# M.Sc.

# (Applied Chemistry)

(Effective from the admitted batch of 2021-22)

# **Scheme and Syllabus**



DEPARTMENT OF ENGINEERING CHEMISTRY AU COLLEGE OF ENGINEERING ANDHRA UNIVERSITY VISAKHAPATNAM

#### ANDHRA UNIVERSITY DEPARTMENT OF ENGINEERING CHEMISTRY Revised Syllabus for M.Sc. Applied Chemistry (With effect from the Admitted batch of 2021-2022 Academic Year)

#### **PROGRAM OUTCOMES:**

PO1: To provide students in the scientific skills and chemical knowledge essential to develop and apply the knowledge in chemical sciences for preparing chemists of exceptional skills and abilities.

PO2: To provide knowledge, application, skills in required areas of chemical education

PO3: To equip students with effective scientific communication skills

PO4: To encourage the pursuit of lifelong education

PO5: To develop each student into a committed individual with ethical and social responsibility.

PO6: Secure suitable employment in the areas of chemical industries like pharmaceutical, steel and metals, polymers, fuels and nuclear, environmental and pollution control, nanotechnology and composite materials, teaching and research, etc.

# **PROGRAM SPECIFIC OUTCOMES:**

The students who complete the M.Sc. Applied Chemistry course shall:

PSO1: Have strong foundation in the fundamentals and applications of chemical knowledgeand understanding

PSO2: Have the abilities to think critically, logically and analytically and solve problem in the area of chemical sciences, materials, environmental aspects, medicines and energy

PSO3: Have the abilities to carry out chemical experiments, record and analyze the results and design advanced models

PSO4: Have the abilities to use modern library and information retrieving tools to obtain information and assimilate to generate concepts and apply them in challenging situations PSO5: Have the abilities to effectively communicate their knowledge and skills to other chemists and non-chemists in oral or written formats

PSO6: Have the personal attributes and ethical sensibilities to enable them to function as effective scientists and citizens

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#### REGULATIONS

- 1. The duration of the course is for two academic years with total four semesters. The nature of the course is full-time.
- 2. Candidates for the degree of Master of Science in Applied Chemistry shall be required to have passed the B.Sc with Chemistry / Applied Chemistry / Industrial Chemistry as one the subject of this university or any other university recognized by the academic council as equivalent thereto.
- 3. The course and scope of instruction shall be as defined in the syllabus prescribed. (Annexure-III )
- 4. Candidate who takes instruction shall be required to take examinations at the end of each semester as specified in Annexure-I.
- 5. Each candidate has to undergo an internship for a duration of four weeks during the fourth semester in any chemical industry/ R&D / organization/ or at the department at their own expense and have to submit project report.
- 6. A candidate shall be declared to have passed in any course if he /she secures not less than "E" grade in theory and not less than "D" grade in the practical /Project, provided the result otherwise is withheld. There is no minimum pass marks for internal assessment marks both theory as well as practical.

A candidate shall be deemed to have satisfied the minimum requirement for the award of the degree of M.Sc. Applied Chemistry.

- i. If he / she is declared to have passed all the subjects included in the scheme of instruction and examination and
- ii. if he /she secures 5.0 CGPA in each of the semesters by the end of the fourth semester.

Further, a candidate shall be permitted to choose any course(s) to appear for improvement in case the candidate fails to secure the minimum prescribed SGPA/CGPA to enable the candidate to pass at the end of any semester examinations. There shall not be any provision for the improvement of internal assessment marks in any theory or practical subjects in any year /semester of study. Grades and calculation of SGPA and CGPA are given in Annexure-II

7. The successful candidates in the M.Sc Applied Chemistry degree examination shall be arranged in the order in which they are registered for the examination in the following classes on the basis of the CGPA. However, students who pass in any supplementary examination shall not be awarded Distinction even if they obtain a CGPA of 8.0 or above, they shall be considered as First Class only.

First Class with Distinction	– CGPA 8.0 or more
First Class	- CGPA 7.0 or more but less than 8.0
Second Class/Pass	- CGPA 5.0 or more but less than 7.0

- 8. The Question course setting and valuation shall be as per the University regulations at the end of each semester.
- 9. The practical examinations shall be conducted and valued by both internal and external examiners at the end of each semester.
- 10. The viva- voce examination for Project Work shall be conducted both internal and external examiners at the end of the completion of project and after submission of the Project Report by each of the candidates.
- 11. Each practical/ laboratory carries 70 marks for external evaluation process in which both the internal and external examiners conducts the examination . Out of these 70 marks 10marks are allocated to Record and 10 marks allocated to Viva-voce examination of the student.

- 12. The Minimum attendance required by a candidate will be 75% of the total number for the working days in that semester. Provided that in special cases and for sufficient cause shown, the Vice-chancellor may, on the recommendation of the Principal and the Head of the department concerned, condone the deficiency in the average attendance to an extent of 9% for reasons such as ill health, if the application for condonation is submitted at the time of actual illness and is supported a certificate of an authorized medical officer approved by the Principal. However, 100% attendance should be maintained for all practicalls/ labs/ Internship>
- 13. Each of the student has to study two MOOC courses from NPTEL/SWAYAM etc. one in the third semester and the other in the fourth semester of the programme and the grade obtained should be submitted to the Department/ College/ University for incorporation in the marks list along with the Grade/ Course Completion Certificate. The Departmental Committee shall decide whether to accept or not the grade/score obtained by the student. The student has to complete each of these courses during the concerned semester period only.
- 14. Keeping in view of the objectives of NPE 2020 and the directives of the University, two value added courses have been included each in 3rd and 4th semesters of the course. Intellectual Property rights in 3rd semester and Research Methodology in the 4th semester under non-credit scheme. However, the students have to attend the examination and pass the examination similar to that of other subjects of the course.
- 15. The University may, from time to time, revise, amend or change the regulations, scheme of examination and syllabus. In the case of students already undergoing the course, the changes will take effect from the beginning of the following academic year after the change are introduced and shall cover the part of the course that remains to be completed.

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Course Code	Course Title	Course Type	Instruction Periods per	External Marks	Internal Marks	Total Marks	Duration of External	Credits
Coue	The	Турс	week L-T-P	WIIIKS	WIIIKS		Examination	
ACT 1.1	Inorganic Chemistry-I	Theory	4-0-0	70	30	100	3 Hours	4
ACT 1.2	Organic Chemistry-I	Theory	4-0-0	70	30	100	3 Hours	4
ACT 1.3	Physical Chemistry-I	Theory	4-0-0	70	30	100	3 Hours	4
ACT 1.4	Analytical Chemistry	Theory	4-0-0	70	30	100	3 Hours	4
ACP 1.5	Inorganic Chemistry Practical-I	Lab	0-0-6	70	30	100	3 Hours	3
ACP 1.6	Organic Chemistry Practical-I	Lab	0-0-6	70	30	100	3 Hours	3
ACP 1.7	Physical Chemistry Practical-I	Lab	0-0-6	70	30	100	3 Hours	3
	Total		16-0-18	490	210	700		25

### Annexure-I Scheme of Instruction and Examination Semester –I

# Semester –II

Course Code	Course Title	Course Type	Instruction Periods	External Marks	Internal Marks	Total Marks	Duration of External	Credits
0000		-510	per week L-T-P				Examination	
ACT 2.1	Inorganic Chemistry-II	Theory	4-0-0	70	30	100	3 Hours	4
ACT 2.2	Organic Chemistry-II	Theory	4-0-0	70	30	100	3 Hours	4
ACT 2.3	Physical Chemistry-II	Theory	4-0-0	70	30	100	3 Hours	4
ACT 2.4	Environmental Chemistry	Theory	4-0-0	70	30	100	3 Hours	4
ACP 2.5	Inorganic Chemistry Practical-II	Lab	0-0-6	70	30	100	3 Hours	3
ACP 2.6	Organic Chemistry Practical-II	Lab	0-0-6	70	30	100	3 Hours	3
ACP 2.7	Physical Chemistry Practical-II	Lab	0-0-6	70	30	100	3 Hours	3
	Total		16-0-18	490	210	700		25

Semester –I	Π
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Course Code	Course Title	Course Type	Instruction Periods	External Marks	Internal Marks	Total Marks	Duration of External	Credits
			L-T-P				Examination	
ACT	Instrumental	Theory	4/0/0	70	30	100	3 Hours	4
3.1	Methods of							
	Analysis							
ACT	Organic	Theory	4/0/0	70	30	100	3 Hours	4
3.2	Spectroscopy							
ACT	Organic	Theory	4/0/0	70	30	100	3 Hours	4
3.3	Synthesis							
ACT	Medicinal							
3.4	Chemistry							
Elective	Energy	Theory	4/0/0	70	30	100	3 Hours	4
	Systems	Theory	4/0/0	70	50	100	5 110015	4
	Surface							
	Chemistry							
ACT	Intellectual	Theory	4/0/0	70	30	100	3 Hours	0
3.5#	Property							
	Rights							
ACT	MOOC	Theory	ONLINE	70	30	100	As per the	3
3.6	Course						course	
ACP	Quantitative	Lab	0/0/6	70	30	100	6 Hours	3
3.7	Analysis							
	Practical-I							
ACP	Organic	Lab	0/0/6	70	30	100	6 Hours	3
3.8	Chemistry							
	Practical-III							
	Total		20-0-12	560	240	800		25

Semester ·	–IV
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Course Code	Course Title	Course Type	Instruction Periods per week L-T-P	External Marks	Internal Marks	Total Marks	Duration of External Examination	Credits
ACT 4.1	Industries based on Organic Raw Materials	Theory	4/0/0	70	30	100	3 Hours	4
ACT 4.2	Fine Chemicals	Theory	4/0/0	70	30	100	3 Hours	4
ACT 4.3	Polymers and Plastics	Theory	4/0/0	70	30	100	3 Hours	4
ACT 4.4 Elective	Green Chemistry Quantum Chemistry Nuclear Chemistry	Theory	4/0/0	70	30	100	3 Hours	4
ACT 4.5 <sup>#</sup>	MOOC Course	Theory	ONLINE	70	30	100	As per the course	0
ACT 4.6 <sup>#</sup>	Research Methodology	Theory	4/0/0	70	30	100	3 Hours	0
ACP 4.6	Quantitative Analysis Practical-II	Lab	0/0/6	70	30	100	6 Hours	3
ACP 4.7	Applied Chemistry Practical	Lab	0/0/6	70	30	100	6 Hours	3
ACP 4.8	Project Work*	Internship		70	30	100		3
	Total		20-0-12	560	240	800		25

\*4 WEEKS Training in Chemical industry/R&D/Organization/Department # Value Added Course

# **Summary of Courses and Credits**

Semester	No. of Theory Courses	No. of Practical Courses	No. of MOOC courses	No. of Value Added Courses	No. of Projects	Total Marks	Total Credits
Ι	4	3	0	0	0	700	25
II	4	3	0	0	0	700	25
III	4	2	1	1	0	800	25
IV	4	2	1	1	1	800	25
TOTAL	16	10	2	2	1	3000	100

# **Total Credits : 100**

S. No	Range of	Grade	<b>Grade Points</b>
	Marks		
1	>90≤100	0	10.00
2	> 80 ≤ 90	А	9.00
3	> 70 ≤ 80	В	8.00
4	> 60 ≤ 70	С	7.00
5	> 50 ≤ 60	D	6.00
6	≥40≤50	Е	5.00
7	< 39	F	0.00

#### Total Marks 3000 Annexure-II

Calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average)

For example if a student gets the grades in one semester A, A, B, B, B, D in six subjects having credits 2(S1) 4(S2), 4(S3), 4(S4), 4(S5), 2(S6), respectively.

The SGPA is calculated as follows:

 $9(A) \times 2(S1) + 9(A) \times 4(S2) + 8(B) \times 4(S3) + 8(B) \times 4(S4) + 8(B) \times 4S5) + 6(D) \times 2 (S6)$ SGPA= 2(S1) + 4 (S2) + 4(S3) + 4(S4) + 4(S5) + 2(S6)= 162/20 = 8.10

A student securing 'F' grade there by securing 0.0 grade points has to appear and secure at least 'E' grade at the subsequent examination(s) in that subject.

If a student gets the grades in another semester D, A, B, C, A, E, A in seven subjects having credits 4(S1), 2(S2),4(S3), 2(S4), 4(S5), 4(S6), 2(S7) respectively.

 $\{6(D)x4(S1)+9(A)x2(S2)+8(B)x4(S3)+7(C)x2(S4)+9(A)x4(S5)+5(E)x4(S6)+9(A)x2(S7)\}$ 

 $SGPA = \frac{162/22}{4(S1)+2(S2)+4(S3)+2(S4)+4(S5)+4(S6)+2(S7)}$  (9X2+9X4+8X4+8X4+8X4+6X2+6X4+9X2+8X4+7X2+9X4+5X4+9X2) CGPA = = = 324/4

CGPA = \_\_\_\_\_\_=324/42

A candidate has to secure a minimum of 5.0 SGPA for a pass in each semester. Further, a candidate will be permitted to choose any course (s) to appear for improvement in case the candidate fails to secure the minimum prescribed SGPA/CGPA to enable the candidate to pass at the end of any semester examination.

Further, classification of successful candidates is based on CGPA as follows. Science, Engineering, Pharmacy (PG)/PG Diplomas:

Distinction – CGPA 7.0 or more

I Class –	CGPA 6.0 or more but less than 7.0
II Class/Pass –	CGPA 5.0 or more but less than 6.0

#### Annexure-III REVISED SYLLABUS FOR M.Sc. APPLIED CHEMISTRY

(with effective from 2021-22 admitted batch)

#### Semester-I ACT 1.1: INORGANIC CHEMISTRY–I

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACT	Inorganic	Theory	4-0-0	70	30	100	3 Hours	4
1.1	Chemistry-I	_	(60)					

#### **Course Objectives:**

- CO 1: To develop an insight into the basic knowledge of inorganic chemistry
- CO 2: To understand chemical bonding, coordination compounds, f-block elements and their theories
- CO 3: To apply the knowledge and understanding in the areas of chemical bonding, coordination compounds and f-block elements for solving existing challenges faced in various chemical and industrial areas

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Identify the principles, structure and reactivity of selected coordination compounds

LO 2: Interpret their electronic spectra and magnetic properties.

LO 3: Utilize the principles of transition metal coordination complexes in understanding functions of chemical systems.

#### Unit-I

#### **Chemical Bonding**

Hybridization, VSEPR-theory and its importance - Molecular orbital theory as applied to homonuclear and simple hetero nuclear diatomic molecules (non-mathematical approach only)- Fajan's rules for prediction of non-polar character, Electroneutrality principle and back bonding,

#### Unit -II

#### **Inorganic Cage and Ring Compounds**

Preparation, structure and reactions of boranes, carboranes, metallocarboranes, boronnitrogen ( $H_3B_3N_3H_3$ ), phosphorus-nitrogen ( $N_3P_3Cl_6$ ) and sulphurnitrogen ( $S_4N_4$ , (SN)x) cyclic compounds. Electron counting in boranes – Wades rules (Polyhedral skeletal electron pair theory). Isopoly and heteropoly acids.

#### Unit -III

#### **Fundamentals of Coordination Compounds**

Theories of metal-ligand bond: Valence bond theory Geometries of coordination numbers, 4tetrahedral and square planar and 6-octahedral. Limitations, Inner and outer orbital complexes-- Crystal field theory: Salient features, Splitting of metal orbitals in regular octahedral, square planar, tetrahedral, square pyramidal and trigonal bipyramidal geometries. Measurement of crystal field splitting energy, High spin and low spin octahedral complexes. Crystal field stabilization energy.

#### (12 hours)

#### (12 hours)

#### Unit -IV

#### **Applications of Coordination Compounds**

Factors affecting the magnitude of crystal field splitting. Limitations of crystal field theory. Application of crystal field theory to account for spectral and magnetic properties of complexes. Jahn-Teller distortion. Introduction to Molecular orbital theory of complex compounds –Nephelauxetic effect. Pearson's concept of hard and soft acids and bases, Hard and soft acids and bases (HSAB) rule - Classification of metals and Ligands as class 'a' and class 'b'. Applications of HSAB rule - Predicting feasibility of a reaction and stability of compounds.

#### Unit -V

#### **Chemistry of Lanthanides and Actinides**

Stable oxidation states-Lanthanide and actinide contraction-Absorption spectra of lanthanides and actinides and their magnetic properties-separation of Lanthanides and actinides, uses of lanthanides and their compounds.

#### **Text Books:**

- 1. Inorganic chemistry, principles of structure and reactivity, 4th Edition by James E. Huheey: Elleu A. Keiter: Richard L. Keiter.
- 2. Advanced inorganic chemistry by F. A. Cotton and G. Wilkinson IV Edition, John Wiley and Sons, New York, 1980.
- 3. Theoretical Inorganic Chemistry, II Edition by M. C. Day and J. Selbin, Affiliated East West press Pvt. Ltd., New Delhi.
- 4. Inorganic Chemistry by Shriver and Atkins, Oxford University Press (1999
- 5. Concepts and Models in Inorganic Chemistry by Doughlas Mc Daniel.
- 6. Introductory Quantum Chemistry by A.K. Chandra (Tata McGrawhill)
- 7. Chemistry of Lanthanides by T. Healler, Chapman and Hall.
- 8. Chemical Applications of Group Theory by B.A. Cotton.
- 9. Inorganic Chemistry by J. E. Huheey, III Edition, Harper International Edition, 1983.

#### Mapping of PO/CO

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	Н	М	L	М	L	М	М
CO 2	М	L	L	М	М	L	L
CO 3	Н	Μ	Μ	L	Μ	Μ	Μ

#### L-LOW M-MEDIUM H-HIGH

#### (12 hours)

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			(Total)					
			L-T-P					
ACT	Organic	Theory	4-0-0	70	30	100	3 Hours	4
1.2	Chemistry		(60)					

#### **Course Objectives:**

CO 1: To develop an insight the basic knowledge of organic chemistry

- CO 2: To understand structure and reactivity, aromatic nucleophilic substution, stereochemistry, pericyclic reactions and heterocyclic compounds
- CO 3: To apply the knowledge and understanding in the areas of structure and reactivity, aromatic nucleophilic substution, stereochemistry, pericyclic reactions and heterocyclic compounds for solving existing challenges faced in various chemical and industrial areas

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Identify the structure and reactivity, aromatic nucleophilic substution, stereochemistry, pericyclic reactions and heterocyclic compounds

LO 2: Interpret structure and reactivity, aromatic nucleophilic substution, stereochemistry, pericyclic reactions and heterocyclic compounds.

LO 3: Utilize the principles structure and reactivity, aromatic nucleophilic substution, stereochemistry, pericyclic reactions and heterocyclic compounds in understanding functions of chemical systems.

#### Unit-I

#### **Structure and Reactivity**

Properties of organic molecules – concept of Aromaticity – Types – Huckel and Craig's rules – Benzenoid and non benzenoid compounds – annulenes – Hetero annulenes – fullerenes (C 60 ) – Types of organic reactions – Mechanisms – Energy and Kinetic aspects – Reactive Intermediates: carbanions, carbonium ions, free radicals, carbenes, nitrenes – their formation stability and reactivity – Nucleophilic substitution at a saturated carbon atom –  $S_N1$ ,  $S_N2$  and  $S_Ni$  reactions. Elimination reactions E1, E2 and E1 c B- Elimination versus substitution.

#### Unit-II:

#### Aromatic Nucleophilic Substitution

The  $S_NAr$ , benzyne and  $S_{RN}1$  mechanisms. Reactivity - Effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser and Smiles rearrangements.

#### Addition to Carbon-Carbon Multiple Bonds:

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolate anions—Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

#### (12 hours)

#### Unit-III :

#### Stereochemistry

Conformational isomerism – cyclohexanes and decalins – optical isomerism – optical activity – molecular asymmetry and dissymmetry. Enantio and diastereo selective synthesis. Chirality – optical isomerism in biphenyls, allenes and spirans – optical isomerism in Nitrogen compounds. Geometrical isomerism – acylic and cyclic compounds.

## Unit-IV:

#### **Pericyclic Reactions**

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3- butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. FMO and PMO approach. Electrocyclic reactions — conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions — antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements — suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5- sigmatropic rearrangements. Claisen, Cope and aza-Gope rearrangements. Ene reaction

#### Unit-V:

#### **Chemistry of Heterocyclic Compounds**

Synthesis and reactivity of Benzofuran, Benzothiophene, Indole, Pyrimidine, Pyrazine, Oxazole, Quinoline and Isoquinoline

#### **Text Books:**

- 1. A guide book to mechanisms in Organic chemistry by Peter Sykes : ELBS.
- 2. Organic chemistry, Vol. I ( 6<sup>th</sup> Edn. ) and Vol. II ( 5<sup>th</sup> Edn . ) by I.L. Finar, ELBS.
- 3. Organic chemistry by Mukherjee, Singh and Kapoor, Vols. I.and II, Wiley Eastern
- 4. Reaction mechanism in Organic chemistry by Mukerjee and Singh, Macmillan India.
- 5. Advanced organic chemistry by Jerry March, Wiley Eastern.
- 6. Chemistry of Natural Products by K.W. Bentley ( Editor ).
- 7. Stereochemistry of carbon compounds by E.Eliel, McGraw –Hill.
- 8. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
- 9. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.

#### (12 hours)

(12 hours)

# ACT 1.3: PHYSICAL CHEMISTRY–I

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACT	Physical	Theory	4-0-0	70	30	100	3 Hours	4
1.3	Chemistry		(60)					

#### **Course Objectives:**

CO 1: To develop an insight the basic knowledge of physical chemistry

- CO 2: To understand solid state chemistry, chemical kinetics and thermodynamics for chemical systems
- CO 3: To apply the knowledge and understanding in the areas of solid state chemistry, chemical kinetics and thermodynamics for solving existing challenges faced in various chemical and industrial areas

## Learning Outcomes:

At the end of the course, the learners should be able to:

- LO 1: Identify the solid state chemistry, chemical kinetics and thermodynamics
- LO 2: Interpret solid state chemistry, chemical kinetics and thermodynamics

LO 3: Utilize the principles of solid state chemistry, chemical kinetics and thermodynamics

## Unit-I

#### **Fundamentals of Solid State Chemistry**

Introduction, classification, laws of crystallography, crystallographic systems, space lattice, types of lattices, Brags Equation, Fourier synthesis, X-ray spectrometer, lane photograph, Rotating crystal method, Powder method, Neutron Diffraction, Heat capacities of solids, Molar heat capacities, application, quantum theories of specific heats (Einstein Equation, Debye equation) Born Hager cycle, cohesive energy Ionic crystal. Properties of solids, Rhedogical plastic flow and elastic its glass transition temperature.

# Unit-II

# Advances in Solid State Chemistry

Defects in solids-point defects- linear defects-Frenkel & Schotky defect (Mathematical derivations). Band theory of solids- semiconductors – Extrinsic & Intrinsic non stochiometric, organic semiconductors, p-n junction, rectifiers, transistors, metal purification by zone refining, preparation of single crystals of Si & Ge (Czochralski crystal pulling method) doping, Integrated circuits.

# Unit-III

#### Fundamentals of Chemical Kinetics

Introduction, order, molecular its rate constant specific reaction rate, zero<sup>th</sup> order first order second order third order rate equations (with suitable gaseous phase and liquid phase reaction determination of order of reactions (method of integrations, Time to complete definite fraction of the reactions, differential method, isolation method) opposing, reactions Hydrogen-bromine, hydrogen- chlorine reactions, consecutive reactions photolysis of acetaldehyde.

#### (12 hours)

# (12 hours)

#### **Unit-IV**

#### **Advances in Chemical Kinetics**

Theories of reaction rates-(collision and transition state teas). Fast reaction Flow systems Stoppers flow method Effect of substitute Hemet equations Taft equation primary and secondary salt effects, effect of dielectric constant of solvent, ion – ion interaction, catalysis, Acid – base Enzyme catalysis. Oscillating reactions, Autocatalysis, chemical chaos

#### Unit-V

#### Laws of Thermodynamics:

Thermodynamic Reversibility, Heat Capacities and Heats of Reactions; Entropy Changes in Chemical Reactions; Thermodynamic Equations of State; Free Energy and Partial Molar Properties: Gibbs-Helmholtz Equations; Fugacity and Activity; Phase Equilibria; Partial Molar Quantities; Third Law of Thermodynamics: Absolute Entropy of Solids, Liquids and Gases; Cryoscopic evaluation of Absolute Entropy of Solids.

#### **Text Books:**

- 1. Solid state chemistry by Kittel.
- 2. Chemical Kinetics- Laidiler.
- 3. Physical Chemistry, R. S. Berry, S. A. Rice and J. Ross, (2ndEdn), Oxford, 2007.
- 4. Physical Chemistry, P. Atkins and Julia de Paula, (9thEdn), Oxford, 2011.
- 5. Physical Chemistry, R. J.Silbey, R.A. Alberty and M. G. Bawendi, Wiley (4thEdn), 2006.
- 6. Thermodynamics for Chemists, S. Glasstone, East-West, 2007

#### (12 hours)

# ACT 1.4: ANALYTICAL CHEMISTRY

Course Code	Course Title	Course Type	Instruction Periods	External Marks	Internal Marks	Total Marks	Duration of External	Credits
		51	per week L-T-P (Total)				Examination	
ACT 1.4	Physical Chemistry	Theory	4-0-0 (60)	70	30	100	3 Hours	4

## **Course Objectives:**

CO 1: To develop an insight the basic knowledge of analytical chemistry

- CO 2: To understand errors, statistics and sampling, volumetric and gravimetric analysis, applied analysis, electroanalytical methods
- CO 3: To apply the knowledge and understanding in the areas of errors, statistics and sampling, volumetric and gravimetric analysis, applied analysis, electroanalytical methods for solving existing challenges faced in various chemical and industrial areas

## Learning Outcomes:

At the end of the course, the learners should be able to:

LO 1: Identify the errors, statistics and sampling, volumetric and gravimetric analysis, applied analysis, electroanalytical methods

LO 2: Interpret errors, statistics and sampling, volumetric and gravimetric analysis, applied analysis, electroanalytical methods.

LO 3: Utilize the principles of errors, statistics and sampling, volumetric and gravimetric analysis, applied analysis, electroanalytical methods

#### Unit-I

#### **Errors, Statistics and Sampling**

Accuracy and precision, Error, types of error, systematic and random errors, minimization of errors, mean and standard deviations, reliability of results, confidence interval, comparison of results, student T test, F test, Comparison of two samples (Paired T test), Sampling , the basis of sampling, sampling procedure, sampling statistics.

#### Unit-II

# Theory of Volumetric and Gravimetric Analysis

Introduction, Titrimetric analysis, classifications of reactions in titrimetric analysis, standard solutions, preparation of standard solutions, primary and secondary standards, Indicators, theory of indicators, Acid–base titrations in non-aqueous media. Gravimetric Analysis, Impurities in precipitates, Gravimetric calculations, precipitation equilibria (Solubility product, common ion effect, stoichiometry), organic precipitation.

# Unit-III

#### **Complexometric Equilibria**

Introduction, Titration curves, Types of EDTA titrations, Methods of End Point Detection, Types of Complexometric Titrations (a) Direct Titration (b) Back Titration (c) Replacement titration (d) Indirect Titration (e) Applications of Complexometric Titrations

#### (12 hours)

(12 hours)

### Unit-IV

#### Applied Analysis

Analytical procedures involved in environmental monitoring. Water quality - BOD, COD, and DO - Air pollution monitoring sampling, collection of air pollutants-SO<sub>2</sub>, and NO<sub>2</sub> - Analysis of metals, alloys and minerals: Analysis of brass and steel. Analysis of limestone

## Unit-V

#### **Electroanalytical methods**:

Basic principle, instrumentation, and applications of Polargraphy, Cyclic voltammetry, anodic stripping voltametry, amperometry, and conductometry

#### **Text Books:**

 Analytical Chemistry Principles and Techniques, L.G. Hargis, Prentice Hall, USA.
Instrumental methods of analysis, H.H. Willard, L.L. Merritt, Jr., J.A. Dean and F.A. Settle, Jr., Van Nostrand Reinhold Co., New York

3. Principles of instrumental analysis, D.A. Skoog, W.B. Saunders Co., New York.

4. Vogel's Textbook of Quantitative An alysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS

5. Vogel's Textbook of Practical Organic Chemistry, A. R. Tatchell, John Wiley

(12 hours)

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P					
			(Total)					
ACP	Inorganic	Lab	0-0-6	70	30	100	3 Hours	3
1.5	Chemistry		(90)					
	Practical-I							

# ACP 1.5: INORGANIC CHEMISTRY PRACTICAL - I

### **Course Objectives:**

CO 1: To develop an insight into the preparation of inorganic complexes

CO 2: To understand the process of preparation of inorganic complexes

CO 3: To acquire skills in the preparation of inorganic complexes

## Learning Outcomes:

At the end of the course, the learners should be able to:

LO 1: Prepare various inorganic complexes

LO 2: Develop skill in handling apparatus, measure the quantities and carryout the reaction and analyze the product formed

LO 3: Applies the skill in preparing novel complexes

# Synthesis of Inorganic Complexes and their Characterization

Preparation of selected inorganic complex compounds and their characterization

Some suggested complex compounds

(1) VO(acac)<sub>2</sub> (2) TiO(C<sub>9</sub>H<sub>8</sub>NO)<sub>2</sub>.2H<sub>2</sub>O (3) cis-K[Cr(C<sub>2</sub>O<sub>4</sub>)<sub>2</sub>(H<sub>2</sub>O)<sub>2</sub>] (4) Na[Cr(NH<sub>3</sub>)<sub>2</sub>(SCN)<sub>4</sub>] (5) Mn(acac)<sub>3</sub> (6) K<sub>3</sub>[Fe(C<sub>2</sub>O<sub>4</sub>)<sub>3</sub>] (7) [Co(NH<sub>3</sub>)<sub>6</sub>][Co(NO<sub>2</sub>)<sub>6</sub>] (8) cis-[Co(trien)(NO<sub>2</sub>)<sub>2</sub>]Cl.H<sub>2</sub>O (9) Hg[Co(SCN)<sub>4</sub>] (10) [Co(Py)<sub>2</sub>Cl<sub>2</sub>] (11) [Ni(NH<sub>3</sub>)<sub>6</sub>]Cl<sub>2</sub> (12) Ni(dmg)<sub>2</sub> (13) [Cu(NH<sub>3</sub>)<sub>4</sub>]SO<sub>4</sub>.H<sub>2</sub>O

- 1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS
- 2. Synthesis and Characterization of Inorganic Compounds, W. L. Jolly, Prentice Hall

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACP	Organic	Lab	0-0-6	70	30	100	3 Hours	3
1.6	Chemistry		(90)					
	Practical-I							

# ACP 1.6: ORGANIC CHEMISTRY PRACTICAL - I

#### **Course Objectives:**

- CO 1: To develop an insight into the preparation of organic compounds in various reactions
- CO 2: To understand the process of preparation of organic through various reactions
- CO 3: To acquire skills in the preparation of organic compounds, their separation, purification and identification

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Prepare various organic compounds using various reactions

LO 2: Develop skill in handling apparatus, measure the quantities and carryout the reaction, separate the products, purify them and analyze the products formed

LO 3: Applies the skill in preparing novel organic moieties

#### Synthesis of Organic compounds

Synthesis, purification and characterization of about ten organic compounds involving one or two stages.

List of some suggested compounds

- 1.  $\beta$ -Napthyl methyl ether from  $\beta$ -Naphthol
- 2. m-dinitrobenzene from Nitrobenzene
- 3. Azo dye from primary amine
- 4. Aromatic acid from ester
- 5. Benzanilide from aniline
- 6. p-nitroaniline from Acetanilide
- 7. p-Bromo acetanilide from aniline
- 8. Phthalimide from phthalic acid
- 9. 1,2,3-Tribromo benzene from aniline
- 10. Benzanilide from Benzophenone

- 1. A Textbook of Practical Organic Chemistry by A. I. Vogel, ELBS and Longman group.
- 2. Practical Organic Chemistry by Mann and Saunders, ELBS and Longman group.

Course Code	Course Title	Course Type	Instruction Periods per week L-T-P (Total)	External Marks	Internal Marks	Total Marks	Duration of External Examination	Credits
ACP 1.7	Physical Chemistry Practical-I	Lab	0-0-6 (90)	70	30	100	3 Hours	3

# ACP 1.7: PHYSICAL CHEMISTRY PRACTICAL - I

# **Course Objectives:**

- CO 1: To develop an insight into the measurement of various quantitative characteristics of chemical systems
- CO 2: To understand the process of measurement of various chemical systems
- CO 3: To acquire skills in the setting up of apparatus, measurement, recording and interpretation of results related to various quantitative characteristics

# **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Set up of apparatus, measurement, recording and interpretation of results related to various quantitative characteristics

LO 2: Develop skill in setting up of apparatus, measurement, recording and interpretation of results related to various quantitative characteristics

LO 3: Applies the skill in measuring the properties of other novel systems

- 1. Critical Solution temperature of phenol-water system; effect of Electrolyte.
- 2. Equilibrium constant of  $KI + I_2 \rightarrow KI_3$ .
- 3. Hydrolysis of an ester A Kinetic study.
- 4. Dimerisation constant of benzoic acid by the distribution method (Benzene –water system )
- 5. Inversion of Sucrose –A kinetic study.
- 6. Conductometric titration of mixture of weak and strong acid with sodium hydroxide.
- 7. Determination of solubility product of a sparingly soluble salt by conductometric method.

- 1. Practical Physical Chemistry by Alexander .
- 2. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS

Course Code	Course Title	Course Type	Instruction Periods	External Marks	Internal Marks	Total Marks	Duration of External	Credits
Couc	1140	Type	per week L-T-P (Total)	101ul H5	iviu ks	TVILLING	Examination	
ACT 2.1	Inorganic Chemistry-II	Theory	4-0-0 (60)	70	30	100	3 Hours	4

#### Semester-II ACT 2.1: INORGANIC CHEMISTRY–II

#### **Course Objectives:**

CO 1: To acquire the basic knowledge of metal-ligand equilibria, electronic spectra, ligand substitution reactions in octahedral and square planar complexes, electron transfer reactions in coordination complexes

CO 2: To understand metal-ligand equilibria, electronic spectra, ligand substitution reactions in octahedral and square planar complexes, electron transfer reactions in coordination complexes

CO 3: To apply the knowledge and understanding in the areas of metal-ligand equilibria, electronic spectra, ligand substitution reactions in octahedral and square planar complexes, electron transfer reactions in coordination complexes

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Explain metal-ligand equilibria, electronic spectra, ligand substitution reactions in octahedral and square planar complexes, electron transfer reactions in coordination complexes

LO 2: Apply metal-ligand equilibria, electronic spectra, ligand substitution reactions in octahedral and square planar complexes, electron transfer reactions in coordination complexes

LO 3: Evaluate the metal-ligand equilibria, electronic spectra, ligand substitution reactions in octahedral and square planar complexes, electron transfer reactions in coordination complexes

#### Unit-I

#### Metal-ligand Equilibria in Solution

Stability of binary metal complexes-thermodynamic stability and kinetic stability. Step wise and overall formation constants and their interaction, trends in stepwise stability constants. Factors influencing the stability of metal complexes with reference to metal and the ligand. Chelate effect and its thermodynamic origin. Macrocyclic effect of crown ethers and cryptates. Determination of stability constants of metal complexes-Spectrophotometric and potentiometric methods.

#### Unit-II

#### **Electronic Spectra of Metal Complexes**

Term symbols – Russell – Sanders (L-S) coupling – derivation of term symbols for various configurations. Spectroscopic ground states Hund's rules to determine ordering of energy levels, Hole formalism. Selection rules- Spin selection rule and Laporte selection rule. Breakdown of selection rules. Orgel diagrams for d1 to d9 systems. Tanabe-Sugano diagrams for d2 and d6 octahedral systems. Charge transfer Spectra.

#### (12 hours)

#### Unit-III

# Ligand Substitution Reactions in Octahedral Complexes (12 hours)

Transition state or activated complex –substrate –Attacking reagents: Electrophilic reagents, Nucleophilic reagents – Types of substitution of reactions  $(S_N)$  - Electrophilic or metal substitution reactions (SE).  $S_N1$  or dissociation mechanism;  $S_N2$  or association or displacement mechanism. Acid and base hydrolysis reactions of cobalt (III) complexes

#### Unit- 1V

#### Ligand Substitution Reactions in Square Planar Complexes (12 hours)

The trans effect – uses of trans effect –different theories of trans effect –mechanism and the factors involved in the substitution reactions in square planar complexes

#### Unit-V

#### Electron Transfer Reactions in Coordination Complexes (12 hours)

Mechanism of one electron transfer reactions –Inner sphere (atom or group transfer) mechanism –outer sphere (or Electron transfer) mechanism .Structure and bonding in some binuclear metal atom clusters

- 1. Inorganic chemistry, principles of structure and reactivity, 4thEdition by James E. Huheey: Elleu A. keiter: Richard L. Keiter.
- 2. Advanced inorganic chemistry by F.A.Cotton and G. Wilkinson IV Edition, John Wiley and Sons, New York, 1980.
- 3. Theoretical Inorganic Chemistry, II Edition by M.C. Day and J. Selbin, Affiliated EastWest press Pvt. Ltd., New Delhi.
- 4. Inorganic Chemistry by Shriver and Atkins, Oxford University Press (1999
- 5. Concepts and Models in Inorganic Chemistry by Doughlas Mc Daniel.
- 6. Introductory Quantum Chemistry by A.K. chandra (Tata McGrawhill)
- 7. Chemistry of Lanthanides by T. Healler, chapman and Hall.
- 8. Chemical Applications of Group Theory by B.A. Cotton.
- 9. Inorganic Chemistry by J.E. Huheey, III Edition, Harper International Edition, 1983.

# **ACT 2.2: ORGANIC CHEMISTRY-II**

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACT	Organic	Theory	4-0-0	70	30	100	3 Hours	4
2.2	Chemistry-II	-	(60)					

#### **Course Objectives:**

CO 1: To acquire the basic knowledge of aliphatic and aromatic substitution, mechanisms, photochemistry and natural products, enzymes and lipids

CO 2: To understand To acquire the basic knowledge of aliphatic and aromatic substitution, mechanisms, photochemistry and natural products, enzymes and lipids

CO 3: To apply To acquire the basic knowledge of aliphatic and aromatic substitution, mechanisms, photochemistry and natural products, enzymes and lipids

## **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Explain To acquire the basic knowledge of aliphatic and aromatic substitution,

mechanisms, photochemistry and natural products, enzymes and lipids

Apply To acquire the basic knowledge of aliphatic and aromatic substitution, LO 2:

mechanisms, photochemistry and natural products, enzymes and lipids

LO 3: Evaluate To acquire the basic knowledge of aliphatic and aromatic substitution, mechanisms, photochemistry and natural products, enzymes and lipids

#### Unit-I

#### **Aliphatic Electrophilic Substitution:**

Bimolecular mechanisms- SE 2 and SEi. The SE 1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity. The Haloform reaction and Haller-Bauer reaction

# **Aromatic Electrophilic Substitution**

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho, para, meta orientations. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeir reaction, Gattermann-Koch reaction.

# **Unit-II**

**Mechanisms of Named Reactions and Rearrangements:** Favorskii, Wagner-Meerwein, Neber, Hofmann, Schmidt, Lossen, Curtius, Beckmann, Baeyer-Villiger, Fries, Stevens, Wittig rearrangements - Michael and Mannich reactions -Pinacol-Pinacolone, Baylis-Hillman reaction, Biginelli reaction.

Free Radical Reactions: Basic concept of free radical formation, their stability and their reactions. Polymerization, Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

# **Unit-III**

#### **Organic Photochemistry:**

Jablonski diagram - cis-trans isomerism, Paterno-Buchi reaction, Norrish Type I and II reactions - Barton reaction- photoreduction of ketones di-pi methane rearrangement. photochemistry of arenes.

# (12 hours)

# (12 hours)

**Reagents in organic synthesis:** Lithium diisopropylamide(LDA), Dicyclohexyl Carbodiimide(DCC), Trimethylsilyl iodide, Gilman's reagent, DDQ, Prevost Hydroxylation, Phosphorous and Sulphur ylides, Ceric ammonium nitrate, Tebbe reagent.

#### Unit-IV

#### **Chemistry of Natural Products:**

Classification, Isolation, synthesis and structural elucidation of the following.

- Terpenoids : Camphor,  $\alpha$ -Pinene and Santonin
- Alkaloids : Papaverine, Nicotine, Quinine and Atropine.
- Purines : Caffeine
- Steroids : Cholesterol

#### Unit-V

#### **Bio-Organic Chemistry:**

**Enzymes:** Introduction, enzymes, mechanism of enzyme action, kinds of reactions catalysed by enzymes, co-enzymes, biomimetic chemistry and biotechnological applications of enzymes

**Lipids**: Lipid classification, brief account of the chemical properties and structure of lipids (without structure elucidation) & biological role of the following: fatty acids, acyl glycerols, phospholipids, plasmalogens, sphingolipids, glycolipids, steroids, eicosanoids - prostaglandins, thromboxanes, & leukotrienes, leptin and visfatin.

#### **Text Books:**

- 1. A Guide book to Mechanisms in Organic Chemistry by Peter Sykes : ELBS.
- 2. Organic chemistry, Vol. I ( 6th Edn. ) and Vol. II ( 5th Edn . ) by I.L. Finar, ELBS.
- 3. Organic chemistry by Mukherjee, Singh and Kapoor, Vols. I.and II, Wiley Eastern
- 4. Reaction mechanism in Organic chemistry by Mukerjee and Singh, Macmillan India.
- 5. Advanced organic chemistry by Jerry March, Wiley Eastern.
- 6. Chemistry of Natural Products by K.W. Bentley (Editor).
- 7. Stereochemistry of carbon compounds by E.Eliel, McGraw –Hill.
- 8. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
- 9. Biochemistry; Voet, D. and Voet, J.G. [Eds.] 3rd Ed. Jhon Wiley and sons, (1999)
- 10. Principles of Biochemistry; Smith et al., McGarw Hill (1986).

# (12 hours)

# ACT 2.3: PHYSICAL CHEMISTRY-II

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACT	Physical	Theory	4-0-0	70	30	100	3 Hours	4
2.3	Chemistry-II	-	(60)					

## **Course Objectives:**

CO 1: To acquire the basic knowledge of photochemistry, electrochemistry, catalysis and molecular spectroscopy

CO 2: To understand photochemistry, electrochemistry, catalysis and molecular spectroscopy

CO 3: To apply photochemistry, electrochemistry, catalysis and molecular spectroscopy

# **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Explain photochemistry, electrochemistry, catalysis and molecular spectroscopy

LO 2: Apply photochemistry, electrochemistry, catalysis and molecular spectroscopy

LO 3: Evaluate photochemistry, electrochemistry, catalysis and molecular spectroscopy

# Unit-I

## Photochemistry:

Consequences of light absorption - quantum yield and its determinations - fluorescence , phosphorescence and sensitized fluorescence - photolysis of aldehydes and ketones photochemical reactions between hydrogen and halogens - photosynthesis - flash photolysis

# Unit-II

# **Electrochemistry:**

Interionic attraction theory of Debye and Huclel – Onsagor's modification - determination of activity coefficients from EMF 's of reversible cells – concentration cells with and with out transference, liquid junction potentials – applicability to hydration numbers – determination of thermodynamic data from EMF measurements – primary cells fuel cells – photoelectrochemical cells .

# Unit-III

# Surface Chemistry:

Adsorption of gages by solids – Langmuir, Freundlich and B-E-T isotherms – applicability to heterogeneous catalysis – determination of surface area of adsorbents – Electrokinetic phenomena – Donnan membrane equilibrium – emulsions.

# Unit-IV

#### **Catalysis:**

Homogneous and Heterogeneous catalysis, Theories of catalysis, Acid – base catalysis, Autocatalysis, Enzyme catalysis, Activated complex theory Michaelis – Menten catalysis and its mechanism.

# (12 hours)

(12 hours)

#### (12 hours)

# Unit-V

#### **Molecular Spectroscopy:**

(12 hours)

Electromagnetic radiation – rotation and vibration of diatomic molecules- selection rules – rotation of polyatomic molecules – microwave spectroscopy – vibration of polyatomic molecules infrared and Raman spectroscopy

#### **Text Books:**

- 1. Physical chemistry S. Glasstone (Macmillan)
- 2. Physical chemistry W.J. Moore (Orient Longmans)
- 3. Physical chemistry G.M. Barrow (Mc Graw Hill)
- 4. Physical chemistry S.A. Maron Prutton (Collier Macmillan)
- 5. Physical chemistry G.W. Castellan (Addison Wesley)
- 6. Thermodynamics N.V.Rao ( Macmillan )
- 7. Molecular Spectroscopy -C.N. B.anwell ( Tata McGraw-Hill )

Please arrange all the references from your subjects in the following pattern without fail to make them Uniform

E. L. Eliel and S. H. Wilen, Stereochemistry of Organic Compounds, John Wiley & Sons, New York, 1994.

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Type	Periods	Marks	Marks	Marks	External	
		••	per week				Examination	
			L-T-P					
			(Total)					
ACP	Inorganic	Lab	0-0-6	70	30	100	3 Hours	3
2.5	Chemistry		(90)					
	Practical-II							

# ACP 2.5: INORGANIC CHEMISTRY PRACTICAL - II

#### **Course Objectives:**

CO 1: To develop an insight into the analysis of inorganic salt mixtures

CO 2: To understand the process of analysis of inorganic salt mixtures

CO 3: To acquire skills in the analysis of inorganic salt mixtures

#### Learning Outcomes:

At the end of the course, the learners should be able to:

LO 1: analyse of inorganic salt mixtures

LO 2: Develop skill in analysis of inorganic salt mixtures

LO 3: Apply the skill in the analysis of new inorganic salt mixtures

#### Analysis of inorganic salt mixtures

(minimum four mixtures)

#### **Course Objectives:**

CO 1: To acquire the basic knowledge of CO 2: To understand CO 3: To apply

#### **Learning Outcomes:**

At the end of the course, the learners should be able to: LO 1: Explain LO 2: Apply LO 3: Evaluate

Semi-micro qualitative analysis of six radical mixtures containing one interfering radical and one less familiar cation each .

Study of Systematic procedure

Spot tests.

#### **Text Books**

text book of Practical Inorganic Chemistry by AI Vogel, ELBS 2.Laboratory manual of Engineering Chemistry by Dr Sudha rani

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P					
			(Total)					
ACP	Organic	Lab	0-0-6	70	30	100	3 Hours	3
2.6	Chemistry		(90)					
	Practical-II							

# ACP 2.6: ORGANIC CHEMISTRY PRACTICAL - II

#### **Course Objectives:**

- CO 1: To develop an insight into the identification of organic compounds by systematic analysis
- CO 2: To understand the process of identification of organic compounds by systematic analysis
- CO 3: To acquire skills in the identification of organic compounds by systematic analysis

## **Learning Outcomes:**

At the end of the course, the learners should be able to:

- LO 1: Identify an organic compounds by systematic analysis
- LO 2: Develop skill in identification of organic compounds by systematic analysis
- LO 3: Apply the skill in the identification of new organic compounds by systematic analysis

## Identification of the unknown organic compounds

Systematic identification of organic compounds – preliminary tests, detection of extra elements, solubility, common functional group tests (determination of functional group/s in a single compound, if present), preparation of two rational derivatives

The given organic compound must be identified by comparing the melting point /Boiling point of the compound and melting points of its derivatives with the literature

#### List of suggested compounds

Glucose, fructose, benzaldehyde, p-anisaldehyde, p-chloro benzaldehyde, acetophenone, phenol, cresols, naphthols, esters, p-chloro benzoic acid, aniline, p-tolune, p-anisidine, p-chloroaniline, diphenyl amine, N,N-dimethylaniline, benzamide, naphthalene and anthracene.

# TEXT BOOKS

- 1. A Textbook of Practical Organic Chemistry by A. I. Vogel, ELBS and Longman group.
- 2. Practical Organic Chemistry by Mann and Saunders, ELBS and Longman group.

Course Code	Course Title	Course Type	Instruction Periods per week L-T-P (Total)	External Marks	Internal Marks	Total Marks	Duration of External Examination	Credits
ACP 2.7	Physical Chemistry Practical-II	Lab	0-0-6 (90)	70	30	100	3 Hours	3

# ACP 2.7: PHYSICAL CHEMISTRY PRACTICAL - II

## **Course Objectives:**

- CO 1: To develop an insight into the various experimental techniques related to distribution, heat of a reaction, adsorption, binary mixtures, phase diagrams
- CO 2: To understand the process of various experimental techniques related to distribution, heat of a reaction, adsorption, binary mixtures, phase diagrams
- CO 3: To acquire skills in the various experimental techniques related to distribution, heat of a reaction, adsorption, binary mixtures, phase diagrams

## **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Carryout various experimental techniques related to distribution, heat of a reaction, adsorption, binary mixtures, phase diagrams

LO 2: Develop skill in various experimental techniques related to distribution, heat of a reaction, adsorption, binary mixtures, phase diagrams

LO 3: Apply the skill in various experimental techniques related to distribution, heat of a reaction, adsorption, binary mixtures, phase diagrams for various new systems

#### List of Experiments:

- 1. Formula of Cuprammonium cation –distrubition method.
- 2. Heat of Neutralisation .
- 3. Heat of solution.
- 4. Study of the adsorption of oxalic acid on charcoal.
- 5. Study of binary liquid mixture involving azeotrope .
- 6. Study of a two component system involving eutectic or compound formation .
- 7. Phase diagram of a three component system ( chloroform -acetic acid water )

- 1. Practical Physical Chemistry by Alexander
- 2. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS

#### SEMESTER-III ACT 3.1: INSTRUMENTAL METHODS OF ANALYSIS

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACT	Instrumental	Theory	4-0-0	70	30	100	3 Hours	4
3.1	Methods of	-	(60)					
	Analysis							

#### **Course Objectives:**

CO 1: To acquire basic knowledge of various instrumental methods of analysis

CO 2: To understand various instrumental methods of analysis

CO 3: To apply various instrumental methods of analysis

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Explain visible spectrophotometry, chromatography, ion-exchange, thermal and image analysis techniques

LO 2: Apply visible spectrophotometry, chromatography, ion-exchange, thermal and image analysis techniques

LO 3: Evaluate visible spectrophotometry, chromatography, ion-exchange, thermal and image analysis techniques

#### Unit I:

#### **UV-Visible Spectrophotometry:**

Principle, Beer -Lambert Law, instrumentation, advantages, applications and limitations of Spectrophotometery, single and double beam spectrophotometers Atomic absorption spectrometery (AAS), Flame photometry (AES) - Basic principles, theory, instrumentation and applications

#### Unit II:

#### **Chromatography**:

Chromatography :Introduction to chromatography, Basic principles, instrumentation and Applications of different chromatography techniques (TLC, column chromatography, paper chromatography, Gas chromatography and HPLC).

#### Unit III:

#### **Ion-Exchange Methods:**

General discussion, Typical synthetic Cation and Anion exchange resins. Action of ion exchange resins. Ion-exchange equilibria, Ion-exchange capacity, Determination of cation and anion exchange capacity, Column operation and ion exchange chromatography

#### Unit IV:

#### **Thermal Methods of Analysis**

Principles, Instrumentation, Comparison and interpretation of TGA and DTG curves, TGA curves of mixtures, Factors affecting TGA curves, Applications of TGA. Differential Thermal Analysis and Differential Scanning Calorimetry - Principles, Instrumentation and quantitative aspects of DTA and DSC curves; Interpretation of DTA and DSC curves.

#### (12 hours)

#### (12 hours)

(12 hours)

#### Unit V:

#### **Image Analysis Techniques:**

(12 hours)

Principle & applications of Optical Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy and X-ray Diffraction Analysis.

- 1. Vogel's Text book of quantitative chemical analysis; G. H. Jeffery et. al. Addison Wesley Longman
- 2. Instrumental methods of analysis, H.H. Willard, L.L. Merritt, Jr., J.A. Dean and F.A. Settle, Jr., Van Nostrand Reinhold Co., New York
- 3. Modern analytical chemistry; David Harvey; McGraw Hill
- 4. Principles and practice of analytical chemistry; F. W. Fifield & amp; D. Kealey, Blackwell Science
- 5. Automatic methods of analysis, M. Valcarcel, M. D. Luque de Castro, Elsevier, Vol. 9
- 6. Principles of Instrumental Analysis, Skoog, Holler and Wieman, Harcount Asia,

# ACT 3.2: ORGANIC SPECTROSCOPY

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACT	Organic	Theory	4-0-0	70	30	100	3 Hours	4
3.2	Spectroscopy	-	(60)					

#### **Course Objectives:**

CO 1: To acquire basic knowledge of spectroscopic techniques for organic analysis

CO 2: To understand various spectroscopic techniques for organic analysis

CO 3: To apply various spectroscopic techniques for organic analysis

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Explain IR, UV, NMR and Mass spectroscopic techniques and their instrumentation for organic analysis

LO 2: Apply visible IR, UV, NMR and Mass spectroscopic techniques and their instrumentation for organic analysis

LO 3: Evaluate IR, UV, NMR and Mass spectroscopic techniques and their instrumentation for organic analysis

#### Unit I:

#### **Infrared Spectroscopy:**

Units of frequency, wave length and wave number-molecular vibrations-modes. Factors influencing vibrational frequencies of organic molecules. Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, afdehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Interpretation of spectra.

#### Unit II:

#### **Ultraviolet Spectroscopy:**

Introduction ,the absorption laws ,measurement of the spectrum, chromophores , standard works of reference, definitions, applications of UV spectroscopy to conjugated dienes, trienes ,unsaturated carbonyl compounds and aromatic compounds. Optical rotatory dispersion and circular dichroism: Phenomena of ORD and CD. Classification of ORD and CD Curves; Cotton effect curves and their application to stereochemical problems; the Octant rule and its application to alicyclic ketones.

#### Unit III:

#### NMR Spectroscopy:

Nuclear Magnetic Resonance -Introduction, basic principles, the chemical shift, the intensity of NMR signals - factors affecting the chemical shifts- spin-spin coupling. some simple splitting patterns- the magnitude of coupling constants-first order spectrum-interpretation of spectra. Chemical shift reagents- nuclear Overhauser effect (NOE). The Fourier transform technique. Structure determination of organic compounds by 1 H NMR spectra.

#### (12 hours)

#### (12 hours)

#### Unit IV:

#### Multinuclear 1H NMR and 13C NMR:

Proton coupled, off resonance decoupled, proton noise decoupled 13C NMR spectra. Assignment of chemical shifts, additively effect, characteristic chemical shifts of common organic compounds and functional groups, The DEPT experiment. 2D NMR techniques :1H - 1H COSY, 1H - 13C COSY - HMBC, and NOESY.

#### Unit V:

#### **Mass Spectroscopy:**

#### (12 hours)

Basic principles, mass analyzers, ionization methods: EI, CI, FAB, MALDI, ES. Liquid chromatography and mass spectrometry, types of ions and fragmentations, even electron rule, nitrogen rule, isotope abundance, McLafferty rearrangement. Organic structure elucidation, techniques of ion production, ion and daughter ions, molecular ion and isotope abundance. Nitrogen rule energetics of fragmentation, metastable ions, common fragmentation pathways, fragmentation pattern of common chemical classes. Interpretation of spectra .

#### **Text Books:**

- 1. Spectroscopic methods in Organic chemistry , Forth Edition D.M williams and I.Flemings Tata –McGraw Hill , New Delhi
- 2. Organic Spectroscopy, W.Kemp, ELBS Macmillan
- 3. Applications of absorption of Spectroscopy of Organic compounds J.R.Dyer, prentice Hall of India ,New Delhi ,1984 .
- 3. Spectrometric identification of Organic Compounds , Sixth Edition, R.M Silverstein ; F.X.Webster ,Johne Willey ,Singapore.
- 4. D. L. Pavia, G. M. Lampman and G. S. Kriz, Introduction to Spectroscopy, 2ndEdn, Saunders
- 5. C. N. Banwell, Fundamentals of Molecular Spectroscopy, 4th Edition Tata McGraw Hill, 2016
- 6. A. Carrington and Machlachlon, Magnetic Resonance, Harper & Row, 1967.
- 7. G. M. Barrow, Introduction to Molecular Spectroscopy, McGraw Hill, 1964.
- 8. J. Micheal Hollas, Modern Spectroscopy, 4th Edition, Wiley India Pvt Ltd, 2010
- Harald Gunther, NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry, 2nd Edition, Wiley India Pvt Ltd, 2010

# **ACT 3.3: ORGANIC SYNTHESIS**

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACT	Organic	Theory	4-0-0	70	30	100	3 Hours	4
3.3	Synthesis		(60)					

#### **Course Objectives:**

CO 1: To acquire knowledge of formation of C-C, C=C bonds, synthetic applications, oxidation and reduction, design of organic synthesis and organometallic chemistry CO 2: To understand formation of C-C, C=C bonds, synthetic applications, oxidation and reduction, design of organic synthesis and organometallic chemistry

CO 3: To apply formation of C-C, C=C bonds, synthetic applications, oxidation and reduction, design of organic synthesis and organometallic chemistry

#### Learning Outcomes:

At the end of the course, the learners should be able to:

LO 1: Explain formation of C-C, C=C bonds, synthetic applications, oxidation and reduction, design of organic synthesis and organometallic chemistry

LO 2: Apply formation of C-C, C=C bonds, synthetic applications, oxidation and reduction, design of organic synthesis and organometallic chemistry

LO 3: Evaluate formation of C-C, C=C bonds, synthetic applications, oxidation and reduction, design of organic synthesis and organometallic chemistry

#### Unit I:

**Formation of Carbon–Carbon Single Bonds and Double Bonds:** (12 hours) Alkylation via enolate, the enamine and related reactions, Umpolung (dipole inversion) – the Aldol reaction – Applications of Organo-palladium, Organo-nickel and Organo-copper reagents - Sulphur ylides -  $\beta$ -Elimination reactions, Pyrolytic syn eliminations, Sulphoxide– sulphenate Rearrangement - the Wittig and related reactions- alkenes from Arylsulphonylhydrazones – Claisen rearrangement of allyl vinyl ethers.

#### Unit II:

#### **Synthetic Applications of Organo Boranes and Organo Silanes** (12 hours) Organo Boranes: Preparation of organo boranes viz hydroboration with BH<sub>3</sub>–THF, Dicylohexyl borane, Disiamyl borane, Thexyl borane, 9-BBN and Di-isopinocampheyl borane. Functional group transformations of organo boranes: oxidation ,protonolysis and rearrangements, Formation of carbon-carbon bonds viz organo boranes carbonylation ,the cyanoborate process and reaction of alkenyl boranes.

Organo Silanes: Synthetic applications of trimethylsilylchloride, dimethyl-t-butylsilyl chloride, trimethylsilylcyanide, trimethylsilyliodide and trimethylsilyltriflate. Synthetic applications of  $\alpha$ -silylcarbanions and  $\beta$ -silylcarbaniumions.

#### Unit III:

#### **Oxidation and Reduction**:

(12 hours)

Oxidations of hydrocarbons, alkenes, alcohols aldehydes and ketones oxidative coupling reactions. Use of Pb(OAc)<sub>4</sub>, NBS, CrO<sub>3</sub>, SeO<sub>2</sub>, MnO<sub>2</sub>, Alkoxyluphonium salts, KMnO<sub>4</sub>,OsO<sub>4</sub>, RuO<sub>4</sub>, Peracid and Tl(III)nitrate.

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Metal based and non-metal based oxidations of alcohols (chromium, manganese, silver, ruthenium, DMSO, and hypervalent iodine). (b) Peracids oxidation of alkenes and carbonyls. (c) Alkenes to diols (manganese, osmium based), alkenes to carbonyls with bond cleavage (manganese, ruthenium, and lead based, ozonolysis), and alkenes to alcohols/carbonyls without bond cleavage (hydroboration-oxidation, Wacker oxidation, and selenium based allylic oxidation). (d) Asymmetric epoxidations (Sharpless, Jacobsen, and Shi epoxidations) and Sharpless asymmetric dihydroxylation.

## **Reduction**:

(a) Catalytic homogeneous and heterogeneous hydrogenation, Wilkinson catalyst. (b) Metal based reductions using Li/Na in liquid ammonia, sodium, magnesium, zinc, titanium, and samarium. (c) Hydride transfer reagents: NaBH4, L-selectride, K-selectride, Luche reduction, LiAlH4, DIBAL-H, Red-Al, Trialkylsilanes, and Trialkylstannane. (d) Enantioselective reductions (Chiral Boranes, Corey-Bakshi-Shibata) and Noyori asymmetric hydrogenation. Catalytic hydrogenation (homogeneous and heterogeneous), Reduction by dissolving metals, Reduction by Hydride Transfer Reagents, Reduction with Hydrazine and Diimide, Selectivity in reduction of nitroso and nitro compounds, Reductive cleavage .

## **Design of Organic Synthesis**

Basic principles and terminology of retrosynthesis, synthesis of aromatic compounds, one group and two group C-X disconnections, one group C-C and two group C-C disconnections, amine and alkene synthesis, important strategies of retrosynthesis, functional group transposition, important functional group interconversions Protecting groups: Protection and deprotection of hydroxy, carboxyl, carbonyl, carboxy amino groups and carbon-carbon multiple bonds; chemo- and regioselective protection and deprotection; illustration of protection in synthesis.

#### Unit-V

#### **Organometallic Chemistry:**

Introduction to organometallic compounds, the 18 electron rule, types of ligands (neutral, spectator ligands, alkenes and alkynes), metal-metal bonds, metal carbonyls, reactions of organometallic compounds (ligand substitution reactions), metal clusters Catalytic reactions of organometallic compounds and isolobal analogy, Sandwich compounds and IR applications in the organometallic compounds.

# **TEXT BOOKS**

1. Modern Methods of Organic Synthesis by W. Carruthers

2.Modern Synthetic Reactions by H.O.House

3. Organic Synthesis by Robert & Ireland

4. Designing Organic Synthesis by B Staurt Warron

5. Organic Synthesis by S. Warrant

#### (12 hours)

# ACT 3.4: MEDICINAL CHEMISTRY

Course Code	Course Title	Course Type	Instruction Periods per week	External Marks	Internal Marks	Total Marks	Duration of External Examination	Credits
ACT 3.4	Medicinal Chemistry	Theory	4-0-0 (60)	70	30	100	3 Hours	4

#### **Course Objectives:**

CO 1: To acquire basic knowledge of drug design, pharmacokinetics and pharmacodynamics, and various classes of drugs

CO 2: To understand drug design, pharmacokinetics and pharmacodynamics, and various classes of drugs

CO 3: To apply drug design, pharmacokinetics and pharmacodynamics, and various classes of drugs

## **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Explain drug design, pharmacokinetics and pharmacodynamics, and various classes of drugs

LO 2: Apply drug design, pharmacokinetics and pharmacodynamics, and various classes of drugs

LO 3: Evaluate drug design, pharmacokinetics and pharmacodynamics, and various classes of drugs

# Unit I:

**Drug Design** 

Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of pro-drugs and soft- drugs, structure activity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism, spatial considerations. Theories of drug activity: occupancy theory, rate theory, induced fit theory. Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors. Elementary treatment of drug receptor interactions. Physicochemical parameters: lipophilicity, partition coefficient, electronic ionization constants, steric, Shelton and surface activity parameters and redox potentials. Free-Wilson analysis, Hansch analysis, relationships between Free-Wilson and Hansch analysis. LD-50, ED-50.

#### Unit II:

#### **Pharmacokinetics and Pharmacodynamics**

Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process. Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, sulphonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry.

#### Unit III:

#### Antineoplastic Agents:

Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic

#### (12 hours)

#### (12 hours)

inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards and 6-mercaptopurine. Recent development in cancer chemotherapy. Hormone and natural products.

#### Unit IV:

#### **Cardiovascular Drugs:**

Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output. Direct acting arteriolar dilators. Synthesis of amyl nitrate, sorbitrate, verapamil, methyldopa, atenolol, oxyprenolol.

#### Unit V:

#### Local Anti-infective Drugs and Antibiotics

Introduction and general mode of action. Synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, dapsone, amino salicylic acid, isoniazid, ethionamide, griseofulvin and chloroquin. Cell wall biosynthesis, inhibitors, â-Iactam rings, antibiotics inhibiting protein synthesis. Synthesis of penicillin G, amoxycillin, chloramphenicol, cephalosporin, tetracyclin and streptomycin.

**Psychoactive Drugs:** Introduction, neurotransmitters, CNS depressants, general anaesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazipines, buspirone, neurochemistry of mental diseases. Antipsychotic drugs - the neuroleptics, antidepressants, butyrophenones, serendipity and drug development, stereochemical aspects of psychotropic drugs. Synthesis of diazepam, alprazolam, phenytoin, ethosuximde, trimethadione, barbiturates.

#### SUGGESTED BOOKS FOR READING

1. Introduction to Medicinal Chemistry, A Gringuage, Wiley-VCH.

 Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed Robert F.Dorge.

3. An Introduction to Drug Design, S. S. Pandeya 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, Academic Press.

7 Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley.

8. Textbook of Organic Medicinal and Pharmaceutical Chemistry (11th ed.)- Wilson and Gisvold's.

9. Introduction to medicinal chemistry, Alex Gringauz-1996

10. A Book of Medicinal Chemistry; (second edition) D. Srirm and P. Yogeswari, published by pearson education.

#### (12 hours)

# ACT 3.5: INTELLECTUAL PROPERTY RIGHTS

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACT	Intellectual	Theory	4-0-0	70	30	100	3 Hours	4
3.5	Property Rights		(60)					

#### **Course Objectives:**

CO 1: To acquire the basic knowledge of Intellectual Property Rights, its nature, trademarks, copyrights, patent rights, trade secrets ant their new developments

CO 2: To understand Intellectual Property Rights, its nature, trademarks, copyrights, patent rights, trade secrets ant their new developments

CO 3: To apply Intellectual Property Rights, its nature, trademarks, copyrights, patent rights, trade secrets ant their new developments

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Explain Intellectual Property Rights, its nature, trademarks, copyrights, patent rights, trade secrets ant their new developments

LO 2: Apply Intellectual Property Rights, its nature, trademarks, copyrights, patent rights, trade secrets ant their new developments

LO 3: Evaluate Intellectual Property Rights, its nature, trademarks, copyrights, patent rights, trade secrets ant their new developments

#### Unit I:

#### **Introduction to Intellectual Property Rights**

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights. International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

#### Unit II:

#### **Nature of Intellectual Property Rights**

Patents, Designs, Trade and Copyright - Process of Patenting and Development: technological research, innovation, patenting, development - International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

#### Unit III:

#### **Trademarks and Copyrights**

Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes. Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

#### (12 hours)

(12 hours)

#### Unit IV:

#### Patent Rights and Trade Secrets and Unfair Competition

Foundation of patent law, patent searching process - Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications - Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation - Misappropriation right of publicity, false advertising.

#### Unit IV:

#### New development of Intellectual Property Rights

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies - New developments in trade mark law; copy right law, patent law, intellectual property audits.

#### **Text Books:**

- 1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
- 2. Intellectual property right Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company Ltd.
- 3. Resisting Intellectual Property, Halbert, Taylor & Francis Ltd, 2007.
- 4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, Intellectual Property in New Technological Age, 2016.
- 5. T. Ramappa, —Intellectual Property Rights Under WTO, S. Chand, 2008

(12 hours)

## ACT 3.6: MOOC COURSE

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACT	MOOC Course	ONLINE	0-4-0	70	30	100	As per the	3
3.6			(60)				course	

#### **Course Objectives:**

CO 1: To acquire the basic knowledge of an advanced area in chemistry through MOOC programmes offered by NPTEL-SWAYAM

CO 2: To appreciate the advantages of learning by online mode

CO 3: To advance the knowledge in the areas of interest

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Successfully complete the course as per his/ her choice

LO 2: Produce his/ her continuous performance report

LO 3: Produce his mastery of the course by providing the pass certificate with the grade awarded by NPTEL SWAYAM

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACP	Quantitative	Lab	0-0-6	70	30	100	3 Hours	4
3.7	Analysis		(60)					
	Practical - I							

# ACP 3.7: QUANTITATIVE ANALYSIS PRACTICAL -I

#### **Course Objectives:**

- CO 1: To acquire the basic knowledge of
- CO 2: To understand
- CO 3: To apply

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

- LO 1: Explain
- LO 2: Apply
- LO 3: Evaluate

#### **VOLUMETRIC ANALYSIS**

- 1. Preparation of vanadium(V) from ammonium metavanadate and standardisation of vanadium(V) with iron (II)
- 2. Preparation of cerium (IV) sulphate from cerium(IV) oxide and standardization of cerium (IV) sulphate with iron (II)
- 3. Determination of iron (III) by photo chemical reduction method.
- 4. Determination of iron (III) and iron (II) present in a synthetic mixture (stannous chloride method).
- 5. Determination of copper (II) present in a brass sample (iodometric method)
- 6. Determination of chromium (IV) present in a sample of potassium dichromate.
- 7. Determination of calcium hardness and magnesium hardness of water sample.
- 8. Determination of zinc by ferrocyanide.
- 9. Determination of chloride in a sample of water (silver nitrate method).

#### **TEXT BOOKS**

- 1. A text book of Practical Inorganic Chemistry by AI Vogel, ELBS
- 2. Laboratory manual of Engineering Chemistry by Dr Sudha rani

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACP	Organic	Lab	0-0-6	70	30	100	3 Hours	4
3.8	Chemistry		(60)					
	Practical - III							

# ACP 3.8: ORGANIC CHEMISTRY PRACTICAL -III

#### **Course Objectives:**

CO 1: To acquire the basic knowledge of separation of an organic binary mixture and identify each of the compound by following systematic procedure

CO 2: To understand separation of an organic binary mixture and identify each of the compound by following systematic procedure

CO 3: To apply separation of given unknown organic binary mixture and identify each of the compound by following systematic procedure

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Explain the procedure and chemistry for separation of an organic binary mixture and identify each of the compound by following systematic procedure

LO 2: Apply separation of given unknown organic binary mixture and identify each of the compound by following systematic procedure

LO 3: Acquire skill in the separation of an organic binary mixture and identify each of the compound by following systematic procedure

#### **Organic Mixture Analysis**

- 1. Separation of organic compounds of a mixture (minimum of four mixtures )
- 2. Systematic identification of the separated organic compounds by functional group analysis, chemical reaction and derivatisation
- 3. Separation of organic compounds of a mixture by TLC

- 1. A.I. Vogel A Text book of practical organic chemistry, ELBS.
- 2. Raj K Bansal Laboratory Manual of Organic Chemistry
- 3. Mann FG and Saunders BC Practical Organic Chemistry, Longman, London

#### SEMESTER-IV ACT 4.1: INDUSTRIES BASED ON ORGANIC RAW MATERIALS

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Type	Periods	Marks	Marks	Marks	External	
		• •	per week				Examination	
			L-T-P					
			(Total)					
ACT	Industries based	Theory	4-0-0	70	30	100	3 Hours	4
4.1	on Organic Raw		(60)					
	Materials							

#### **Course Objectives:**

CO 1: To acquire the basic knowledge of starch, cellulose, pulp, paper, oils, soaps, detergents, surface coatings, food processing and food by-products

CO 2: To understand the chemistry of starch, cellulose, pulp, paper, oils, soaps, detergents, surface coatings, food processing and food by-products

CO 3: To apply starch, cellulose, pulp, paper, oils, soaps, detergents, surface coatings, food processing and food by-products

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Explain starch, cellulose, pulp, paper, oils, soaps, detergents, surface coatings, food processing and food by-products

LO 2: Apply starch, cellulose, pulp, paper, oils, soaps, detergents, surface coatings, food processing and food by-products

LO 3: Evaluate starch, cellulose, pulp, paper, oils, soaps, detergents, surface coatings, food processing and food by-products

#### Unit I:

Starch:

Structure, Chemical and Physical properties of polysaccharides. Structure of starch. Manufacture of starch and dextrin . Hydrolysis of starch to edible and industrial glucoseapplications of starch: textile sizing and fermentation industries- Manufacture of Industrial Alcohol-Manufacture of Vitamin C from glucose.

#### Unit II:

#### **Cellulose, Pulp and Paper**

Composition of wood -Structure, Chemical and Physical properties of cellulose. Sources and uses of cellulose. Enzymatic and chemical hydrolysis of cellulose- conversion of cellulose to alcohol. Industrial preparation of chemical cellulose. Cellulose derivatives : cellulose nitrate, cellulose acetate and carboxy methyl cellulose. Different methods of wood pulping: Manufacture and cases of different qualities of paper products like cardboard, Bond paper, newsprint, writing paper, tissue paper and filter paper.

#### Unit III:

#### **Oils, Fats and Waxes**

Introduction- Sources of Animal fats and oils -Classification : Vegetable, animal and mineral oils – Manufacture of Vegetable oils, Chemical properties and uses – Extraction and processing of Vegetable oils, hydrogenation of oils- Industrial production of cotton seed and

#### (12 hours)

(12 hours)

soya been oils. Chemical modification of fats and oils: Isomerization. transesterification and interestirications. **Waxes :** Introduction- Classification , properties and uses of waxes.

#### Unit IV:

#### Soaps, Detergents and Surface Coatings

**Soaps**: Manufacture, Raw materials, typical soaps, Glycerin recovery from soap manufacture **Detergents**: Classification of surfactants- Raw materials ,Manufacture – Biodegradability of Detergents. **Surface Coatings**: Paints – Drying oils, Pigments, Pigment extenders - Special paints – Varnishes – Lacquers. Industrial coatings - properties and uses.

(12 hours)

#### Unit V:

**Food Processing and Food By-products** (12 hours) Introduction- Types of Food processing: refining and milling, canning, concentration, freezing, drying, pasteurization and sterilization, fermentation, irradiation. **Food Byproducts**: Introduction- Manufacture and properties of Leather, gelatin and adhesives - animal glues, synthetic resins.

#### **TEXT BOOKS:**

1. Shreve's Chemical process industries by GEORGE T.AUSTIN

- 2 .Industrial chemistry by B.K.SHARMA.
- 3. Engineering chemistry by S S DARA.
- 4. Organic chemistry, Vol. I ( 6<sup>th</sup> Edn. ) and Vol. II ( 5<sup>th</sup> Edn . ) by I.L. Finar, ELBS.

# ACT 4.2: FINE CHEMICALS

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Type	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P					
			(Total)					
ACT	Fine Chemicals	Theory	4-0-0	70	30	100	3 Hours	4
4.2			(60)					

#### **Course Objectives:**

CO 1: To acquire the basic knowledge of chemistry of dyes, fragrances and flavours, agrochemicals, Vitamins, Minerals and Toxic chemicals

CO 2: To understand chemistry of dyes, fragrances and flavours, agrochemicals, Vitamins, Minerals and Toxic chemicals

CO 3: To apply chemistry of dyes, fragrances and flavours, agrochemicals, Vitamins, Minerals and Toxic chemicals

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Explain chemistry of dyes, fragrances and flavours, agrochemicals, Vitamins, Minerals and Toxic chemicals

LO 2: Apply chemistry of dyes, fragrances and flavours, agrochemicals, Vitamins, Minerals and Toxic chemicals

LO 3: Evaluate chemistry of dyes, fragrances and flavours, agrochemicals, Vitamins, Minerals and Toxic chemicals

#### Unit I:

#### **Chemistry of Dyes**:

Introduction – Dye intermediates - Unit processes in the preparation of dye intermediates – Structural features of a dye (Chromophores and Auxochromes) – Bathochromic and Hypsochromic effects – Diazotization and coupling – colour and chemical constitution (Witt's theory, Armstrong theory &Modern theory); Classification of dyes. **Synthesis and Application of the following dyes**: Napthol Yellow S. Naphthol green Y. Methyl orange, Bismark Brown, Congo Red, Phenolphthalein, Fluorescein, Rhodamines B, Indophenol blue, Phenylene blue, Methylene blue, Quinoline blue, Alizarin, Indigo (Indigotin), Thioindigo.

#### Unit II:

#### **Chemistry of Perfumes and Flavours**:

**Perfumes:** Theory of olfaction and mechanism, relation between perfumes and phermones, classification of perfumes, chemistry, manufacture and isolation of the following compounds –Citral, Geraniol, Nerol, Linalool, citronellol, hydroxy citronillol cincal, jasmone, civetone and Muskone, acetylcarane ,acetyl Longifolene. **Flavours:** The difference between perfumes and flavours, classification of flavour compounds, chemistry of species and oleoresins, pepper, ginger, aniseed, cuminseed, Coriander, Cellery and cardamon, Chemistry of some major flavours like coffee, tea, cocoa, onion. Assessment of flavours and blending of flavours. Chemistry and application of flavour compounds: Menthol, Piperitone, Vanillin, Eugenol, monosodium glutamate and carvone

#### (12 hours)

#### Unit III:

#### **Chemistry of Agrochemicals**:

**Insecticides**: DDT, BHC, Aldrin, Endosulfon; **Herbicides**: 2,4-dichloro phenoxy acetic acid, dalapon, paraquat; **Fungicides**: Boardeaux mixture, Copper oxychloride, Zineb, Benomyl (Benlate); **Rodenticides**: Warfarin, Sodium monofluoroacetate, Zinc phosphide; **Plant-Growth Modifiers**: Growth Regulators, Second-Growth Inhibitors and Defoliants and Yield Stimulators

#### Unit IV:

#### **Chemistry of Vitamins**:

Classification, functions, requirements, distribution in foods, loss during processing, effects of deficiency and characteristic properties of vitamins – B1(Thiamine), B2 (Riboflavin), B3 (Pantothenic acid), B6 (pyridoxine), B12 ( Cyanocobalamine), H (Biotin), P (Rutin), C (ascorbic acid), A (Retinol), D (Calciferol), E (Tocopherol), K (naphthoquinone), Folic acid (PGA) and Niacin - Methods for the determination of Water soluble vitamins :(B1, B2, B3, B6, B12, C and folic acid and fat soluble vitamins: A, D, E and K by visible spectrophotmetric technique only.

#### Unit V:

#### Chemistry of Essential Minerals, Toxic Metals:

Classification, functions, requirements, distribution in foods, loss during processing, effects of deficiency and characteristic properties of Essential Minerals: Calcium, Magnesium, Sodium, Potassium, Calcium, Phosphorous, Iron, Zinc, Copper, Manganese, Selenium, Iodine and chloride. Toxic Metals and their Toxic mechanism: Arsenic, Cadmium, Lead, Mercury, Chromium, Nickel

#### **Text Books:**

- 1. Medicinal Chemistry, A. Burger, 3<sup>rd</sup> Edn., Wiley, 1970.
- 2. Chemistry of pesticides, N.M. Melnikov, Residue Reviews, Vol.36, Springer Verlag, New York , 1971.
- 3. Future for insecticides , R.C. Netealr, J.J.Mckalvery, Jr. John Wiley & Sons, New York, 1976.
- 4. Pesticide processes Encyclopedia, Marshal Sitting Hoyes Data Corporation, U.S.A., 1977.

5. Synthetic Organic Chemistry, O.P. Agarwal ,10<sup>th</sup> edition , Publishing House, Meerut, 1994.

6. Chemical process industries by R.N. Shreeve.

7. The Chemistry of Synthetic Dyes, Academic Press.

8. Finar, Organic Chemistry, Vol. I. Ch. 31 Dyes, Longmann.

9. Gilman, Organic Chemistry, An Advanced Treatise Vol. III Ch., 4. Organic Dyes. Wiley (1953).

10Juster, Colour and Chemical constitution J. Chem. Educ., 3:596 (1962).

11.Maccoll, Colour and constitution, Reviews (Chem. Soci.) 1:16 (1947).

12. Encylopedia of Chemical Technology, Vol 10 and 11.

13. Chemistry of Herbicides, U.S. Sree Ramulu, Oxford & I.B.H. Publishing Co. (1985).

# (12 hours)

#### (12 hours)

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P					
			(Total)					
ACT	Polymers and	Theory	4-0-0	70	30	100	3 Hours	4
4.3	Plastics		(60)					

## ACT 4.3: POLYMERS AND PLASTICS

#### **Course Objectives:**

CO 1: To acquire the basic knowledge of polymers, mechanism and kinetics of polymerisation, analysing and testing of polymers, compounding of plastics and polymer composites, Rubbers, Elastomers and Adhesives

CO 2: To understand polymers, mechanism and kinetics of polymerisation, analysing and testing of polymers, compounding of plastics and polymer composites, Rubbers, Elastomers and Adhesives

CO 3: To apply polymers, mechanism and kinetics of polymerisation, analysing and testing of polymers, compounding of plastics and polymer composites, Rubbers, Elastomers and Adhesives

#### Learning Outcomes:

At the end of the course, the learners should be able to:

LO 1: Explain polymers, mechanism and kinetics of polymerisation, analysing and testing of polymers, compounding of plastics and polymer composites, Rubbers, Elastomers and Adhesives

LO 2: Apply polymers, mechanism and kinetics of polymerisation, analysing and testing of polymers, compounding of plastics and polymer composites, Rubbers, Elastomers and Adhesives

LO 3: Evaluate polymers, mechanism and kinetics of polymerisation, analysing and testing of polymers, compounding of plastics and polymer composites, Rubbers, Elastomers and Adhesives

#### Unit I:

#### **Introduction to Polymers**:

Basic concepts Nomenclature- Degree of polymerization – polymerisation process – Classification of polymerization reactions – Difference between thermoplastics and thermosets. Types of polymerization – Addition and step growth. Copolymerisation- Block copolymerisation – Graft copolymerisation. Stereo isomers – isotactic, atactic and syndyotactic polymers Zeigler-Natta catalysis.

#### Unit II:

#### Mechanism and Kinetics of Polymerisation

Mechanism of polymerization – free radical and ionic. Heterogeneous polymerization Kinetics of polymer reaction – addition – Free-radical, cationic and Anionic polymerization. Condensation polymerization – acid catalysed condensation reactions.

#### 50

#### (12 hours)

#### Unit III:

#### Analysing and Testing of Polymers

Weight average and number average molecular weights of polymers ratio of  $M_w$  and  $M_n$ . - Determination of molecular weight of polymers by Cryoscopy – Light scattering – X-ray scattering – Viscosity – Ultra centrifuge and gel permeation chromatographic methods.

#### Unit IV:

#### **Compounding of Plastics and Polymer Composites**

Compounding of plastics – Additives: Stabilizers, anti oxidants, flame retardants, smoke suppressants - Physical Properties Modification: Plasticizers, Lubricants, Nucleating, processing, mould release, curing, antifogging, coupling and anti-microbial agents - Fabrication techniques of plastic - Polymer composites

#### Unit V:

#### **Rubbers, Elastomers and Adhesives**

Origin and chemical nature of natural rubber – Direct processing of Latex – Compounding of rubber – Fabrication of rubber – Vulcanization of rubber. Elastomers – Manufacture, properties and uses of Butadiene, Isoprene and chloroprene. Natural and Synthetic Adhesives - Classification animal glue. Protein and starch adhesives – Resin Adhesives. Difference between plastics, elastomers and adhesives.

#### **Text Books:**

- 1. Introduction to Polymer Chemistry, Raymond B, Seymour.
- 2. Polymer science, V.R. Gowariker et al., New Age International (P) Ltd, New Delhi.
- 3. Organic Chemistry of Synthetic High Polymers, Robert W. Lenz, Interscience Publishers.
- 4. Textbook of Polymer Science P. W. Billmeyer, John Wiley, 1962

# (12 hours)

(12 hours)

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P					
			(Total)					
ACT	Research	Theory	4-0-0	70	30	100	3 Hours	4
4.4	Methodology		(60)					

# ACT 4.4: RESEARCH METHODOLOGY

#### **Course Objectives:**

CO 1: To acquire the basic knowledge of introduction to research, literature review, research proposal, data collection and research report preparation and research evaluation

CO 2: To understand introduction to research, literature review, research proposal, data collection and research report preparation and research evaluation

CO 3: To apply introduction to research, literature review, research proposal, data collection and research report preparation and research evaluation

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Explain introduction to research, literature review, research proposal, data collection and research report preparation and research evaluation

LO 2: Apply introduction to research, literature review, research proposal, data collection and research report preparation and research evaluation

LO 3: Evaluate introduction to research, literature review, research proposal, data collection and research report preparation and research evaluation

#### Unit I:

#### Introduction to Research:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

#### Unit II:

#### Literature Review and Research Gaps:

Survey of Literature including Patents – Chemical Nomenclature – Primary and Secondary sources including Reviews, Treatises and Monographs - Abstraction of a Research Paper – Possible ways of getting familiar with Current literature – Art of Literature Review and Writing Review Articles

#### Unit III:

#### **Research Problem and Research Proposal:**

Identification of Research Problem – Factors influencing selection of problems Statement and Development of a Research Problem – Analysis and Interpretation of Research Proposal and Finalization of a Research Topic

#### Unit IV:

#### **Errors, Statistics and Sampling Techniques:**

Classification of Errors, Accuracy, Precision; Minimization of Errors, Mean Deviation, Standard Deviation, Distribution of Random Errors. The basics of Sampling, Sampling

#### (12 hours)

# (12 hours)

# (12 hours)

Procedure, Sampling Statistics, Sampling Physical State, Crushing and Grinding, Hazards in sampling

#### Unit V:

## **Research Report and Publication of Results:**

(12 hours)

Effective technical writing, how to write a Research Report (Dissertation/ Thesis), Research Paper Writing - Developing a Research Report, Format of Research Report, Presentation and Assessment by a Review Committee - Plagiarism and Ethical issues - Evaluation of Research

- 1. Wayne Goddard and Stuart Melville Research Methodology: An Introduction
- Ranjit Kumar, Research Methodology: A Step by Step Guide for beginners 2<sup>nd</sup> Edition
- 3. C R Kothari Research Methodology: Methods and Techniques (2nd Revised Edition) New Age International (P) Limited, Publishers, New Delhi, 1990

# ACT 4.5: MOOC COURSE

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACT	MOOC Course	ONLINE	0-4-0	70	30	100	As per the	3
4.5			(60)				course	

#### **Course Objectives:**

CO 1: To acquire the basic knowledge of an advanced area in chemistry through MOOC programmes offered by NPTEL-SWAYAM

CO 2: To appreciate the advantages of learning by online mode

CO 3: To advance the knowledge in the areas of interest

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Successfully complete the course as per his/ her choice

LO 2: Produce his/ her continuous performance report

LO 3: Produce his mastery of the course by providing the pass certificate with the grade awarded by NPTEL SWAYAM

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACP	Quantitative	Lab	0-0-6	70	30	100	3 Hours	4
4.6	Analysis		(60)					
	Practical - II							

# ACP 4.6: QUANTITATIVE ANALYSIS PRACTICAL - II

#### **Course Objectives:**

CO 1: To acquire the basic skills in quantitative analysis using potentiometers, pH meters, conductometers, colorimeters

CO 2: To understand the methods of quantitative analysis using potentiometers, pH meters, conductometers, colorimeters

CO 3: To apply quantitative analysis using potentiometers, pH meters, conductometers, colorimeters

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Explain the procedures of quantitative analysis using potentiometers, pH meters, conductometers, colorimeters

LO 2: Determine the quantitative analysis using potentiometers, pH meters, conductometers, colorimeters

LO 3: Evaluate quantitative analysis using potentiometers, pH meters, conductometers, colorimeters

#### POTENTIOMETRIC TITRATIONS

- 1. Determination of Iron (II) with chromium (VI) .
- 2. Determination of Iron (II) with cerium (IV) .
- 3. Determination of Vanadium (V) with Iron (II).

# **pH METRIC TITRATIONS**

- 4. Titration of a strong acid against a strong base.
- 5. Titration of a weak acid against a strong base.
- 6. Titration of a mixture of weak acid and a strong acid against a strong base.

#### CONDUCTOMETRIC TITRATIONS

- 7. Titration of a weak acid against a strong base.
- 8. Determination of percentage purity of AgNO<sub>3</sub> Solution using KCl.

#### COLOURIMETRIC TITRATIONS

- 9. Determination of Manganese.
- 10. Determination of Fe (II) .

#### **Text Books:**

1. A text book of Practical Inorganic Chemistry by AI Vogel, ELBS

2. Laboratory manual of Engineering Chemistry by Dr Sudha rani

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACP	Applied	Lab	0-0-6	70	30	100	3 Hours	4
4.7	Chemistry		(60)					
	Practical							

# **ACP 4.7: APPLIED CHEMISTRY PRACTICAL**

#### **Course Objectives:**

- CO 1: To acquire the basic knowledge of
- CO 2: To understand
- CO 3: To apply

#### **Learning Outcomes:**

At the end of the course, the learners should be able to:

- LO 1: Explain
- LO 2: Apply
- LO 3: Evaluate
  - 1. Determination of saponification value and Acid value of a vegetable oil
  - 2. Determination of Iodine value of a non-edible oil
  - 3. Determination of Glucose
  - 4. Analysis of Honey
  - 5. Determination of Molecular Weight of a Polymer
  - 6. Determination of Aspirin
  - 7. Preparation of Soap
  - 8. Preparation of cold Cream
  - 9. Preparation of Shampoo
  - 10. Preparation of Phenol- Formaldehyde Resin
  - 11. Preparation of Copper pigment
  - 12. Preparation of Paracetamol
  - 13. Preparation of Fluorescein dye
  - 14. Isolation of Caffeine
  - 15. Isolatiopn of Lycopene

### ACP 4.8: PROJECT WORK

Course	Course	Course	Instruction	External	Internal	Total	Duration of	Credits
Code	Title	Туре	Periods	Marks	Marks	Marks	External	
			per week				Examination	
			L-T-P (Total)					
ACP	Project Work	Internship	0-0-24	70	30	100	3 Hours	4
4.8	-	_	(144)					

#### **Course Objectives:**

CO 1: To develop scientific aptitude, critical thinking, experiment planning through the conduct of project

CO 2: To understand experiment planning, reporting and auditing the experimental data CO 3: To acquire interpretation to result discussion, research writing and research presentation.

## **Learning Outcomes:**

At the end of the course, the learners should be able to:

LO 1: Investigate various aspects related to the chemical process/ QC/ instrumental analysis/ chemistry problem

LO 2: Appreciate the literature and its relevance to his/her topic of interest

LO 3: Write research proposal independently

LO 4: Would generate interest in current topics of research

# **Project Work:**

Project supervisor at the chemical industry/ R&D unit/ laboratory would be allocated at the start of the project work and research project would be undertaken in discussion with the project supervisor. At the end of the project tenure the student has to prepare a project report as per the university guidelines. Upon submission of the project report, the projects would be evaluated based on a project presentation and viva-voce examination.