interactions. Physiochemical parameters: lipophilicity, partition-coefficient, electronic ionization constant, steric, Shelton and surface activity parameters and redox potential. Evaluation methods: Free-Wilson analysis, Hansch-analysis, relationship between FreeWilson analysis and Hansch-analysis – LD50, ED50, ID50, IC50 (mathematical derivation of equation excluded).

Synthetic drugs: Introduction, pharmacodynamics, pharmacokinetics, pharmatherapeutics, chemotherapy, metabolites antimetabolites, agonists and antiagonists. Routes of drug administration, factors affecting choice of routes.

A general study of following class of drugs:

Sulpha drugs: Sulphonamides - Mechanism of action, resistance to sulphonamides, sulfametaoxazole.

Antipyretics: aspirin, paracetamol, phenacetin, novalgin and their mechanism of action.

Antimalarials: structure , synthesis and mechanism of action of quinine and chloroquine.

Hypnotics, analgesics and sedatives: phenosorbitol, chlordiazepoxide, mebrobamide.

Stimulants: structure and action of caffeine

Antineoplastic Agents: Introduction, cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, mustards and mercaptopurine. Recent development in cancer chemothery – podophyllotoxin and its derivatives, taxol. %-flouro uracil, Chlorambucil and cisplatin.

Cardiovascular drugs: Introduction, cardiovascular diseases, drug inhibitors of peripheral symphatetic function, central intervention of cardiovascular output direct acting arteriolar dilators, synthesis of dithiazem, verapamil, methyldopa, atenolol, oxprenolol, antihypertensive drugs, lipid lowering agents (atorvastatin, statin derivatives).

Local antiinfective drugs: Introduction and general mode of action, structure of sulphonamides, forazalidione, nalidixic acid, ciprofloxacin, norfloxicin, dapsone, aminosalicylic acid, isoniazid, ethionamide, ethambutal, fluconazole, griseofulvin, Chloroquineand primoquine.

Antibiotics: Introduction, cell wall biosynthesis, inhibitors, □-lactum group of antibiotics-Penicillin, Ampicillin and Amoxycillin, amoxicillin, chloramphenicol, cephalosporin analogs, tetracycline, streptomycin, Erythromycin analogs and Ciprofloxacin.

Antiprotozoal drugs -Metronidazole

Antihelmenthics-Mebendazole/albendazole

Antivirals- Azothymidine (AZT), Acyclovir

Antitubercular drugs - Ethambutol

Antifungals - Griseofulvin

Histamines-Histamine antagonists, -H1 blockers - Chlorpheneramine, -H2 blockers - Ranitidine-5-HT Seratonin, 5-HT receptor antagonist – Metaclopramide Computational chemistry and combinatorial chemistry.

References

1. Introduction to medicinal chemistry, A Gringuage, Wiley-VCH.
2. Wilson and Gisvold's Text Book of organic medicinal and pharmaceutical chemistry, Ed Robert F. Dorge.
3. An introduction to drug design, S.S. Pandey and J.R. Dimmock, New Age International.
4. Burger's medicinal chemistry and drug discovery, Vol-1 (Chapter-9 and Ch-14), Ed. M.E. Wolff, John Wiley.
5. Goodman and Gilman's pharmacological basis of therapeutics, McGraw-Hill.
6. The organic chemistry of drug design and drug action, R. B. Silverman, AcademicPress.
7. Strategies for organic drug synthesis and design, D. Lednicer, John Wiley
8. Medicinal Chemistry, A Kar, Wiley, 2000.
9. Synthetic drugs, G. R. Chatwal, Himalaya, New Delhi, 1995.

10. Comprehensive organic chemistry, Vol. 5 (Antibiotics), D.H.R. Barton, W. D. Ollis, Pergamon Press, NY, 1979.

11. Instant Notes Medicinal Chemistry, P Graham, Viva, New Delhi, 2002.

OCOHCD 4.3 - DISSERTATION

Course outcome:

This course outcome brings the student to acquire skills in the area of drug-discovery and development via industrial exposure.

Pedagogy:

To introduce the hands on training as a chemistry to work in any pharmaceutical industry.

Course content:

Industrial work for 3 months to make their own thesis.

OCOSCP 4.41 - ORGANIC CHEMISTRY PRACTICAL–V

Course outcome:

This course outcome brings the student to have a analytical R&D on drugs or organic compounds estimation and detection in samples.

Pedagogy:

To enable hands on training in analytical organic chemistry.

Course content:

Estimations

1. Determination of equivalent weight of acids by silver salt method
2. Determination of iodine value of n oil and fats by chloramine-T
3. Saponification value of an oil or fats
4. Estimation of sugars by Fehlings method
5. Determination of enol content by Meyer’s method
6. Estimation of hydroxyl groups
7. Estimation of vicinal hydroxyl groups
8. Estimation of ketones by haloform reaction
9. Estimation of sugars by Bertrand’s method
10. Estimation of nitro groups

11. Estimation of amino acids

12. Estimation of ketones by oxime method

References

1. Manual of Organic Chemistry - Dey and Seetharaman.
2. A Text Book of Practical Organic Chemistry – A.I. Vogel, Vol.III
3. Practical Organic Chemistry - Mann & Saunders.

OCOSCP 4.42 - ORGANIC CHEMISTRY PRACTICAL–VI

Course outcome:

This course outcome enables the student to make many organic drugs and their characterization using advanced techniques.

Pedagogy:

To have hands on training in synthesis of organic compounds thtat are useful in pharmaceutical chemistry

Course content:

Multi step synthesis -II

Synthesis of organic compounds

1. Preparation of benzoccaine (p- amino ethyl benzoate) from p-nitrotoluene
2. Preparation of p-nitro aniline from aniline.

3. Preparation of m-amino benzoic acid from ethyl benzoate(via nitration, hydrolysis and reduction).
4. Synthesis if 2,4-dinitro phenyl hydrazine
5. Preparation of phenacetin from p-nitro phenol(via reduction, acetylation and ethylation)
6. Synthesis of Luminol (fieser page no 199)
7. Grignard reaction: Synthesis of triphenyl carbinol from benzoic acid
8. Preparation of pyrazole from acetophenone

Identification of the structures of the simple organic compounds using UV-visible IR, NMR and Mass spectra.

Reference

1. Experiments in organic chemistry, III edition, Louis F. Fieser.
2. Vogel's Text book of practical organic chemistry, V edition, B. B Furniss, A.J. Hannaford, P.W.G. Smith.
3. Practical Organic chemistry-Mann and saunders.