



CIRCULAR NO.SU/Sci. & Tech./Colleges./NEP/24/2023

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies & Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted **the following curriculum of Post Graduate Degree Courses as per Norms of National Education Policy - 2020 under the Faculty of Science & Technology run to the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Syllabi of Affiliated Colleges under BAMU, Aurangabad.	Semester
1.	M.Sc.Chemistry Specialization: Analytical Chemistry, Inorganic Chemistry, Physical Chemistry, Organic Chemistry, Polymer Chemistry and Drug Chemistry.	Ist and IInd Semester
2.	M.Sc.Electronics	Ist to IVth Semester
3.	M.Sc.Herbal Technology	Ist and IInd Semester
4.	M.Sc.Industrial Chemistry	Ist and IInd Semester
5.	MCA(Science)	Ist and IInd Semester

This is effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.

REF.NO.SU/NEP/2023/10551-59

Date:- 22.08.2023.

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*Deputy Registrar,
Academic Section*

Copy forwarded with compliments to :-

- 1] **The Principal of all concerned affiliated Colleges, Dr. Babasaheb Ambedkar Marathwada University,.**
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

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- 1] **The Director, Board of Examinations & Evaluation, Dr.BAMU,A'bad.**
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NAAC Reaccredited with 'A' Grade

FACULTY OF SCIENCE & TECHNOLOGY

Two Years P.G. Programme
Subject: Industrial Chemistry

(Effective from 2023-24)

Proposed NEP-2020 Course Structure

Illustrative Credit distribution structure for Two Years Programme with Multiple Entry and Exit options

Course Structure

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Inter. Assmen.	End. Sem Exam	Total Marks
Major Mandatory DSC	CHET/MJ/500	DSC-1 Anal. Chem	2	-	2	-	8T	20	30	50
	CHET/MJ/501	DSC-2 Inorg. Chem	2	-	2	-		20	30	50
	CHET/MJ/502	DSC-3 Org. Chem	2	-	2	-		20	30	50
	CHET/MJ/503	DSC-4 Phy. Chem	2	-	2	-		20	30	50
	CHEL/MJ/504	DSC-5 Inorg. Chem. Lab course	-	4	-	2	6L	20	30	50
	CHEL/MJ/505	DSC-6 Org. Chem. Lab course	-	4	-	2		20	30	50
	CHEL/MJ/506	DSC-7 Phy. Chem. Lab course	-	4	-	2		20	30	50
DSE (Choose one from your specialization and any one from remaining three)	CHETE/SE/507	DSE-1 Anal. Chem	2	-	2	-	4T	20	30	50
	CHETE/SE/508	DSE -2 Inorg. Chem	2	-	2	-		20	30	50
	CHETE/SE/509	DSE -3 Org. Chem	2	-	2	-		20	30	50
	CHETE/SE/510	DSE -4 Phy. Chem	2	-	2	-		20	30	50
	CHETE/SE/511	DSE -5 Drug Chem.	2	-	2	-		20	30	50
	CHETE/SE/512	DSE -6 Industrial chem	2	-	2	-		20	30	50
Research methodology	CHE/RM-513	Research methodology	4	-	4	-	4T	40	60	100
Total			16	12	16	06	22	220	330	550

Course Code Nomenclature :

DSC-Discipline Specific Core, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, CHET- Chemistry Theory Core , CHEL- Chemistry Laboratory Core , CHETE- Chemistry Theory Elective , CHERM- Chemistry Research Methodology

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Inter. Assmen.	End. Sem Exam	Total Marks
Major Mandatory DSC	CHET/MJ/550	DSC-1 Anal. Chem	2	-	2	-	8T	20	30	50
	CHET/MJ/551	DSC-2 Inorg. Chem	2	-	2	-		20	30	50
	CHET/MJ/552	DSC-3 Org. Chem	2	-	2	-		20	30	50
	CHET/MJ/553	DSC-4 Phy. Chem	2	-	2	-		20	30	50
	CHEL/MJ/554	DSC-5 Inorg. Chem. Lab course	-	4	-	2	6L	20	30	50
	CHEL/MJ/555	DSC-6 Org. Chem. Lab course	-	4	-	2		20	30	50
	CHEL/MJ/556	DSC-7 Phy. Chem. Lab course	-	4	-	2		20	30	50
DSE (Choose one from your specialization and any one from remaining three)	CHETE/SE/557	DSE-1 Anal. Chem	2	-	2	-	4T	20	30	50
	CHETE/SE/558	DSE -2 Inorg. Chem	2	-	2	-		20	30	50
	CHETE/SE/559	DSE -3 Org. Chem	2	-	2	-		20	30	50
	CHETE/SE/560	DSE -4 Phy. Chem	2	-	2	-		20	30	50
	CHETE/SE/561	DSE -6 Industrial chem	2	-	2	-		20	30	50
On job training /Filed work	CHE/OJT-562	Research methodology	-	8	-	4	4L	40	60	100
	CHE/OJT-563	Field Project	-	8	-	4		40	60	100
Total			12	20	16	10	22	220	330	550

Course Code Nomenclature :

DSC-Discipline Specific Core, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, CHET- Chemistry Theory Core , CHEL- Chemistry Laboratory Core , CHETE- Chemistry Theory Elective , CHEOJT- Chemistry On job training CHEFP Chemistry Field Project



 Specialization Subject: Industrial Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	INCHTC-600	DSC-15 (Ind. Chem.)	2	-	2	-	10T	20	30	50
	INCHTC-600	DSC-16 (Ind. Chem.)	2	-	2	-		20	30	50
	INCHTC-601	DSC-17 (Ind. Chem.)	2	-	2	-		20	30	50
	INCHTC-602	DSC-18 (Ind. Chem.)	2	-	2	-		20	30	50
	INCHTC-603	DSC-19 (Ind. Chem.)	2	-	2	-		20	30	50
	INCHLC-604	DSC-20 (Ind. Chem.). Lab course)	-	4	-	2	4P	20	30	50
	INCHLC-605	DSC-21 (Ind. Chem.). Lab course)	-	4	-	2		20	30	50
DSE (Choose any Two from pool of courses)	INCHEC-606	DSE-9 (Ind. Chem.)	2	-	2	-	4T	20	30	50
	INCHEC-607	DSE-10 (Ind. Chem.)	2	-	2	-		20	30	50
	INCHEC-608	DSE-11 (Ind. Chem.)	2	-	2	-		20	30	50
	INCHEC-609	DSE-12 (Ind. Chem.)	2	-	2	-		20	30	50
Research Project	INCHRP-649	Research Project -1	-	8	-	4	4P	40	60	100
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, **DSE**- Discipline Specific Elective, **T**-Theory,
L- Laboratory course, **INCHTC**- Industrial Chemistry Theory Core course, **INCHLC**- Industrial
 Chemistry Laboratory Core course, **INCHEC**- Industrial Chemistry Elective Course,
INCHRP- Industrial Chemistry Research Project

Class: M.Sc. Second Year Semester: IVth Semester specialization Subject: Industrial Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	INCHTC-650	DSC-20 (Ind. Chem.)	2	-	2	-	10T	20	30	50
	INCHTC-651	DSC-21 (Ind. Chem.)	2	-	2	-		20	30	50
	INCHTC-652	DSC-22 (Ind. Chem.)	2	-	2	-		20	30	50
	INCHTC-653	DSC-23 (Ind. Chem.)	2	-	2	-		20	30	50
	INCHTC-654	DSC-24 (Ind. Chem.)	2	-	2	-		20	30	50
	INCHLC-655	DSC-25 (Ind. Chem.. Lab course)	-	4	-	2	2P	20	30	50
DSE (Choose any Two from pool of courses)	INCHEC-656	DSE-13 (Ind. Chem.)	2	-	2	-	4T	20	30	50
	INCHEC-657	DSE-14 (Ind. Chem.)	2	-	2	-		20	30	50
	INCHEC-658	DSE-15 (Ind. Chem.)	2	-	2	-		20	30	50
	INCHEC-659	DSE-16 (Ind. Chem.)	2	-	2	-		20	30	50
Research Project	INCHRP-699	Research Project-2	-	12	-	6	6P	60	90	150
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, **DSE**- Discipline Specific Elective, **T**-Theory,
L- Laboratory course, **INCHTC**- Industrial Chemistry Theory Core course , **INCHLC**- Industrial
 Chemistry Laboratory Core course, **INCHEC**- Industrial Chemistry Elective Course,
INCHRP- Industrial Chemistry Research Project,

Semester : I		
Course Name: Analytical Chemistry-1		Course Code: CHET/MJ/500
Course type : DSC-1		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes: on completion of this course student will be able to :		
1.	Understand why analytical measurements need to be made.	
2.	Understand the importance of producing reliable results.	
3.	define what is meant by 'quality'.	
4.	understand the importance of sampling and able to identify different types of samples.	
5.	understand the basics in each separation techniques, viz. crystalization, sublimation, distillation, extraction.	
6.	understand the theory of liquid-liquid extraction.	
7.	understand the theory of solid-phase extraction.	
8.	understand basic of chromatographic Techniques for separation of constituents of mixtures	
9.	understand rate and plate theory of chromatography.	
Unit-I : Basic concepts of analytical chemistry		10Hrs
	The role of analytical chemistry, The analytical perspectives, Common analytical problems, Purpose of analysis, Types of analysis, Qualitative and quantitative analysis, The analytical process, Steps in an analysis, Sampling: Types of samples and sampling, Introduction to the validation of a method	
Unit-II : Basic separation techniques		10Hrs
	Precipitation, Recrystallization, Sublimation, Distillation: Simple, Fractional, Steam distillation, Distillation under vacuum, Theory of operation of distillation methods, Some practical considerations. Solvent and Solid Phase extraction: Phase equilibrium, The partition coefficient, The distribution ratio, Percent extracted, Theory of phase contact methods: Single equilibrations, Repeated equilibrations, Counter current distribution, Practical aspects and applications - Extraction of metals, Extraction of molecular species, Ion pair extractions, Accelerated and microwave assisted extraction, Solid phase extraction, Numericals	
Unit-III : Chromatography		10Hrs
	Introduction, Elution, Eluent, Retention time, Retention volume, Retention ratio, Basic principles and theory of chromatographic techniques, Plate theory of chromatography, Rate theory of chromatography, Other factors in zone broadening, Development of the chromatogram: Frontal analysis,	

	elution analysis displacement analysis, Selection of chromatograph system, Qualitative and quantitative analysis by chromatography.	
References Books		
1.	Analytical Chemistry 6th Edition., Gary D. Christian	
2.	Fundamental of Analytical Chemistry 8th Ed ⁿ . Skoog, West Hollar, Crouch	
3.	Chemical Separations and Measurements, D.G. Peters, J.M. Hayes and G.M. Hieftie	
4.	Instrumental Method of Chemical Analysis, G.R. Chatwal & S. K. Anand	
5.	Introduction to instrumental analysis – Robert D. Braun	

MA

-Semester : I		
Course Name: Inorganic Chemistry-1		Course Code: CHETE/MJ/-501
Course type : DSE-2		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes: On completion of this course, the students will be able:		
1.	To understand the stability constant of metal complex, stepwise and overall formation constant.	
2.	To describe the factors affecting for stability of metal complexes.	
3.	To identify and describe techniques for determination of formation constant of metal complexes.	
4.	To analyse the structural and stereoisomerism of metal complexes and their classifications.	
5.	To understand the mechanism in metal complexes.	
6.	To understand acid and base hydrolysis of metal complex and their mechanism.	
7.	To understand the role of trans effect in the synthesis of platinum complex.	
8.	To distinguish between the inner and outer sphere mechanism of electron transfer reaction of metal complexes.	
9.	To memorise the function of essential and trace elements in biological systems.	
10.	To describe the structure and function of metalloporphyrins, Hemoglobin, cytochrome and hemocyanine.	
11.	To understand the electron transfer, respiration and photosynthesis of biological system.	
12.	To know the diseases caused by deficiencies of Fe, Zn, Cu and Mn ions in biological system and remedies to them.	
Unit-I : Metal ligand equilibria in coordination compounds		10Hrs
	Definition of stability constant of metal complex , Step wise and overall formation constant, Factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Determination of formation constant for binary complexes using pH-metric technique. Isomerism in coordination compound, Types of isomerism.	

Unit-II : Reaction mechanism of transition metal complexes		10Hrs
	Ligand substitution reaction and their mechanisms of octahedral complexes. Acid hydrolysis, factors affecting the acid hydrolysis. Base hydrolysis, conjugate base mechanism. Trans effect in platinum complex, Theories of trans effect, reaction on platinum complex based on trans effect, Electron transfer reaction: mechanism of inner and outer sphere electron transfer reactions in octahedral complexes.	
Unit-III :Inorganic chemistry in biological systems		10Hrs
	Essential and trace elements in biological systems and their functions, structure and function of metalloporphyrins, Hemoglobin, cytochrome and hemocyanine. Electron transfer, Respiration and photosynthesis reaction, Metal ion deficiency diseases of Fe, Zn, Cu and Mn and their therapy.	
	References Books	
1.	Principles of Inorganic chemistry- B.R. Puri, L. R. Sharma , K. C. Kalia	
2.	Concise Inorganic Chemistry- J.D. Lee.	
3.	Inorganic Chemistry- J.E. Huhey and Keiter R. L	
4.	Inorganic Chemistry - Gary L. Miessler, Paul J. Fischer, Donald A. Tarr ; 5 th Edn	
5.	Mechanism of Inorganic Reaction- Fred Basolo and R.G. Pearsons.	
6.	Selected Topic in Inorganic Chemistry- Wahid U. Malik, G.D. Tuli and R. D. Madan.	
7.	Advanced Inorganic Chemistry- F. A . Cotton and Wilkinson.	
8.	Advanced Inorganic Chemistry- Satyaprakash, G.D. Tuli, S.K. Basu and R.D. Madan.	
9.	Advanced Inorganic Chemistry- Volume I and II Gurdeep Raj.	
10.	A Textbook of bioinorganic chemistry- A. K. Das	

44

Semester : I		
Course Name: Organic Chemistry-1		Course Code:CHET/MJ/-502
Course type : DSC-3		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes		
Student will be able to		
1.	Understand the chemical and molecular processes in organic chemical reactions.	
2.	Study the concept of Alternant and non-alternant hydrocarbons	
3.	Study the energy levels of π -molecular orbitals	
4.	Explain the concept of aromaticity	
5.	Know the types of mechanism in organic reactions	
6.	Understand the correlation between the thermodynamic and kinetic parameters	
7.	Study the different intermediates involved in organic chemical reactions	
8.	Learn the various types of aliphatic nucleophilic substitution reactions	
Unit-I :Nature of Bonding in Organic Molecules		10 Hrs
	Delocalized chemical bonding, conjugation, cross conjugation, resonance, hyperconjugation, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non- alternant compounds, Huckel rule, energy level of π -molecular orbitals, annulenes, aromaticity, Bonds weaker than covalent - addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.	
Unit-II :Reaction Mechanism: Structure and Reactivity		10 Hrs
	Types of Mechanisms, Types of reactions, Thermodynamic and Kinetic requirements, Kinetic and Thermodynamic control, Hammond's postulate, methods of determining mechanisms, isotope effects. Generation, structure, stability and reactivity of carbocations, Carbanions, free radicals, carbenes and Nitrenes. Effect of structure on reactivity, resonance and field effect, steric effect quantitative treatment, The Hammett equation, Linear free energy relationship, substituent and reaction constants, Taft equation.	
Unit-III :Aliphatic Nucleophilic Substitutions		10 Hrs
	Nucleophilic: The SN^2 , SN^1 mixed SN^1 and SN^2 and SET mechanisms. The neighbouring group mechanism, Neighbouring group participation by π and σ -bonds, anchimeric assistance. Nucleophilic Substitution at an allylic aliphatic trigonal and a vinylic carbon. Reactivity: Effect of substrate structure, attacking nucleophile, leaving group, Reactivity and reaction medium. Phase transfer catalysis, Ambident nucleophiles, regioselectivity.	
Course Outcome :		
After completion of the course, students will be able to		
6.	Explore conceptual fact of chemical bonding and basis of reactivity	
7.	Apply the concept of aromaticity to various molecules	
8.	Explain the types of reactions and reaction intermediates	

9.	Compare the SN^1 , SN^2 and SN^i with respect to mechanism, orientation and stereochemical outcome	
10.	Differentiate various nucleophilic substitution reactions	
11.	Explore conceptual fact of chemical bonding and basis of reactivity	
References Books		
1.	Advanced Organic Chemistry, IV Edition: J. March	
2.	Advanced organic Chemistry, Part-A and Part-B: F. A. Carey, & R. J. Sundburg	
3.	A Guide Book to Mechanism in Organic Chemistry: Peter Sykes	
4.	Synthetic Organic Chemistry: H. O. House	
5.	Principles of Organic Synthesis: R. O. C. Norman	
6.	Organic Chemistry (Second Edition): Clayden, Greeves and Warren	
7.	Mechanism and Structure in Organic Chemistry: E. S. Gould	

11

Semester: I		
Course Name: Physical Chemistry-1		Course Code: CHET/MJ/-503
Course Type: DSC-4		2 Hrs/ Week
Total Contact Hours: 30	Theory Credit: 2	Marks : 50
Course outcomes: student will be able		
1. To understand the fundamental principles of chemical kinetics.		
2. To learn different theories of chemical kinetics.		
3. To understand concept of fast and slow reactions based on their rate constant and reaction rates.		
4. To understand the concept of thermodynamics.		
5. To apply critical thinking and problem solving skills to solve problem related to thermodynamics and chemical kinetics.		
6. To understand the basic concept of micelles.		
Unit-I: Chemical Dynamics		10 Hrs
	Collision theory, modified collision theory, weakness of the collision theory, Theory of absolute reaction rates, equilibrium hypothesis, Derivation of the rate equation, statistical mechanical derivation and thermodynamic formulation. Isotope effect on reaction rate. Primary salt effect, secondary salt effect. Dynamics of uni-molecular reactions, Lindmann and Hinshelwood theory, Kinetics of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and NMR method. Reactions in solution: Reaction between ions, influence of solvent-double sphere model, single sphere model, influence of ionic strength, numericals.	
Unit-II: Classical Thermodynamics		10 Hrs
	Nernst heat theorem, the third law of thermodynamics, determination of absolute entropies of solids, liquids and gases. Partial molar properties : Partial molar free energy, chemical potential, partial molar volume and partial molar heat content and their significance, determination of these quantities, concept of fugacity and determination of fugacity.	
Unit-III: Micelles		10 Hrs
	Colloidal electrolytes, Types of micelles in colloidal electrolytes, Micellization, Thermodynamics of micellization, Mechanism of Micellization, critical micellar concentration, Determinations of critical micellar concentration, Surface active agents, Classifications of surface active agents, Reverse micelles, Solubilization	
Reference Books:		
1.	Chemical Kinetics - Laidler (McGraw-Hill)	

2.	Kinetic and Mechanism of Chemical Transformations - J. Rajaram and J.C. CURIACOSE (Macmillan India Ltd.)
3.	Physical Chemistry - Atkins (Oxford)
4.	Thermodynamics for Chemists - S. Glasstone (EWP, New Delhi)
5.	Physical Chemistry - G. M. Barrow
6.	Advanced Physical Chemistry - Gurdeep-Raj (Pelenum)
7.	Micelles : Theoretical and Applied Aspects - V. Moroi (Plenum)
8.	Text Book of Physical Chemistry - S. Glasstone (McMillan)
9.	Physical chemistry – Robert A .Alberty ., Robert J .Silbey
10.	Statistical Thermodynamic – M. C. Gupta

PA

Semester : I		
Course Name: Inorganic Chemistry Laboratory Course-1		Course Code:CHEL/MJ/-504
Course type : DSC-5		4 Hrs/ Week
Total contact hours :60 Hrs	Lab. Work Credit: 2	Marks : 50
Course outcomes:		
On completion of this course, the students will be able:		
1.	To understand the difference between qualitative and quantitative analysis.	
2.	To understand the concept of qualitative and quantitative chemical analysis and their chemical reactions and constituents .	
3.	To understand the design and development of experimental setup and procedure, for volumetric and gravimetric analysis of chemical compound.	
4.	To identify constituents of chemicals qualitatively and quantitatively	
5.	To understand importance of accuracy and precision in measurement of chemical analysis	
6.	To apply grasped knowledge to solve chemical analysis related issues of stakeholder.	
7.	To understand importance of laboratory skills, precaution, accuracy and precision.	
8.	To separate and identify acidic & basic radicals from chemical sample.	
9.	To apply the grasped knowledge in chemical analysis of unknown sample.	
List of experiments		
Sr No	Group- I (Any 3)	
1.	Separation and Identification of three basic radicals from II group sample mixture by semimicro qualitative analysis method and their chemical reactions .	
2.	Separation and Identification of three basic radicals from III-A group sample mixture by semimicro qualitative analysis method and their chemical reactions .	
3.	Separation and Identification of three basic radicals from III-B group sample mixture by semimicro qualitative analysis method and their chemical reactions .	
4.	Separation and Identification of three basic radicals from IV group sample mixture by semimicro qualitative analysis method and their chemical reactions	
5.	Separation and Identification of three basic radicals from special group sample mixture by semimicro qualitative analysis method and their chemical reactions .	
Group- II (Any 3)		

6.	Separation and Identification of three basic radicals from II, IIIA and IIIB groups sample mixture by semimicro qualitative analysis method and their chemical reactions .	
7.	Separation and Identification of three basic radicals from IIIA , IIIB & IV groups sample mixture by semimicro qualitative analysis method and their chemical reactions.	
8.	Separation and Identification of three basic radicals from IIIA , IIIB & V groups sample mixture by semimicro qualitative analysis method and their chemical reactions.	
9.	Separation and Identification of three basic radicals from IIIA , IV & special groups sample mixture by semimicro qualitative analysis method and their chemical reactions .	
	Group- III (Any 3)	
10.	Identification of Carbonate, Chloride Iodide and Acetate, ions from given mixture by semimicro qualitative analysis method along with chemical reaction of each radicals.	
11.	Identification of Nitrate, Phosphate, Oxalate and Sulphate ions from given mixture by semimicro qualitative analysis method along with chemical reaction of each radicals.	
12.	Identification of the Chloride , Bromide , Iodide and Acetate ions from given mixture along with chemical reaction of each radicals.	
13.	Identification of Phosphate , Oxalate , thiosulphate and Acetate ions from given mixture by semimicro qualitative analysis method along with chemical reaction of each radicals.	
14.	Identification of Carbonate , Nitrate , Oxalate and thiosulphate ions from given mixture by semimicro qualitative analysis method along with chemical reaction of each radicals.	
	Group- IV (Any 3)	
15.	Qualitative analysis of metal ions present in soil sample.	
16.	Determine the temporary and permanent hardness of given sample of water	
17.	To determine the percentage of phosphate as Phosphorous in chemical fertilizer Ammonium phosphomolybdate method.	
18.	To determine the percentage of oxalate ion from sodium oxalate by volumetric method.	
19.	To determine the percentage purity of Sodium chloride in commercial salt sample by Volhard's method.	
	References Books	
1.	.A Text book of Micro and Semi micro Qualitative Inorganic Analysis- IV Edn, A. I. Vogel	
2.	A Text book of Quantitative Inorganic Analysis- A. I. Vogel	

3.	Practical Inorganic Chemistry- Pass Geoffrey and Haydn Sutcliffe	
4.	Advanced Practical Inorganic Chemistry- Gurudeep Raj	
5.	Vogel's Qualitative Inorganic Analysis- VII Edn. Orient Longman Ltd. D. Svehla	
6.	A Text book of Micro and Semi micro Qualitative Inorganic Analysis- IVedn, A. I. Vogel	
7.	A Text book of Quantitative Inorganic Analysis- A. I. Vogel	
8.	Practical Inorganic Chemistry- Pass Geoffrey and Haydn Sutcliffe	



Semester : I		
Course Name: Organic Chemistry Laboratory Course-1		Course Code:CHEL/MJ/-505
Course type : DSC-6		4 Hrs/ Week
Total contact hours :60 Hrs	Lab. Work Credit: 2	Marks : 50
	Learning Outcome : On completion of this course, the students will be able 1. Understand the separation and purification techniques 2. Understand various step involved in identification of organic compounds 3. Understand the handling of equipment required for the analysis of organic compounds. 4. Understand the stichometry of the reaction 5. To check the purity of compound using TLC 6. To check the Melting point	
	List of experiments	
1	Qualitative Organic Analysis Separation, purification and identification of binary (Solid-Solid) mixtures with one water soluble compound. The separation should be carried out using Chemical method/ physical method The two components are solid-solid mixtures. Student should submit the purified samples of the separated compounds and prepare a suitable derivative of the two compounds separated out. Note: Analysis of at least five mixtures should be carried out.	
2	Single Stage Preparations i) <i>p</i>-nitro acetanilide from acetanilide. ii) Dibenzylidene acetone from Benzaldehyde iii) <i>p</i>-nitrobromobenzene from bromobenzene iv) salicyladehyde from phenol (Reimer Tiemann reaction) v) b benzol propionic acid from succinic anhydride Note: i) The preparations should be carried out using (0.02 to 0.05 mole) of the starting material. ii) The yield, melting point and TLC of the recrystallised product should be recorded. Note: Student will not be allowed for practical examination if his/her record book is not completed and certified.	

AKA

Semester: I		
Course Name: Physical Chemistry Laboratory Course-1		Course Code:CHEL/MJ/-506
Course Type: DSC-7		4 Hrs/ Week
Total contact hours :60 Hrs	Lab. Work Credit: 2	Marks: 50
Course Outcomes : On completion of this course, the students will be able:		
1.	To analyse sample by various instrumental techniques	
2.	To handling of electronic equipment	
3.	To understand laboratory skills, precaution, accuracy and precision.	
4.	To design experimental procedure for analysis important chemicals & samples	
5.	To understand the physical properties of chemicals	
6.	To distinguish accuracy of results in instrumental and non instrumental methods	
Unit-I: Instrumental		
1.	Determination of strengths of halides in a mixture potentiometrically.	
2.	Determination of the strength of strong and weak acid in a given mixture conductometrically.	
3.	Determination of solubility and solubility product of sparingly soluble salt BaSO ₄ .	
4.	Determine the pK ₁ and pK ₂ value of phosphoric acid by pH me try.	
5.	Determine the indicator constant of given indicator by colorimetric measurements.	
6.	Study of kinetics of inversion of cane sugar.	
7.	Synthesis and XRD characterization & indexing of bcc & fcc metal oxides & calculation of lattice parameters & particle sizes.	
8.	Synthesis and study of thermal decomposition patterns to investigate types of desorbed water, evolution of lattice oxygen and phase transition in a suitable compound.	
9.	Thermal analysis of any 5 well known polymers and interpretation of their glass transition temperatures.	
Unit-II: Non-Instrumental		

1.	Determine the molecular refraction of methyl acetate, ethyl acetate, n-hexane and carbon tetrachloride and calculate the refraction of CH ₂ , C, H and O atoms.
2.	To study the effect of surfactants (sodium chloride) on surface tension of given liquid.
3.	To determine the radius of molecule by viscosity measurements.
4.	Determine the solubility of benzoic acid in water at different temperature and hence its heat of solution.
5.	Determine the formula of the complex formed between Cu(II) and ammonia by distribution method.
6.	Determine the velocity constant of hydrolysis of ester.
Reference Books:	
1.	Systematic experimental physical chemistry – T. K. Chondhekar & S.W. Rajbhoj
2.	Experiments in chemistry – D.V. Jahagirdar

249

Semester : I		
Course Name: Analytical Chemistry-2		Course Code: CHETE/SE-507
Course type : DSE-1		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes : after completion of course students will be able		
1.	to define the different regions of an electromagnetic radiation.	
2.	To understand the interaction/transition of the matter with different region of electromagnetic radiation.	
3.	to define basic elements of spectroscopic technique.	
4.	to calculate the wavelength at which a molecule show maximum absorption of UV-visible radiation.	
5.	To interpret the ultraviolet-visible spectrum	
6.	to define the bands in the IR spectrum due to fundamental frequency, and overtones, combination bands and Fermi resonance	
7.	to define the vibrational frequency of a particular bond	
8.	to calculate the vibrational frequency of a particular bond	
9.	To interpret the infrared spectrum	
10.	to predict the structure using UV-visible and IR spectrum.	
Unit-I : General introduction of spectral methods of analysis.		10Hrs
	Characterization of electromagnetic radiations, Regions of the spectrum, Interaction of radiations with matter - absorption, emission, transmission, reflection, dispersion, polarization and representation of spectra, basic elements of practical spectroscopy, Resolving power, Signal to noise ratio. Uncertainty relation and natural line width, Natural line broadening, Intensity of spectral lines, Energy levels, Selection rules, Components of spectrometer and their functions.	
Unit-II : Ultraviolet- Visible Spectroscopy		10Hrs
	Elementary ideas (Recapitulation), Instrumentation, Presentation of spectra, Effect of solvent on electronic transitions, The effect of conjugation, Woodward-Fieser rules for dienes, enones, aldehydes, acids, esters and aromatic compounds, Model compound studies, Visible spectra : color in compounds, Interpretation of an ultraviolet spectrum, Numericals	
Unit-III : : Infrared Spectroscopy		10Hrs
	Elementary ideas (Recapitulation), Characteristic vibrational frequencies : hydrocarbons, aromatic rings, Alcohol, Phenols, Ethers, Carbonyl compounds, Amines, Nitriles, Isocyanates, Imines, Nitro compounds, Carboxylate salts, Amine salts, Amino acids, Sulfur compounds,	

	Phosphorus compounds, Alkyl halides, Arylhalides, and metal-ligand complexes. Factors affecting IR group frequencies, overtones, combination bands and Fermi resonance. Applications of IR. Problems based on combined applications of UV and IR spectroscopy.	
References Books		
1.	Analytical Chemistry 6th Edition., Gary D. Christian	
2.	Fundamental of Analytical Chemistry 8th Edn. Skoog, West Hollar, Couch	
3.	Chemical Separations and Measurements, D.G. Peters, J.M. Hayes and G.M. Hieftie	
4.	Instrumental Method of Chemical Analysis, G.R. Chatwal& S. K. Anand	
5.	Introduction to instrumental analysis – Robert D. Braun	
6.	Instrumental methods of analysis – Willard, Merritt, Dean, Settle	
7.	Principle of instrumental analysis Skoog, Holler, Nieman	
8.	Introduction to spectroscopy – Pavia, Lampman, Kriz, Vyvyan	
9.	Spectroscopic methods in organic chemistry – Dudley Williams, Ian Fleming	
10.	Spectrometric identification of organic compounds – Robert M. Silverstein, Francis X. Webster	
11.	Organic structure analysis – Phillip Crews, Jaime Rodriguez, Marcel Jaspars	
12.	Spectroscopy of organic compounds – P. S. Kalsi	

(Signature)

Semester : I		
Course Name: Inorganic Chemistry-2		Course Code:CHETE/SE/-508
Course type : DSC-2		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Learning outcomes: On completion of this course, the students will be able:		
1.	To understand how to perform symmetry operation to chemical molecules.	
2.	To identify the symmetry elements based on structure of molecules.	
3.	To apply the knowledge of concept of symmetry element and operations and centre, axis and planes symmetries possessed by an object / orbitals / molecule.	
4.	To identify & classify of point group of molecules	
5.	To apply knowledge of group theory to understand properties of molecules, character of matrix, product of symmetry operations, reducible and irreducible representations.	
6.	To use knowledge of character of representations to designate appropriate Mulliken symbols.	
7.	To calculate the appearance of irreducible representation by correlating relation between IRs, RRs and order of group.	
8.	To evaluation of predict the product of symmetric and asymmetric representations and evaluate new irreducible representation.	
9.	To identify modes of molecular vibrations of chemical compounds.	
Unit-I :Group theory and Symmetry concepts		10Hrs
	Symmetry elements and symmetry operations, Centre of symmetry(i), Axis of symmetry(C_n), Plane of symmetry (σ_v , σ_h , σ_d), Rotation reflection axis of symmetry(S_n), Identity(E). Point groups, Classifications of point groups, Identification of point group of : H_2O , NH_3 , CO_2 , BF_3 , C_2H_4 , PCl_3 , PCl_5 , $[PtCl_4]^-$, cis and trans $[PtCl_2(NH_3)_2]$, $[CoCl_2(NH_3)_4]$, $[FeF_6]$, H_2 , HCl , CO , BeF_2 , $C_2H_2Cl_2$, C_6H_6 , and substituted benzene molecule. Application of point group with respect to dipole moment, polar and non polar molecules.	
Unit-II :Representations of groups		10Hrs
	Group, Properties of group, Group multiplication tables, Matrix representation of symmetry elements. Reducible representation, Generation	

	of reducible representation for H ₂ O, NH ₃ , POCl ₃ , CH ₃ Cl ,Matrix representation for symmetry operations, Character of representation, Character of p, and d orbital representations.	
Unit-III : Application of character tables		10Hrs
	Character table, Rules for construction of character tables. Construction of character table for C _{2v} & C _{3v} point group. Mulliken symbolism rules for irreducible representations. Reduction formula, Reducing representations to Irreducible Representations with examples, Direct product of irreducible representation, Molecular vibrations, Modes of vibrations, calculation IR active modes of vibrations with examples.	
References Books		
12.	Symmetry and Spectroscopy of Molecules- K.Veera Reddy.	
13.	Group Theory and its Chemical Application- P.K. Bhattacharya	
14.	Inorganic Chemistry - Gary L. Miessler, Paul J. Fischer, Donald A. Tarr, 5 th Edn	
15.	Inorganic Chemistry- J.E.Huhey and Keiter R. L	
16.	Principle of Inorganic chemistry-Brian W. Pfennig .	
17.	Inorganic Chemistry – Shriver & Atkins	
18.	Symmetry and Group theory in Chemistry- R Ameta	
19.	Group Theory and symmetry in Chemistry- Gurdeep Raj .AjayBhagi and Vinod Jain.	

FM

Semester : I		
Course Name: Organic Chemistry-2		Course Code:CHETE/SE/-509
Course type : DSE-3		
Total contact hours : 30 h	Theory Credit: 2	Marks : 50
Course Objectives Student will be able to		
1	Understand the concept of Stereochemistry	
2	Know the stereochemical notations	
3	Know the difference between stereospecific and stereoselective reactions	
4	Study the stereochemistry of some Chiral molecules like Biphenyls, allenes and Spiranes.	
5	Acquire the knowledge of various methods of resolution	
6	Understand stereochemistry of the compounds containing Nitrogen, Sulphur and phosphorous	
7	Know about enantiomeric and diastereomeric excess	
Unit-I :Introduction to Stereochemistry		10L
	Introduction and Significance of stereochemistry, Terminologies: Optical activity, Asymmetric atom, Stereogenic centre or Stereocentre, Conformation, Configuration, types of isomers, Essential criteria for a molecule to be chiral. Elements of symmetry: (A) Axis of symmetry (B) Plane of symmetry (C) Centre of symmetry, Problems based on elements of symmetry.R/S configuration and sequence rule, E/Z configuration. R/S Nomenclature in Fischer projection, Conversion of Fisher projection to Wedge and Newmann, Enantiomers, Properties of enantiomer, Diastereoisomers, Meso Compounds. Problems based on the above concepts.	
Unit-II : Stereochemistry-I		10L
	Molecules with more than one chiral center, Epimers, Anomers, Threo and Erythro isomers, Prochiral relationships, stereospecific and stereoselective reactions. Optical activity in the absence of chiral carbon in (i)	

	biphenyls, (ii) allenes (iii) spiranes and Essential criteria for chirality, Problems based on these molecules. Methods of resolution: Resolution through the formation of diastereomers, Resolution of racemic acids, bases and alcohols. Stereochemistry of the compounds containing Nitrogen, Sulphur and phosphorous.	
Unit-III : Conformational Analysis		10L
	Conformational analysis of cycloalkanes, Mono- and di-substituted cyclohexanes, decalins, effect of conformation on reactivity, Conformation in six membered rings containing hetero atoms, Specific Rotation, Enantiomeric Excess, Diastereomeric excess, Topocity, Homotopic, Homotopic ligands and Faces, Enantiotopic ligand and faces, Diastereotopic ligands and faces, Problems based on these concepts	
Reference Books		
1	Stereochemistry of Carbon Compounds: E. L. Eliel	
2	Stereochemistry of Organic Compounds: D. Nashipuri	
3	Organic Chemistry (Second edition): J. Clayden, N. Greeves, S. Warren	
4	Advanced organic Chemistry, Part-A and Part-B: F. A. Carey, & R. J. Sundburg	

148

Semester: I		
Course Name: Physical Chemistry-2		Course Code:CHETE/SE/-510
Course Type: DSE-4		2 Hrs/ Week
Total Contact Hours: 30	Theory Credit: 2	Marks : 50
Course outcomes: after completion of the course Students will be able to		
1. To understand the concept of ionic equilibria, dissociation constant, buffer solution and solubility products.		
2. To calculate dissociation constant, pH, pOH, pKa, pKb of acidic and basic solutions.		
3. To understand the theories of electrolytes, electrocapillary phenomenon and its properties.		
4. To understand the concept of surface tension of liquid and curved surfaces.		
Unit-I: Ionic Equilibria and Biological Reactions		10 Hrs
	Exact treatment of the dissociation of weak acids and bases, Dissociation constant of polyprotic acids, Statistical effects in polyprotic acids, Dissociation constant of complex ions, Logarithmic expression for pH and pOH, Calculations involving buffer solution, buffer capacity and buffer index, Salt effect and solubility product and its applications. Thermodynamics of biochemical reactions, Binding of oxygen by myoglobin and haemoglobin, Reaction between microscopic and macroscopic dissociation constant.	
Unit-II: Electrochemistry		10 Hrs
	Debye-Huckel theory of strong electrolytes, Debye-Huckel-Onsager equation Testing of the equation, Debye-Falkenhagen effect, Wein effect, activity coefficient, mean ionic activity coefficient; Debye-Huckel limiting law ionic strength. Electrocapillary phenomena, and its measurements. Effect of anions, cations and molecules on electrocapillary curves. Electrocapillary properties of mercury-solution interface. Polarography: the Ilkovic equation and its derivation, concentration polarization, Instrumentation, advantages of DME, half wave potential. Applications of polarography, numerical.	
Unit-III: Surface Chemistry		10 Hrs
	Surface tension, capillary action, pressure difference across curved surface (Laplace equation) vapour pressure of droplets (Kelvin equation) Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro kinetic phenomenon), catalytic activity at surfaces, numericals.	
Reference Books:		
1.	Chemical Kinetics - Laidler (McGraw-Hill)	

2.	Kinetic and Mechanism of Chemical Transformations - J. Rajaram and J.C. CURIACOSE (Macmillan India Ltd.)
3.	Physical Chemistry - Atkins (Oxford)
4.	Thermodynamics for Chemists - S. Glasstone (EWP, New Delhi)
5.	Physical Chemistry - G. M. Barrow
6.	Advanced Physical Chemistry - Gurdeep-Raj (Pelenum)
7.	Micelles : Theoretical and Applied Aspects - V. Moroi (Plenum)
8.	Text Book of Physical Chemistry - S.Glasstone (McMillan)
9.	Physical chemistry – Robert A .Alberty ., Robert J .Silbey
10.	Statistical Thermodynamic – M. C. Gupta

MP

Semester: I		
Course Name: Industrial Chemistry-1		Course Code: CHETE/SE SE/-511
Course Type: DSE-5		2 Hrs/ Week
Total Contact Hours: 30	Theory Credit: 2	Marks : 50
Course Objectives: 1. To learn in Basic calculations and stoichiometry of the chemical reactions. 2. To learn the to design reactor, boilers based on material balance at large scale needed in industries 3. To learn to design equipment based on Energy balance		
Unit-I: Dimensions & Units.		10 Hrs
	Basic chemical calculations, atomic weight molecular weight, mole, composition of liquid mixtures & gaseous mixture. Stoichiometric & composition relationships & chemical equations	
Unit-II: Material Balance:		10 Hrs
	Techniques of material balance direct approach, Algebraic equations, Using tie elements, case studies in unit operation & Unit process with bypass & recycles. Steam properties of steam, Boilers, classification & efficiency liquid phase reactions, Gas phase reactions with/without recycle & bypass	
Unit-III: Energy Balance:-		10 Hrs
	Law of conservations of Energy, Thermo Chemistry, Heat capacity sensible heat latent heat, Enthalpy calculations involving physical & chemical changes. Mixing & separations operations & chemical processes. Note:- 25% weightage should be given to problems Reduction reactions	
	Course Outcome: Students will be able to – 1. Understand about stichometry of the reactions to design a reactor. 2. Understand the design and working of boilers and reactors by calculating material balance 3. Understand the difference changes in energy during chemical reaction 4. Design the reactor boiler based on energy changes.	
Reference Books:		
1.	Stoichiometry for Chemical Engineering Jonson	
2.	Stoichiometry [Bhatt & Vora] Tata McGraw Hill.	
3.	Chemical engineering [Coulson & Richardson]	
4.	Introduction to chemical Engineering [Cabe & Smith]	

Semester : I		
Course Name: Research methodology		Course Code: CHE/RM/-512
Course type :- ---		4 Hrs/ Week
Total contact hours :60 Hrs	Theory Credit: 4	Marks :100
Course outcomes:		
On completion of this course, the students will be able to:		
1.	Understand the basic concepts of research methodology	
2.	know recent trends in chemical research.	
3.	Acquire the fundamental knowledge of various characterization techniques.	
4.	apply of characterization techniques viz.; XRD, SEM, TEM, UV, IR, NMR and Mass spectrometry in research	
Unit-I : Unit-I :Literature Survey		10Hrs
	Print: Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples. Digital: Web resources, E-journals, Journal access, TOC alerts, Hot articles, Citation index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Preprint servers	
Unit-II :Search Engines		10Hrs
	Scirus, Google Scholar, Wiki- Databases, Chem Spider, Science Direct, Pub Med, Sci Finder, Mendeley, Scopus, Web of Science. Information Technology and Library Resources: The Internet and World Wide Web. Internet resources for chemistry. Finding and citing published information	
Unit-III : Methods of Scientific Research and Writing Scientific Papers		10Hrs
	Reporting practical and project work. Writing literature surveys and reviews. Organizing a poster display. Giving an oral presentation. Writing scientific papers – justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work. Writing ethics. Avoiding plagiarism.	

Unit-IV : Chemical Safety and Ethical Handling of Chemicals:		10Hrs
	Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric – safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals.	
Unit-V : Data Analysis		10Hrs
	The Investigative Approach: Making and Recording Measurements. SI Units and their uses, Scientific method and design of experiments, Analysis and Presentation of Data: Descriptive statistics. Choosing and using statistical tests. Chemometrics. Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r and its abuse, basic aspects of the multiple linear regression analysis.	
Unit-VI : Fundamentals of Computers and Application		10Hrs
	a. Introduction to basic software i. MS Word, ii. Power Point, iii. Excel, b. Introduction to Chemistry related software i. Gaussian, ii. Gaussview, iii. ChemDraw / Chem Sketch	
References Books		
1.	Practical Skills in Chemistry, J. R. Dean, A. M. Jones, D. Holmes, R. Reed, J. Weyers and A Jones, Pearson Education Ltd. [Prentice Hall] (2002)	
2.	Research Methodology. Methods and Techniques: C. R. Kothari.	
3.	Research Methodology: Tools and Techniques by Dr. Prabhat Pandey, Dr.Meenu Mishra Pandey	

MM

M.Sc. First Year Semester-II Course Structure

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Inter. Assm en.	End. Sem Exam	Total Marks
Major Mandatory DSC	CHET/MJ/-550	DSC-8 Anal. Chem	2	-	2	-	8T	20	30	50
	CHET/MJ/-551	DSC-9 Inorg. Chem	2	-	2	-		20	30	50
	CHET/MJ/-552	DSC-10 Org. Chem	2	-	2	-		20	30	50
	CHET/MJ/-553	DSC-11 Phy. Chem	2	-	2	-		20	30	50
	CHET/MJ/-554	DSC-12 Inorg. Chem. Lab course	-	4	-	2	6L	20	30	50
	CHET/MJ/-555	DSC-13 Org. Chem. Lab course	-	4	-	2		20	30	50
	CHET/MJ/-556	DSC-14 Phy. Chem. Lab course	-	4	-	2		20	30	50
DSE (Choose one from your specialization and any one from remaining three)	CHETE -557	DSE-6 Anal. Chem	2	-	2	-	4T	20	30	50
	CHETE -558	DSE -7 Inorg. Chem	2	-	2	-		20	30	50
	CHETE -559	DSE -8 Org. Chem	2	-	2	-		20	30	50
	CHETE -560	DSE -9 Phy. Chem	2	-	2	-		20	30	50
	CHETE/SE/561	DSE -10 Drug .Chem	2	-	2	-		20	30	50
OJT/FP (Chose any one)	CHOJT-562	On the Job Training	-	8	-	4	4L	40	60	100
	CHFP-563	Field Project	-		-			40	60	100
Total			12	20	12	10	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core ,**DSE**- Discipline Specific Elective, **T**-Theory, **L**- Laboratory course, **CHTC**- Chemistry Theory Core , **CHLC**- Chemistry Laboratory Core , **CHTE**- Chemistry Theory Elective , **CHOJT**- Chemistry On the Job Training, **CHFP**- Chemistry Field Project



Semester : II		
Course Name: Analytical Chemistry-3		Course Code: CHET/MJ/-550
Course type : DSC-8		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes : after completion of the this course students will be able		
1.	To understand basic principle of different chromatographic Techniques for separation of constituents of mixtures	
2.	To understand theory, instrumentation, working procedure and application as well as limitations of TLC	
3.	To understand theory, instrumentation, working procedure and application as well as limitations of liquid- liquid partition chromatography	
4.	To understand theory, instrumentation, working procedure and application as well as limitations of column chromatography	
5.	To understand theory, instrumentation, working procedure and application as well as limitations of gel permeation chromatography	
6.	To understand theory, instrumentation, working procedure and application as well as limitations of ion exchange chromatography	
7.	To understand theory, instrumentation, working procedure and application as well as limitations of high performance liquid chromatography	
8.	To understand theory, instrumentation, working procedure and application as well as limitations of gas chromatography	
9.	To be able to select a particular chromatographic technique for separation of the constituents from a mixture.	
10	To be aware of the various problems associated with different chromatographic techniques.	
Unit-I : Chromatographic Techniques.		10Hrs
	Paper Chromatography: Elementary ideas (Recapitulation) Thin layer Chromatography: Elementary ideas (Recapitulation), Introduction, Principles, Superiority of TLC over other chromatographic technique, Experimental techniques, Solvent systems, Plate development, Detection of components, Evaluation of chromatogram by different methods, Applications, Limitation. High performance thin layer chromatography Liquid-Liquid partition chromatography: Introduction, theory, solid supports, selection of stationary and mobile phases, solvent systems, reverse phase chromatography, choice of adsorption or partition, applications of partition chromatography. Ultra performance liquid chromatography	

AD

	Column Chromatography: Principle, Experimental details, Theory of development, Column efficiency, Factors affecting column efficiency, and applications. Advanced flash chromatography Gel permeation Chromatography: Principle materials, Gel preparation, Column packing, Detectors and applications. Ion Exchange Chromatography: Ion Exchange resins, Ion exchange equilibria, Ion exchange capacity of resins and its determination, Applications of ion exchange resins to chromatography, Ion chromatography based on suppressors	
Unit-II : Gas Chromatography		10Hrs
	Introduction, Branches of gas chromatography, principles of gas-liquid chromatography, instrumentation-Carrier gas, Sample introduction system, Columns, Detectors, substrates, Temperature control, Evaluation, Retention volume, Resolution, Applications, Numericals.	
Unit-III : : High Performance Liquid Chromatography		10Hrs
	Principle, instrumentation - Column, Column packing, Mobile phase, Pumping system, Detector system, Practical procedure, Applications, HPLC adsorption and partition chromatography	
References Books		
1.	Analytical Chemistry 6th Edition., Gary D. Christian	
2.	Fundamental of Analytical Chemistry 8th Ed ⁿ . Skoog, West Hollar, Crouch	
3.	Chemical Separations and Measurements, D.G. Peters, J.M. Hayes and G.M. Hieftie	
4.	Instrumental Method of Chemical Analysis, G.R. Chatwal & S. K. Anand	
5.	Introduction to instrumental analysis – Robert D. Braun	
6.	Principles of instrumental analysis – Skoog, Holler and Crouch	



Semester : II		
Course Name: Inorganic Chemistry-3		Course Code: CHET/MJ-551
Course type : DSE-7		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes:		
On completion of this course, the students will be able:		
1.	To define and classify metal carbonyls	
2.	To design procedure to synthesize mononuclear and binuclear metal carbonyl	
3.	To understand the properties and structure metal carbonyl .	
4.	To apply the concept of effective atomic number for prediction of stability of metal carbonyls.	
5.	To synthesize the nitrosyl halides and their properties .	
6.	To understand the structure and properties and application of sodium nitroprusside.	
7.	To apply the knowledge of EAN and 18 electron rules metal nitrosyl compound of transition elements	
8.	To understand the d orbital splitting in different environment .	
9.	To understand factor affecting crystal field splitting energy	
10.	To describe Jahn Teller distortion and CFSE for high and low spin complexes	
Unit-I : Chemistry of Metal Carbonyls		10Hrs
	Classification of metal carbonyls, structure carbonyl group, Preparation, properties, structures and bonding of $\text{Ni}(\text{CO})_4$, $\text{Fe}(\text{CO})_5$, $\text{Fe}_2(\text{CO})_9$, $\text{Cr}(\text{CO})_6$, $\text{Mn}_2(\text{CO})_{10}$, $\text{Co}_2(\text{CO})_8$, , $\text{Mo}(\text{CO})_6$ and $\text{W}(\text{CO})_6$, $\text{Co}_4(\text{CO})_{12}$ and $\text{V}(\text{CO})_6$. EAN rule applied to metal carbonyls. Application of EAN rule to of mixed metal carbonyls. Preparations and properties of metal carbonyl halides.	
Unit-II : Metal nitrosyl compounds		10Hrs
	Preparations and properties of Nitrosyl Fluoride, Nitrosyl chloride, and Nitrosyl bromide. Preparation and properties of Metal nitrosyl halides containing NO^- anion and NO^+ cations; Preparation, structure and application of sodium nitroprusside. Application EAN and Eighteen electron rules to nitrosyl compounds of Cobalt, Iron and Manganese. Significance of NO for the life of living animal	

Unit-III : Crystal field theory		10Hrs
	Important feature of CFT, Crystal field splitting d orbital in octahedral , tetrahedral, square planer and tetragonal complexes, Factors affecting 10Dq, Spectrochemical series, Calculation of CFSE of high and low spin complex Jahn teller distortion , Limitation of CFT	
	References Books	
1.	Advance Inorganic chemistry- S.K. Agrawal, Keemti Lal	
2.	Principles of Inorganic chemistry, B.R. Puri, L. R. Shrma , K. C. Kalia	
3.	Concise Inorganic Chemistry - J. D. Lee.	
4.	Inorganic Chemistry - G.Y.Miessler and D.A. Tarr	
5.	Inorganic Chemistry – Shriver & Atkins	
6.	Principle of Inorganic chemistry- Brian W. Pfennig .	
7.	Advanced Inorganic Chemistry- Satyaprakash, G.D. Tuli, S.K. Basu and R.D. Madan.	
8.	Selected Topic in Inorganic Chemistry- Wahid U. Malik, G.D. Tuli and R. D. Madan.	
9.	Advanced Inorganic Chemistry- F. A . Cotton and Wilkinson.	

Semester : II		
Course Name: Organic Chemistry-3		Course Code: CHET/MJ/-552
Course type : DSC-10		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course Objectives		
Student will be able to		
1	Understand various reactions involved in addition to C-C and C-O double bond	
2	Acquire the stereochemical aspects in addition reaction	
3	Demonstrate/apply the concepts involved in elimination reaction	
4	Understand mechanism of various named reactions	
Unit-I : Addition to Carbon –Carbon multiple bond		10 Hrs
	Mechanism and stereochemical aspect of addition reaction involving electrophile, nucleophile and free radicals. Regioselectivity and chemoselectivity, orientation and reactivity, Michael addition, Sharpless asymmetric epoxidation.	
Unit-II: Addition to Carbon–Hetero Multiple bond		10 Hrs
	Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acid, ester and nitriles. Addition of Grignard reagent, Organo zinc and organo lithium reagent to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reaction involving enolates, Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin, Stobbe reaction. Hydrolysis of esters.	
Unit-III : Elimination Reactions:		10 Hrs
	The E ₁ , E ₂ , and E ₁ CB mechanism, orientation of double bond. Reactivity: effect of substrate structure, attacking base, the leaving group and the medium, Hoffmann elimination, Saytzeff elimination, Chugaev elimination, pyrolytic syn elimination, Elimination vs Substitution	
References Books		
1	Advanced Organic Chemistry, IV Edition: J. March	
2	Advanced organic Chemistry, Part-A and Part-B: F. A. Carey, & R. J. Sundburg.	
3	A Guide Book to Mechanism in Organic Chemistry: Peter Sykes	
4	Synthetic Organic Chemistry: H. O. House	
5	Principles of Organic Synthesis: R. O. C. Norman	
6	Organic Chemistry: Clayden, Greeves and Warren	
7	Mechanism and Structure in Organic Chemistry: E. S. Gould	

AB

Semester: II		
Course Name: Physical Chemistry-3		Course Code: CHET/MJ/553
Course Type: DSC-11		2 Hrs/ Week
Total Contact Hours: 30	Theory Credit: 2	Marks : 50
Course Outcomes: student will be able		
1. To understand the fundamental principles of quantum mechanics.		
2. To solve the Schrodinger equations calculate wave function and energy levels.		
3. To understand the postulates of quantum mechanics.		
4. To understand the Huckel Molecular Theory of conjugated system and its applications.		
Unit-I: Quantum Chemistry-I		10 Hrs
	The Schrodinger's equation for particle waves, Wave function ψ and its physical meaning, Wave particle duality, Uncertainty principle, The wave function ψ and its physical meaning, Eigen value and eigen functions. Postulates of quantum mechanics, Operators, Hermitian, Linear and Hamiltonian, Condition of Normalization, particle in one dimensional box particle in three dimensional box, .numericals. Theory of Angular Momentum: Angular Momentum Operators, Ladder Operators,	
Unit-II: Quantum Chemistry II		10 Hrs
	Unit-II :- Harmonic Oscillator, particle on a sphere, Schrodinger's equation for spherical coordinates rigid rotator, Variation theorem, The method of perturbation (Theory) and Applications to two electron systems, Term symbols and selection rules spin orbit coupling.	
Unit-III: Molecular Orbital Theory		10 Hrs
	Huckel's Molecular Orbital theory of conjugated systems, Application to ethylene, butadiene, cyclopropenyl, and cyclobutadiene, Electron densities, Bond Order, Free valence indices.	
Reference Books:		
1.	Quantum Chemistry : Ira N. Levine	
2.	Quantum Chemistry : R.K. Prasad	
3.	Quantum Chemistry : B.K. Sen	
4.	Principles of Physical Chemistry : Puri, Sharma, Pathania	
5.	Advanced Physical Chemistry: Gurdeep - Raj, Plenum.	
6.	Physical Chemistry : Maron and Prutton	

	Semester : II	
Course Name: Inorganic Chemistry Laboratory Course		Course Code:CHEL/MJ/-554
Course type : DSC-12		4 Hrs/ Week
Total contact hours :60 Hrs	Lab. Work Credit: 2	Marks : 50
Learning outcomes:		
On completion of this course, the students will be able:		
1.	To design experimental procedure for synthesis of metal complexes , calculation of conversion factors and characterization of synthesized coordination complexes compounds.	
2.	To understand, which skills are required in chemical laboratory .	
3.	To understand importance of accuracy and precision in chemical analysis	
4.	To design the experimental procedure for separation and estimation of metals from mixture solution	
5.	To estimate the amount of constituents of chemicals by volumetric and gravimetric methods.	
6.	To apply grasped knowledge for finding purity of chemicals.	
List of experiments		
	Group- I (Any 3)	
1.	Preparation of [Mn(acac) ₃] complex and its spectral analysis .	
2.	Preparation of Hg[(Co(SCN) ₄] complex and its spectral analysis.	
3.	Preparation of [Co(III)(NH ₃) ₆]Cl ₃ complexes and its spectral analysis.	
4.	Preparation of [Ni (NH ₃) ₆]Cl ₂ complex and its spectral analysis.	
	Group- II (Any 2)	
5.	Preparation of Cis-K[Cr(C ₂ O ₄) ₂ (H ₂ O) ₂] complex and its thermogravimetric analysis.	
6.	Preparation of VO(acac) ₂ complex and its thermogravimetric analysis.	
7.	Preparation of [Cu(NH ₃) ₄]SO ₄ .H ₂ O complex and its thermogravimetric analysis .	
	Group- III (Any 3)	

8.	Preparation of $K_3[Fe(C_2O_4)_3]$ complex and estimate the amount Iron present in it.	
9.	Preparation of $[Co(III)(NO_2)(NH_3)_5]Cl_2$ complex and estimate the amount cobalt present in it.	
10.	Preparation and estimation of percentage of copper from the $[Cu(NH_2CSNH_2)_5](NO_3)_2$ complexes	
	Group- IV (Any 3)	
11.	Separation of Copper and Nickel from the given binary mixture sample and estimate the amount of Copper by volumetric and Nickel by gravimetric method.	
12.	Separation of Nickel & Zinc from given binary mixture sample and estimate the amount of Zinc by volumetric method and Nickel by gravimetric method.	
13.	Separation of Copper & Barium from given binary mixture sample and estimate the amount of Copper by volumetric method and Barium by gravimetric method.	
14.	Separation of Iron & Aluminium from given binary mixture sample and estimate the amount of Aluminium by volumetric method and Iron by gravimetric method .	
15.	Separation of Copper & Iron from given binary mixture sample and estimation of amount of Copper by volumetric method and Iron by gravimetric method.	
16.	Separation of Iron & Magnesium from given binary mixture sample and estimation of amount of Iron & Magnesium volumetric method .	
	Group- V (Any 3)	
17.	Determination of percentage purity of concentrated hydrochloric acid by volumetric method.	
18.	Determination of chemical oxygen demand from given sample of water by volumetric method.	
19.	Determination of dissolved oxygen from given sample of water by volumetric method .	
20.	Determination of the percentage purity of copper sulphate from given commercial sample.	
21.	Determination of the amount of water content in commercial sample of copper sulphate .	

	References Books	
1.	Advanced Practical Inorganic Chemistry- GurudeepRaj;.	
2.	Practical Inorganic Chemistry- Pass Geoffrey and Haydn Sutcliffe.	
3.	A Text book of Micro and Semi micro Qualitative Inorganic Analysis, IVedn, A. I. Vogel	
4.	A Text book of Quantitative Inorganic Analysis; A. I. Vogel	
5.	Vogel's Qualitative Inorganic Analysis, VII Edn. Orient Longman Ltd. D. Svehla	

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Semester : II		
Course Name: Organic Chemistry Laboratory Course		Course Code:CHEL/MJ/-555
Course type : DSC-13		4 Hrs/ Week
Total contact hours :60 Hrs	Lab. Work Credit: 2	Marks : 50
	Course Outcomes 1. To Perform/demonstrate the techniques involved in organic binary mixture separation specially solid- liquid mixture. 2. To perform distillation techniques for purification of organic compounds. 3. To use/ apply the technique of separation, crystallization derivatization and function Group detection. 4. To use the methods for the preparation of useful compounds using named reaction	
	List of experiments	
1	Qualitative Organic Analysis: Separation, purification and identification of binary (Solid-Liquid) mixtures. The separation should be carried out using Chemical method. The two components are solid-liquid mixtures. Student should submit the purified samples of the separated compounds and prepare a suitable derivative of the two compounds separated out. Note: Analysis of at least Five mixtures should be carried out.	
2	Single Stage Preparations: i) <i>p</i>-Bromo acetanilide from acetanilide. ii) 1,4-dichlorobenzene from <i>p</i>-chloroaniline iii) Benzophenone from benzene (Friedel Craft) iv) Cinnamic acid from Benzaldehyde (Perkins reaction) v) <i>o</i>-iodo benzoic acid from anthranilic acid Note: i) The preparations should be carried out using (0.02 to 0.05 mole) of the starting material. ii) The yield, melting point and TLC of the recrystallized product should be recorded. Note: Student will not be allowed for practical examination if his/her record book is not completed and certified.	

Semester: II		
Course Name: Physical Chemistry Laboratory Course		Course Code: CHEL/MJ/556
Course Type: DSC-14		4 Hrs/ Week
Total contact Hours :60 Hrs	Lab. Work Credit: 2	Marks: 50
1.	Course Outcome :	
	On completion of this course, the students will be able:	
2.	To analyse sample by various instrumental techniques	
3.	To handling of electronic equipment	
4.	To understand laboratory skills, precaution, accuracy and precision.	
5.	To design experimental procedure for analysis important chemicals & samples	
6.	To understand the physical properties of chemicals	
7.	To distinguish accuracy of results in instrumental and non instrumental methods	
1.	Unit-I: Instrumental	
2.	Determination of dissociation constants of phosphoric acid potentiometrically.	
3.	Determination of dissociation constants of weak acid potentiometrically.	
4.	Determination of acidic and basic dissociation constants of an amino acid and its isoelectric point.	
5.	Determination of equilibrium quotient for the formation of monothiocynato iron (III) complex.	
6.	To study the kinetics of mutarotation of glucose/fructose polarographically.	
7.	Study of thermal analysis (TG/DTA/DSC) in atmosphere of evolved gases e.g decomposition of CaCO_3 , KClO_3 etc in environment of gases such as N_2 , O_2 , CO_2	
8.	Synthesis of various crystalline modifications of a hydrous transition metal oxide and their characterization by infra – red spectroscopy.	
9.	Investigating esterification reaction by using solid acid catalyst and study of the reaction kinetics by IR spectroscopy.	
10.	Study of kinetics of zeolite synthesis by infrared spectroscopy.	
11.	Identification of acidic and basic sites of a catalyst by in situ infrared spectroscopy.	
	Unit-II: Non-Instrumental	
1.	To study the adsorption of acetic acid from aqueous solution by activated charcoal and examine the validity of Freundlich and Langmuir's isotherm.	
2.	To construct the phase diagram for three component system (chloroform-acetic acid water).	
3.	To study auto catalysis reaction between potassium permanganate and oxalic acid.	

4.	Determine the rate constant of the reaction between potassium persulphate and potassium iodide having equal/unequal concentration of the reacting species.
5.	To study the variation of viscosity with the composition of mixtures (ethanol-water-HNO ₃ -chloroform) and to determine the formation of complex between two liquids.
Reference Books:	
1.	Systematic experimental physical chemistry – T. K. Chondhekar & S.W. Rajbhoj
2.	Experiments in chemistry – D.V. Jahagirdar

Semester : I		
Course Name: Analytical Chemistry-4		Course Code: CHETE-557
Course type : DSE-6		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes :		
11	To be able to define the factors that determine chemical shift	
12	To be able to locate chemical shift positions of ^1H attached to common functional groups.	
13	To be able to define the characteristic chemical shifts for different protons.	
14	To be able to predict the structure of a compound using NMR data/spectrum.	
15	To be able to predict the structure of a compound using UV-visible, IR, and NMR data/spectrum.	
16	To understand the principle, instrumentation and applications of mass spectrometry.	
17	To be able to define different ionization techniques in mass spectrometry.	
18	To understand the fragmentation processes in mass spectrometry.	
19	To be able to define the molecular formula from molecular ion peaks.	
20	To understand the principle, instrumentation and applications of atomic absorption spectroscopy, flame emission spectroscopy, electron spectroscopy for chemical analysis, Auger electron spectroscopy and ultraviolet photoelectron spectroscopy.	
Unit-I : Nuclear Magnetic Resonance Spectroscopy.		10Hrs
	Elementary ideas (Recapitulation), Factors affecting chemical shifts, Spin-Spin couplings and coupling constants (J), ^1H - ^1H vicinal coupling, ^1H - ^1H germinal coupling, Long range coupling, The magnitude of ^1H - ^1H coupling constants, Integration. Problems based on combined applications of UV, IR and NMR spectroscopy..	
Unit-II : Mass Spectrometry		10Hrs
	Sample flow in a mass spectrometer, Inlet sample system, Ionization methods, Mass analyzers, Ion-collection systems, Vacuum system, Data handling, Isotope-ratio spectrometry, Correlation of mass spectra with molecular structure, Applications of mass spectrometry, Quantitative analysis of mixtures, Fourier transform mass spectrometry.	
Unit-III : Elemental methods of analysis		10Hrs
	Flame emission spectroscopy: Principles, instrumentation, interferences, limitations, applications.	

	Atomic absorption spectroscopy: Introduction, principles, instrumentation, sources of EMR-hollow cathode lamps, temperature gradient lamps, cells, flames, furnaces, detectors, interferences, background corrections and use of AAS for qualitative and quantitative analysis. Electron Spectroscopy Photoelectron spectroscopy: Basic principles, ESCA- Introduction - ESCA - ESCA satellite peaks, spectral splitting, ESCA chemical shifts, Principle, instrumentation, applications, Auger electron spectroscopy, Ultraviolet photoelectron spectroscopy.	
References Books		
1.	Analytical Chemistry 6th Edition., Gary D. Christian	
2.	Fundamental of Analytical Chemistry 8th Ed ⁿ . Skoog, West Hollar, Crouch	
3.	Chemical Separations and Measurements, D.G. Peters, J.M. Hayes and G.M. Hieftie	
4.	Instrumental Method of Chemical Analysis, G.R. Chatwal & S. K. Anand	
5.	Introduction to instrumental analysis – Robert D. Braun	
6.	Inrumental methods of analysis – Willard, Merritt, Dean, Settle	
7.	Principle of instrumental analysis - Skoog, Holler, Nieman	
8.	Introduction to spectroscopy – Pavia, Lampman, Kriz, Vyvyan	
9.	Spectroscopic methods in organic chemistry – Dudley Williams, Ian Fleming	
10.	Spectrometric identification of organic compounds – Robert M. Silverstein, Francis X. Webster	
11.	Organic structure analysis – Phillip Crews, Jaime Rodriguez, Marcel Jaspars	
12.	Spectroscopy of organic compounds – P. S. Kalsi	

140

Semester : II		
Course Name: Inorganic Chemistry-4		Course Code : CHETE/SE/-558
Course type : DSC-9		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Learning outcomes: On completion of this course, the students will be able:		
1.	To describe the generation of spectroscopic term symbols , ground state term & total term symbols, significance of spin multiplicities.	
2.	To use of microstates for representation electron representations	
3.	To sketch term energy level diagram.	
4.	To understand the designation of spin multiplicities to ligand field excited states of high and low spin complex.	
5.	To interpret A,E, T symmetric label for electronic configurations.	
6.	To construct correlation diagram of various electronic configurations	
7.	To analyse and interpretation Orgel diagram and Tanabe Sugano diagram.	
8.	To interpret electronic spectra of transition metal complexes.	
9.	To calculate the D_q , B and β parameters of complex.	
10.	To understand the Lewis and Bronsted Concept of Acids and Bases.	
11.	To apply knowledge of VBT & VSEPR theory for prediction structure of molecules .	
Unit-I : Spectroscopic term symbols and ligand field excited states		10Hrs
	Spectroscopic terms symbols, Inter-electronics repulsion, Spin-orbit coupling, Ground state term, Microstates and its use, Rules for determination of total terms symbol of d^1 to d^5 configurations. Energy ordering of terms and their energy level diagram, Weak and stronger field approach, Calculation and labelling of spin multiplicities to ligand field excited states of low spin complex. Designation of A, E, T symmetric label to electronic configuration, Correlation diagram of d^1 , d^2 , d^8 and d^9 configuration in octahedral and tetrahedral environments, Non-crossing rule.	
Unit-II : Interpretation of electronic spectra of metal complexes		10Hrs
	Orgel diagram of d^1 to d^9 configuration/ metal complex in an octahedral and tetrahedral environment, Selection rule for electronic transitions, Tanabe Sugano diagram of d^2 and d^3 configurations. Measurement of the absorption spectra, Charge transfer transitions, Types of charge transfer	

	transitions, Examples of charge transfer spectra, Band intensities, Intensity of d-d and charge transfer bands. Interpretation of electronic spectra of transition metal complex, Konig's method for calculation of D_q , B and β parameters and numericals.	
Unit-III: Lewis and Bronsted Concept of Acids and Bases and Geometry of molecules		10Hrs
	Lewis and Bronsted Concept of Acids and Bases, examples of Lewis acid - Lewis base complex formation, Strong and weak acid, strength of acid factors affecting acid strength. Donor acceptor chemistry of NH_3 : BF_3 , BF_3 : $\text{O}(\text{C}_2\text{H}_5)_2$, Br_2 : CH_3OH adducts, HOMO -LUMO energy. Application of valence bond theory to identify structure of : H_2SO_4 , K_2CO_3 , HNO_3 , NH_4Cl , NaBH_4 , AlCl_3 , LiAlH_4 , SiCl_4 , SnCl_2 , SnCl_4 , H_3PO_2 , H_3PO_3 , H_3PO_4 , HClO_4 , K_2CrO_4 , $\text{K}_2\text{Cr}_2\text{O}_7$ and KMnO_4	
	References Books	
1.	Inorganic electronic spectroscopy - A.B.P. Lever.	
2.	Concise Inorganic Chemistry - J. D. Lee.	
3.	Principles of Inorganic chemistry, B.R. Puri, L. R. Sharma , K. C. Kalia	
4.	Symmetry and Spectroscopy of Molecules - K. Veera Reddy	
5.	Symmetry and Group theory in Chemistry , R Ameta	
6.	Inorganic Chemistry - G.Y.Miessler and D.A. Tarr	
7.	Inorganic Chemistry – Shriver & Atkins	
8.	Principle of Inorganic chemistry- Brian W. Pfennig .	

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Semester : II		
Course Name: Organic Chemistry-4		Course Code: CHETE/SE/-559
Course type : DSE-8		2 Hrs/ Week
Total contact hours : 30 hrs	Theory Credit: 2	Marks : 50
Course Objectives		
Student will be able to		
1	Understand aromatic electrophilic substitution reactions	
2	Acquire the knowledge of directing nature of functional groups	
3	Know directing nature of attacking electrophiles on various aromatics	
4	Understand requirement for aromatic nucleophilic substitution reactions	
5	Describe the basic concepts in molecular rearrangement	
6	Acquire the knowledge of migratory aptitude	
Unit-I :Aromatic Electrophilic Substitutions		10 Hrs
	The arenium ion mechanism, orientation and reactivity, energy profile diagram. Directing nature of various groups, Orientation of attacking electrophile on mono and di-substituted benzene, Five and six membered heterocycles, Electrophilic substitution on polycyclic aromatic hydrocarbons (Naphthalene, anthracene) The ortho/para ratio, IPSO substitution, orientation in other ring system, Recapitulation of halogenation, nitration, sulphonation and Friedel Craft's reaction (Alkylation and acylation), diazonium coupling	
Unit-II :Aromatic Nucleophilic Substitutions		10 Hrs
	. The S _N Ar, S _N 1, benzyne mechanism, Effect of substrate structure, leaving group and attacking nucleophile on reactivity, Chichibabin reaction (Pyridine, quinoline and isoquinoline)	
Unit-III : Rearrangements:		10 Hrs
	General mechanistic consideration, nature of migration, migratory aptitude, memory effect, pinacol-pinacolone, Benzil-Bezile acid, Beckmann, Hoffman and Fries rearrangements.	
References Books		
1	Advanced Organic Chemistry, IV Edition: J. March	
2	Advanced organic Chemistry, Part-A and Part-B: F. A. Carey, & R. J. Sundburg.	
3	A Guide Book to Mechanism in Organic Chemistry: Peter Sykes	
4	Synthetic Organic Chemistry: H. O. House	
5	Principles of Organic Synthesis: R. O. C. Norman	
6	Organic Chemistry: Clayden and Greeves	
7	Mechanism and Structure in Organic Chemistry: E. S. Gould	

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Semester: II		
Course Name: Physical Chemistry-4		Course Code: CHETE/SE/-560
Course Type: DSE-9		2 Hrs/ Week
Total Contact Hours: 30	Theory Credit: 2	Marks : 50
Course outcomes:		
1. To understand the basic concepts of phase rule		
2. To analyse and interpret phase diagrams for single and multicomponent systems.		
3. To understand the basic concept of crystallography.		
4. To understand the basic concepts of photochemistry, their different theories and possible applications.		
Unit-I: Phase Rule		10 Hrs
Recapitulation of phase rule and terms involved in it, one component system, two component systems (solid-solid, solid-liquid and liquid-liquid), reduced phase rule, three component systems, partially miscible three liquid systems : one partially miscible pair, two partially miscible pairs, three partially miscible pairs, systems composed of two solids and a liquid : crystallization of pure components only, formation of binary compounds, formation of ternary compounds, formation of solid solutions, partial miscibility of solid phases, numericals.		
Unit-II: Crystallography		10 Hrs
Classification of solids on the basis of shapes, and bonding, crystal lattice and unit cell, laws of crystallography crystal symmetry, symmetry elements, lattice planes and their designations, liquid crystals. Principle of crystal structure. close packing of atoms, packing of equal sized spheres in HCP, CCP, BCC structures. packing in ionic solids, atomic packing factor in crystal structures, ionic radius, radius ratio rule, (3, 4, 6, 8 coordinate structures). Octahedral and tetrahedral voids, isomorphism and polymorphism, numericals.		
Unit-III: Photochemistry		10 Hrs
Absorption of light and nature of absorption spectra, electronic transitions. Photo-dissociation and pre-dissociation. photo-oxidation, photo-reduction and photo-dimerization. photo-physical phenomenon. Jablonski diagram. photo-physical pathways of molecular deexcitation, difference between delayed fluorescence and phosphorescence, Stern-Volmer equation, deviations from Stern-Volmer equation, concentration dependence of quenching and excimer formation, quenching of fluorescence formation of excimer and exciplexes.		
Reference Books:		
1.	Principles of Physical Chemistry : Puri, Sharma, Pathania	
2.	Advanced Physical Chemistry : Gurdeep - Raj, Plenum.	
3.	Physical Chemistry : Maron and Prutton	
4.	Introduction to Molecular Photo-chemistry : C.H.J. Wells	

5.	Fundamentals of Photo-chemistry : Rohatgi-Mukherjee.
6.	Photo-chemistry : J.G. Calvert & J.N. Pitts.
7.	Photo-luminescence of solutions : C.A. Parker.
8.	Photo-chemistry : A. Singh and R. Singh
9.	Atkin's Physical Chemistry : Peter Atkins
10.	Solid State Chemistry : D.K. Chakraborti
11.	Solid State Chemistry and its applications : A.R. West.
12.	The Determination of Molecular Structure : P.J. Wheatley.
13.	Solid State Chemistry : N.B. Hannay.
14.	Principles of Solid State : H.V. Keer.
15.	Physical Chemistry : G.K. Vemulapalli.

141

Semester: II		
Course Name: Industrial Chemistry-2		Course Code: CHETE/SE/-561
Course Type: DSE-10		2 Hrs/ Week
Total Contact Hours: 30	Theory Credit: 2	Marks : 50
Course Objectives:		
1. To know mechanism of heat transfer in solids, heating and cooling mechanism.		
2. To know mass transfer and calculations based design of equipments		
3. To know the calculations and techniques involved in mixing of solids and preparing pastes		
Unit-I: Heat Transfer:		10 Hrs
Mechanism of study state heat transfer solids & cylinders, conductance through solids in series, convection, forced & natural convection; mechanism of boiling & condensation, radiations heat transfer & its applications, Unsteady heat transfer & simple cases with negligible internal resistance in cooling & heating Equation of energy exchange & heat transfer equipment like heat exchange condensers double pipe & shell & tube exchange condensers, double pipe & shell & tube exchanges, 1,2 and 2-4 pass exchangers.		
Unit II: Mass Transfer Principle		10 Hrs
Molecular diffusion in gases, liquids & solids Fick's law & diffusion coefficient of pure component & mixtures mass transfer across heterogeneous gas- liquid system mass transfer coefficient & overall mass transfer coefficient Principles of mass transfer in chemical reactions.		
Unit-III: Mixing of solids & pastes:		10 Hrs
Types of mixer for solid & pastes criteria of mixer effectiveness Mixing power viscous material & pastes types of non Newtonian fluids time-dependent fluids, Thixotropic fluids. Rheopectic fluids. Boundary layer flow & turbulence. 25% weight-age should be given to numerical problems.		
Reference Books:		
1.	Transport processes & Unit operations [C.J. Geankoplis]	
2.	Chemical Engineering [Coulson & Richardson]	
3.	Introduction to chemical engineering [Maccabe & Smith]	
4.	Introduction to chemical engineering [Badger & Banchero]	
5.	Unit operations-II [K.A. Garhane]. Chemical process industries [Shreve & Norris]	
6.	Chemical Engineers Handbook.[Robert Perry]	
Course Outcomes:		
Student will be able		

1. Understand the heat transfer mechanism and calculations based on heat transfer
2. Understand the mechanism and process of mass transfer
3. Understand preparing paste to be used in reactors

194

Semester : II		
Course Name: On the Job Training		Course Code:CHOJT-561
Course type :-		8 Hrs/ Week
Total contact hours :120 Hrs	Lab. Work Credit: 4	Marks :100
	Course outcomes: On completion of this course, the students will be able: Able to get on the job training	
1.		
2.		
3.		

Semester : II		
Course Name: Field Project		Course Code:CHFP-562
Course type :- --		8 Hrs/ Week
Total contact hours :120 Hrs	Lab. Work Credit: 4	Marks :100
Learning outcomes: On completion of this course, the students will be able: Get experiential learning while field work		
1.		
2.		
3.		
4.		


 21.8.23
 R.P. Marathe