CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK

B.Sc Chemistry

Those who have joined from the Academic year 2023-24 onwards

- Students will possess basic subject knowledge required for higher studies, professional andapplied courses
- Students will acquire basic Practical skills & Technical knowledge along with domain knowledge of different subjects in the science & humanities stream.
- Students will develop scientific aptitude Integrate skills of analysis, critiquing, application andcreativity.
- Students will employ appropriate digital tools and techniques necessary in analysing data andcreative design.
- Students will gain competence to pursue higher learning, research and careers or will be able toopt for entrepreneurship
- Students will interact meaningfully with others displaying leadership and coordination inexecuting projects.
- Students will demonstrate responsibility as citizens committed to national developmentthrough community outreach, wellness of self and a sustainable environment.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Students acquire in-depth knowledge of the fundamental concepts in all disciplines ofchemistry.

PSO2: Students can disseminate the basics of chemistry and advanced topics and analyticalskills in organic, inorganic and physical chemistry.

PSO3: Students will be able develop creativity in academics and research.

PSO4: Students will be able apply digital tools to collect, analyse and interpret data and presentscientific findings.

PSO5: gain competence to pursue higher education and career opportunities in chemistry andallied fields.

PSO6: exhibit leadership qualities to work individually and within a team in organizingcurricular, co-curricular and extracurricular activities.

PSO7: apply the concepts of chemistry to solve problems in the community, entrepreneurial andresearch pursuits.

PSO8: exhibit competence in educational, industrial and research pursuits that contributetowards the holistic development of self and community.

Credit Distribution for UG Programme in Chemistry

Sem I	Credit	Sem II	Credit	Sem III	Credit	Sem IV	Credit	Sem V	Credit	Sem VI	Credit	
1.1. Language	3	2.1. Language	3	3.1. Language	3	4.1. Language	3	5.1 Core Course – \CC IX	4	6.1 Core Course – CC XIII	4	
1.2 English	3	2.2 English	3	3.2 English	3	4.2 English	3	5.2 Core Course – CC X	4	6.2 Core Course – CC XIV	4	
1.3 Core Course – CC I	4	2.3 Core Course – CC III	4	3.3 Core Course – CC V	4	4.3 Core Course – CC VII Core Industry Module	4	5. 3.Core Course CC -XI	4	6.3 Core Course – CC XV	4	
1.4 Core Course – CC II	4	2.4 Core Course – CC IV	4	3.4 Core Course – CC VI	4	4.4 Core Course – CC VIII	4	5. 3.Core Course – / Project with viva-voce CC -XII	4	6.4 Elective -VII Generic/ Discipline Specific	3	
1.5 Elective I Generic/ Discipline Specific	3	2.5 Elective II Generic/ Discipline Specific	3	3.5 Elective III Generic/ Discipline Specific	3	4.5 Elective IV Generic/ Discipline Specific	3	5.4 Elective V Generic/ Discipline Specific	3	6.5 Elective VIII Generic/ Discipline Specific	3	
1.6 Skill Enhancement Course SEC-1 (NME)	2	2.6 Skill Enhancement Course SEC-2 (NME)	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	4.6 Skill Enhancement Course SEC-6	2	5.5 Elective VI Generic/ Discipline Specific	3	6.6 Extension Activity	1	
		2.7 Skill Enhancement Course –SEC-3	2	3.7 Skill Enhancement Course SEC-5	2	4.7 Skill Enhancement Course SEC-7	2	5.6 Value Education	2	6.7 Professional Competency Skill	2	
1.7Ability Enhancement Compulsory Course (AECC) Soft Skill-1	2	2.8 Ability Enhancement Compulsory Course (AECC) Soft Skill-2	2	3.7 Ability Enhancement Compulsory Course (AECC) Soft Skill-3	2	4.7 7Ability Enhancement Compulsory Course (AECC) Soft Skill-4	2	5.5 Summer Internship /Industrial Training	2			
1.8 Skill Enhancement - (Foundation Course)	2			3.8 E.V.S	-	4.8 E.V.S	2					
	23		**23**		**22**		**25**		**26**		**21**	
	Total Credit Points										**140**	

CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK

UG Chemistry

Semester I

Part	Courses	Subject	Code	Cr.	Hrs
I	Lang. – I	பொதுத்தமிழ் - **I**	230103101	3	6
II	Lang. - II	General English	231003101	3	4
III	CC – 1	General Chemistry I	232203101	5	5
	CC – 2	Quantitative Inorganic Estimation and Preparation - Lab	232203102	2	3
	EC – I [Any One]	Allied Mathematics – I / Animal Diversity	232003121/ 232303121	4	*6/4
			*6hr for Maths / 4hr for Zoology(I & II Semester		
	EC I Lab	Animal Diversity, Genetics, Cell Biology and Biochemistry Lab	-	-	2
IV	SEC –I(NME)	Food Chemistry	234603122	2	2
IV	FC	Basic Principles of Chemistry	234403122	2	2
	AECC - 1	Soft Skill - I	236003101	2	2
	Total			**23**	**30**
		SEMESTER II			
I	Lang. -I	பொதுத்தமிழ் - **II**	230103201	3	6
II	Lang. -II	General English	231003201	3	4
III	CC – 3	General Chemistry – II	232203201	5	5
	CC - 4	Qualitative Organic Analysis and Preparation of Organic Compounds - Lab	232203202	2	3
	EC – II Theory	Allie Mathematics – II / Genetics, Cell biology and Bio Chemistry	232003221/ 232303221	2	6/4
			*4 Cr for Maths / 2Cr for Zoology		
	EC – II Lab	Animal Diversity, Genetics, Cell Biology and Biochemistry Lab	232303222	2	2
IV	SEC –II (NME)	Dairy Chemistry	234603222	2	2
	SEC - III	Cosmetics and Personal Grooming	234403222	2	2
	AECC –II	Soft Skill - II	236003201	2	2
				23	**30**
		SEMESTER III			
I	Lang. -I	பொதுத்தமிழ் - **III**	230103301	3	6
II	Lang. -II	General English	231003301	3	4
III	CC – 5	General Chemistry III	232203301	5	5
	CC - 6	Qualitative Inorganic Analysis - Lab	232203302	2	3
	EC –3	Allied – Physics Paper	232103321	4	6
IV	SEC –IV	Entrepreneurial Skills in Chemistry	234403322	1	1
	SEC – V	Pesticide Chemistry	238203322	2	2
	AECC – III	Soft Skill -III	236003301	2	2
	EVS	Environmental Studies	234103301	1	1
				23	**30**

Part	Courses		Code	Cr.	Hrs
SEMESTER IV					
I	Lang. – I	பொதுத்தமிழ் - **IV**	230103101	3	6
II	Lang. - II	General English	231003101	3	4
III	CC – 7	General Chemistry - IV	232203401	4	4
	CC - 8	Physical Chemistry Practical - I	232203402	3	3
	EC – IV	Allied – Physics Paper	232103421	4	6
IV	SEC –VI	Instrumental Methods of Chemical Analysis	234403422	2	2
IV	SEC –VII	Forensic Science	238203422	2	2
	AECC- IV	Soft Skill – IV	236003401	2	2
	EVS	Environmental Studies	234103401	1	1
	Total			**24**	**30**
SEMESTER V					
III	CC – 9	Organic Chemistry – I	232203501	4	5
	CC - 10	Inorganic Chemistry – I	232203502	4	5
	CC - 11	Physical Chemistry - I	232203503	4	5
	Core 12	Project with Viva voce	232203504	4	5
	EC – V	Biochemistry	232203505	4	5
	EC – VI	Industrial Chemistry	232203506	3	4
IV		Value Education	234303501	1	1
		Internship/Industrial Training (carried out in II year summer vacation) 30 hrs	232203507	2	
				25	**30**
SEMESTER VI					
III	CC – 13	Organic Chemistry – II	232203601	4	5
	CC – 14	Inorganic Chemistry – II	232203602	3	4
	CC – 15 T	Physical Chemistry – II	232203603	4	5
	CC – 15 P	Physical Chemistry Practical – II	232203604	2	3
	EC –7	Fundamentals of Spectroscopy	232203605	3	4
	EC - 8	Nano Science	232203606	2	4
IV	Processional competency skill enhancement course		232203607	2	4
		Value Education	234303601	1	1
V		Extension Activity (outside college hrs)	232203608	1	
				22	**30**

ALLIED – CHEMISTRY FOR PHYSICS					
Sem	**Title of the Paper**	**SUB CODE**	**Hrs.**	**Cr.**	**Generic/Discipline Specifit**
III		232203321			EC 3 - Theory
III	Chemistry Practical for Physical and Biological Science	232203322			EC 3 - Practical
IV		232203421			EC 4 - Theory
IV	Chemistry Practical for Physical and Biological Chemistry	232203422			EC 4 - Practical

ALLIED – CHEMISTRY FOR ZOOLOGY					
Sem	**Title of the Paper**	**SUB CODE**	**Hrs.**	**Cr.**	**Generic/Discipline Specifit**
I	Chemistry for Biological Science I	232203121	4	3	EC 1 - Theory
I	Chemistry Practical for Physical and Biological Science	232203122	2	1	EC 1 - Practical
II	Chemistry for Biological Science – II	232203221	4	3	EC 2 - Theory
II	Chemistry Practical for Physical and Biological Science	232203222	2	1	EC 2 - Practical

Title of the Course		**General Chemistry - I**						
Part		**III**						
Category	Core 1	**Year**	I	**Credits**	5	**Course Code**	**232203101**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	1	--	5	25	75	100

Learning Objectives	
	various atomic models and atomic structure
	wave particle duality of matter
	periodic table, periodicity in properties and its application in explaining thechemical behaviour
	nature of chemical bonding, and
	fundamental concepts of organic chemistry

UNIT	**Details**	**No. of Periods for the Unit**
I	**Atomic structure and Periodic trends** History of atom (J.J.Thomson, Rutherford); Moseley's Experiment and Atomic number, Atomic Spectra; Black-Body Radiation and Planck's quantum theory - Bohr's model of atom;The Franck-Hertz Experiment; Interpretation of H- spectrum; Photoelectric effect, Compton effect; Dual nature of Matter- De- Broglie wavelength-Davisson and Germer experiment Heisenberg's Uncertainty Principle; Electronic Configuration of Atoms and ions- Hund's rule, Pauli'exclusion principle and Aufbau principle; Numerical problems involving the core concepts**.**	**15**
II	**Introduction to Quantum mechanics** Classical mechanics, Wave mechanical model of atom, distinction between a Bohr orbit and orbital; Postulates of quantum mechanics; probability interpretation of wavefunctions, Formulation of Schrodinger wave equation - Probability and electron density-visualizing the orbitals -Probability density and significance of Ψ and Ψ^2. **Modern Periodic Table** **Cause of periodicity**; Features of the periodic table; classification of elements - Periodic trends for atomic size- Atomic radii, Ionic, crystal and Covalent radii; ionization energy, electron affinity, electronegativity-electronegativity scales, applications of electronegativity. Problems involving the core concepts	**15**
III	**Ionic bond** Lewis dot structure of ionic compounds; properties of ionic compounds; Energy involved in ionic compounds; Born Haber cycle – lattice energies, Madelung constant; relative effect of lattice energy and solvation energy; Ion polarization – polarising power and polarizability; Fajans' rules - effects of polarisation on properties of compounds; problems involving the core concepts. **Covalent bond** Shapes of orbitals, overlap of orbitals – σ and Π bonds; directed valency - hybridization; VSEPR theory - shapes of molecules of the type AB_2, AB_3, AB_4, AB_5, AB_6 and AB_7 Partial ionic character of covalent bond-dipole moment, application to molecules of the type A_2, AB, AB_2, AB_3, AB_4; percentage ionic character-numerical problems based on calculation of percentage ionic character.	**15**
IV	**UNIT-IV: Structure and bonding - II** VB theory – application to hydrogen molecule; concept of resonance - resonance structures of some inorganic species – CO_2, NO_2, CO_3^{2-}, NO_3^- ; limitations of VBT; MO theory - bonding, antibonding and nonbonding orbitals, bond order; MO diagrams of H_2, C_2, O_2, O_2^+, O^{2-}, O^{2-}	**15**

	N_2, NO, HF, CO; magnetic characteristics, comparison of VB and MO theories. Coordinate bond: Definition, Formation of BF_3, NH_3, NH_4^+, H_3O^+ properties Metallic bond-electron sea model, VB model; Band theory-mechanism of conduction in solids; conductors, insulator, semiconductor – types, applicationsof semiconductors Weak Chemical Forces - Vander Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces; Hydrogen bonding – Types, special properties of water, ice, stability of DNA; Effects of chemical force, melting and boiling points.	
V	**UNIT-V:** **Basic concepts in Organic Chemistry and Electronic effects** Types of bond cleavage – heterolytic and homolytic; arrow pushing in organic reactions; reagents and substrates; types of reagents - electrophiles, nucleophiles, free radicals; reaction intermediates – carbanions, carbocations,carbenes, arynes and nitrynes. Inductive effect - reactivity of alkyl halides, acidity of halo acids, basicity of amines; inductomeric and electromeric effects. Resonance – resonance energy, conditions for resonance - acidity of phenols,basicity of aromatic amines, stability of carbonium ions, carbanions and freeradicals, reactivity of vinyl chloride, dipole moment of vinyl chloride andnitrobenzene, bond lengths; steric inhibition to resonance. Hyperconjugation - stability of alkenes, bond length, orienting effect of methylgroup, dipole moment of aldehydes and nitromethane Types of organic reactions- addition, substitution, elimination and rearrangements	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	**e**xplain the atomic structure
CO2	classify the elements in the periodic table
CO3	apply the theories of atomic structure
CO4	evaluate the relationship existing between electronic configuration
CO5	construct MO diagrams

Text Books (Latest Editions)	
1	Madan, R. D. and Sathya Prakash, *Modern Inorganic Chemistry*, 2nded.; S.Chand and Company: New Delhi, 2003.
2	Rao, C.N. R. University General Chemistry, Macmillan Publication: NewDelhi, 2000.
3	Puri, B. R. and Sharma, L. R. *Principles of Physical Chemistry*, 38thed.;Vishal Publishing Company: Jalandhar, 2002.
4	Bruce, P. Y. and PrasadK. J. R. *Essential Organic Chemistry*, PearsonEducation: New Delhi, 2008.
5	Dash UN, Dharmarha OP, Soni P.L. Textbook of Physical Chemistry, Sultan Chand & Sons: New Delhi,2016
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Maron, S. H. and Prutton C. P. *Principles of Physical Chemistry*,4thed.;The Macmillan Company: Newyork,1972.
2	Lee, J. D. *Concise Inorganic Chemistry*, 4th ed.; ELBS WilliamHeinemann: London,1991.
3	Gurudeep Raj, *Advanced Inorganic Chemistry*, 26thed.; Goel PublishingHouse: Meerut, 2001.
4	Atkins, P.W. & Paula, J. *Physical Chemistry*, 10th ed.; Oxford UniversityPress:New York, 2014.
5	Huheey, J. E. *Inorganic Chemistry: Principles of Structure and Reactivity*,4th ed .; Addison, Wesley Publishing Company: India,1993.

Web Resources	
1	https://onlinecourses.nptel.ac.in
2	http://www.mikeblaber.org/oldwine/chm1045/notes_m.htm
3	http://www.ias.ac.in/initiat/sci_ed/resources/chemistry/Inorganic.html
4	https://swayam.gov.in/course/64-atomic-structure-and-chemical-bonding
5	https://www.chemtube3d.com/

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**Quantitative Inorganic Estimation and Preparation - Lab**						
Part		**III**						
Category	Core – 2	**Year**	I	**Credits**	2	**Course Code**	**232203102**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		-	-	3	3	25	75	100

Learning Objectives

- laboratory safety
- handling glasswares
- Quantitative estimation
- preparation of inorganic compounds

UNIT	**Details**	**No. of Periods for the Unit**
I	**Chemical Laboratory Safety in Academic Institutions** Introduction - importance of safety education for students, common laboratory hazards, assessment and minimization of the risk of the hazards, prepare for emergencies from uncontrolled hazards; concept of MSDS; importance and care of PPE; proper use and operation of chemical hoods and ventilation system; fire extinguishers-types and uses of fire extinguishers, demonstration of operation; chemical waste and safe disposal. **Common Apparatus Used in Quantitative Estimation (Volumetric)** Description and use of burette, pipette, standard flask, measuring cylinder, conical flask, beaker, funnel, dropper, clamp, stand, wash bottle, watch glass, wire gauge and tripod stand. **Principle of Quantitative Estimation (Volumetric)** Equivalent weight of an acid, base, salt, reducing agent, oxidizing agent; concept of mole, molality, molarity, normality; primary and secondary standards, preparation of standard solutions; theories of acid-base, redox, complexometric, iodimetric and iodometric titrations**;** indicators – types, theory of acid–base, redox, metal ion and adsorption indicators, choice of indicators.	
II	**Quantitative Estimation(Volumetric)** Preparation of standard solution, dilution from stock solution **Permanganometry** Estimation of sodium oxalate using standard ferrous ammonium sulphate **Dichrometry** Estimation of ferric alum using standard dichromate (external indicator) Estimation of ferric alum using standard dichromate (internal indicator) **Iodometry** Estimation of copper in copper sulphate using standard dichromate **Argentimetry** Estimation of chloride in barium chloride using	
III	**Unit III** **Complexometry** Estimation of hardness of water using EDTA **Estimations** Estimation of iron in iron tabletsEstimation of ascorbic acid. **Preparation of Inorganic**	

	compounds-Potash alum Tetraammine copper (II) sulphateHexamminecobalt (III) chloride Mohr's Salt	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	explain the basic principles involved in titrimetric analysis and inorganic preparations.	
CO2	compare the methodologies of different titrimetric analysis.	
CO3	calculate the concentrations of unknown solutions in different ways and develop the skillto estimate the amount of a substance present in a given solution.	
CO4	assess the yield of different inorganic preparations and identify the end point of various titrations.	

Text Books (Latest Editions)	
	Venkateswaran, V.; Veeraswamy, R.; Kulandivelu, A.R. *Basic Principles ofPractical Chemistry*,2nd ed.; Sultan Chand &Sons: New Delhi, 1997.
	Nad, A. K.; Mahapatra, B.; Ghoshal, A.; *An advanced course in Practical Chemistry*, 3rd ed.; New Central Book Agency: Kolkata, 2007.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
	Mendham, J.; Denney, R. C.; Barnes, J. D.; Thomas, M.; Sivasankar, B.; *Vogel's Textbook of Quantitative Chemical Analysis*, 6th ed.; Pearson Education Ltd: New Delhi, 2000.
Web Resources	
	http://www.federica.unina.it/agraria/analytical-chemistry/volumetric- analysis
	https://chemdictionary.org/titration-indicator/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	12	12	12	12	12
Weightage	3.0	3.0	3.0	3.0	3.0
Weighted percentage of Course Contribution to Pos	3	3	3	3	3

Level of Correlation between PSO's and CO'

Title of the Course		**Food Chemistry**						
Part		**IV**						
Category	SEC – 1: NME	**Year**	I	**Credits**	2	**Course Code**	**234603122**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		2	-	--	2	25	75	100

Learning Objectives		
	• Types of food • Food adulteration and poisons • Food additives and preservation	
UNIT	**Details**	**No. of Periods for the Unit**
I	**Food Adulteration** Sources of food, types, advantages and disadvantages. Food adulteration - contamination of wheat, rice, milk, butter etc. with clay stones, water and toxic chemicals -Common adulterants, Ghee adulterants and their detection. Detection of adulterated foods by simple analytical techniques.	**6**
II	**Food Poison** Food poisons - natural poisons (alkaloids - nephrotoxin) - pesticides, (DDT, BHC, Malathion) -Chemical poisons - First aid for poison consumed victims.	**6**
III	**Food Additives** Food additives -artificial sweeteners – Saccharin - Cyclomate a n d Aspartate Food flavours -esters, aldehydes and heterocyclic compounds – Food colours – Emulsifying agents – preservatives -leavening agents. Baking powder – yeast – tastemakers – MSG - vinegar.	**6**
IV	**Beverages** Beverages-softdrinks-soda-fruitjuices-alcoholicbeverages-examples. Carbonation-addictionto alcohol– diseases ofliver andsocial problems.	**6**
V	**Edible Oils** Fats and oils - Sources of oils - production of refined vegetable oils - preservation.Saturated and unsaturated fats - iodine value - role of MUFA and PUFA in preventing heartdiseases-determination of iodine value,RM value,saponification values and their significance.	**6**

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	learn about Food adulteration - contamination of Wheat, Rice, Milk, Butter.	
CO2	get an awareness about food poisons like natural poisons (alkaloids - nephrotoxin)pesticides, DDT, BHC, Malathion	
CO3	get an exposure on food additives, artificial sweeteners, Saccharin, Cyclomate andAspartate in the food industries.	
CO4	acquire knowledge on beverages, soft drinks, soda, fruit juices and alcoholic beveragesexamples.	
CO5	study about fats and oils - Sources of oils - production of refined vegetable oils - preservation. Saturated and unsaturated fats –MUFA and PUFA	

Text Books (Latest Editions)	
	1. Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishing house,2010. 2. Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand& Co.Publishers, second edition, 2006. 3. Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishning house,2010. 4. Food Chemistry, Dr. L. Rakesh Sharma, Evincepub publishing, 2022. 5. Food processing and preservation, G. Subbulakshmi, Shobha A Udipi, Pdmini S Ghugre, New age international publishers, second edition, 2021.
References Books **(Latest editions, and the style as given below must be strictly adhered to)**	
	1. H.-D. Belitz, Werner Grosch, Food Chemistry Springer Science &Business Media, 4th Edition, 2009. 2. M.Swaminathan, Food Science and Experimental Foods, Ganesh and Company,1979. 3. Hasenhuettl, Gerard. L.; Hartel, Richard. W. Food Emulsifiers and their applications Springer New York 2nd ed. 2008. 4. Food Chemistry, H.-D. Belitz, W. Grosch, P. Schieberle, Springer, fourth revised and extended edition, 2009. 5. Principles of food chemistry, John M. deMan, John W. Finley, W. Jefferey Hurst, Chang Yong Lee, Springer, Fourth edition, 2018.

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

Title of the Course		**Basic Principles of Chemistry**						
Part		**IV**						
Category	FC	**Year**	I	**Credits**	2	**Course Code**	**234403122**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		2	-	--	2	25	75	100

Learning Objectives

- To acquire basic importance in Chemistry
- To understand the basic concepts of estimation of elements
- To gain a knowledge of Titrations, Indicators and Semimicro Qualitative Analysis

UNIT	**Details**	**No. of Periods for the Unit**
I	**Detection and Estimation of Elements:** Lassaigne's Test, Beilstein Test, Estimation of Nitrogen by Kjeldahl's Method, Halogens and Sulphur by Carius Method.	**6**
II	**Molecular Weight Determinations:** Silver Salt Method for Acids, Platinic Chloride Method for bases, Volumetric Method for Acids and Bases, Problem in Determining Empirical and Molecular Formula.	**6**
III	**Volumetric Analysis:** Basic Principles of Volumetric Analysis – Concentration Units – Molarity, Molality, Normality, Formality. Percentage solution. Standard Solution – Requirements of a Primary Standard Solution – Secondary standard solutions.	**6**
IV	**Types of Titrations:** Types of Titrations and Indicators - Neutralization, Redox, Precipitation and Complex Formation Reactions –Calculation of Oxidation Number- Choice of Indicators in Acid – Base Titrations – Phenolphthalein and Methyl orange.	**6**
V	**Semimicro Qualitative Analysis** Types of Reactions Involved in Qualitative Analysis (Definition only) – Dry Reactions – Precipitation Reaction – Complexation Reaction – RedoxReaction –Removal of Interfering Ions in the Analysis of Cations – Oxalate, Borate, Fluoride, Chromate and Phosphate.	**6**

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	learn about the detection and estimation of elements	
CO2	get knowledge on the molecular weight determination	
CO3	acquire information about the concept of volumetric analysis	
CO4	discuss about the the concept of types of titrations and indicators	
CO5	discuss the concept of semi micro qualitative analysis	

Text Books (Latest Editions)	
	1. Bahl S., and Arun Bahl, Advanced Organic Chemistry, S.Chand and Co., New Delhi, 1999. 2. Finar I.L., Organic Chemistry, Vol. II, 5th Edition, ELBS, England, 1975. 3. Soni P.L., Organic Chemistry, S.Chand and Co., New Delhi, 2007.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
	01. Bahl S., and Arun Bahl, Advanced Organic Chemistry, S.Chand and Co., New Delhi, 1999. 02. Bansal, A Text Book of Organic Chemistry, New Age International Publishers, New Delhi, 1999. 03. Finar I.L., Organic Chemistry, Vol. I and II, 5th Edition, ELBS, England, 1975. 04. Morrison R.T., and Boyd R.W., Organic Chemistry, 6th Edition, Prentice – Hall, 1995, New Delhi. 05. Singh and Mukherji, Reaction Mechanism in Organic Compounds, Mcmillan, India, 1998. 06. Soni P.L., Organic Chemistry, S.Chand and Co., New Delhi, 2007. 07. Pandey O.P., Bajpai D.N., and Giri S., Practical Chemistry, S.Chand and Company Limited, New Delhi, 2005. 08. Venkateswaran V., Veerasamy R., and Kulandaivelu A.R., Basic Principles of Practical Chemistry, Sultan Chand and Sons, New Delhi, 1993.
Web Resources	
	1) https://onlinecourses.nptel.ac.in 2) http://www.mikeblaber.org/oldwine/chm1045/notes_m.htm l 3) http://www.ias.ac.in/initiat/sci_ed/resources/chemistry/Inorganic.html 4) https://swayam.gov.in/course/64-atomic-structure-and-chemical-bonding 5) https://www.chemtube3d.com/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**General Chemistry - II**						
Part		**III**						
Category	Core – 3	**Year**	I	**Credits**	5	**Course Code**	**232203201**	
		Semester	II					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	1	--	5	25	75	100

Learning Objectives

- chemistry of acids, bases and ionic equilibrium
- properties of s and p-block elements
- chemistry of hydrocarbons
- applications of acids and bases
- compounds of main block elements and hydrocarbons

UNIT	**Details**	**No. of Periods for the Unit**
I	**Acids, bases and Ionic equilibria** Concepts of Acids and Bases - Arrhenius concept, Bronsted-Lowry concept, Lewis concept; Relative strengths of acids, bases and dissociation constant; dissociation of poly basic acids, ionic product of water, pH scale, pH of solutions; Degree of dissociation, common ion effect, factors affecting degree of dissociation; acid base indicators, theory of acid base indicators – action of phenolphthalein and methyl orange, titration curves - use of acid base indicators; Buffer solutions – types, mechanism of buffer action in acid and basic buffer, Henderson-Hasselbalch equation; Salt hydrolysis - salts of weak acids and strong bases, weak bases and strong acids, weak acids and weak bases - hydrolysis constant, degree of hydrolysis and relation between hydrolysis constant and degree of hydrolysis; Solubility product - determination and applications; numerical problems involving the core concepts**.**	**15**
II	**Chemistry of s - Block Elements** Hydrogen: Position of hydrogen in the periodic table. Alkali metals: Comparative study of the elements with respect to oxides, hydroxides, halides, carbonates and bicarbonates. Diagonal relationship of Li with Mg. Preparation, properties and uses of NaOH, Na_2CO_3, KBr, $KClO_3$ alkaline earth metals. Anomalous behaviour of Be. **Chemistry of p- Block Elements (Group 13 & 14)** preparation and structure of diborane and borazine. Chemistry of borax. Extraction of Al and its uses. Alloys of Al. comparison of carbon with silicon. Carbon-di-sulphide – Preparation, properties, structure and uses. Percarbonates, per monocarbonates and per dicarbonates.	**15**

III	**Chemistry of p- Block Elements (Group 15-18)** General characteristics of elementsof Group 15; chemistry of H_2N-NH_2, NH_2OH, HN_3 and HNO_3. Chemistry of PH_3, PCl_3, PCl_5, $POCl_3$, P_2O_5 and oxy acids of phosphorous (H_3PO_3 and H_3PO_4). General properties of elements of group16 - Structure and allotropy of elements - chemistry of ozone - Classification and properties of oxides - oxides of sulphur and selenium – Oxy acids of sulphur (Caro's and Marshall's acids). Chemistry of Halogens: General characteristics of halogen with reference to electro-negativity, electron affinity, oxidation states and oxidizing power. Peculiarities of fluorine. Halogen acids (HF, HCl, HBr and HI), oxides and oxy acids ($HClO_4$). Inter-halogen compounds (ICl, ClF_3, BrF_5 and IF_7), pseudo halogens [$(CN)_2$ and $(SCN)_2$] and basic nature of Iodine. Noble gases: Position in the periodic table. Preparation, properties and structure of XeF_2, XeF_4, XeF_6 and $XeOF_4$; uses of noble gases - clathratecompounds.	**15**
IV	Hydrocarbon Chemistry-I Petroproducts: Fractional distillation of petroleum; cracking, isomerisation, alkylation, reforming and uses Alkenes-Nomenclature, general methods of preparation – Mechanism of □- elimination reactions – E1 and E2 mechanism - factors influencing – stereochemistry – orientation – Hofmann and Saytzeff rules. Reactions of alkenes – addition reactions – mechanisms – Markownikoff's rule, Kharasch effect, oxidation reactions – hydroxylation, oxidative degradation, epoxidation, ozonolysis; polymerization. Alkadienes Nomenclature - classification – isolated, conjugated and cumulated dienes; stability of conjugated dienes; mechanism of electrophilic addition to conjugated dienes - 1, 2 and 1, 4 additions; free radical addition to conjugated dienes– Diels–Alder reactions – polymerisation – polybutadiene, polyisoprene (natural rubber), vulcanisation, polychloroprene. Alkynes Nomenclature; general methods of preparation, properties and reactions; acidic nature of terminal alkynes and acetylene, polymerisation and isomerisation. Cycloalkanes: Nomenclature, Relative stability of cycloalkanes, Bayer's strain theory and its limitations. Conformational analysis of cyclohexane, mono and di substituted cyclohexanes. Geometrical isomerism in cyclohexanes.	**15**

V	**UNIT-V** **Hydrocarbon Chemistry - II** **Benzene:** Source, structure of benzene, stability of benzene ring, molecularorbital picture of benzene, aromaticity, Huckel's (4n+2) rule and its applications. Electrophilic substitution reactions - General mechanism of aromatic electrophilic substitution - nitration, sulphonation, halogenation, Friedel-Craft's alkylation and acylation. Mono substituted and disubstituted benzene - Effect of substituent – orientation and reactivity. **Polynuclear Aromatic hydrocarbons**: Naphthalene – nomenclature, Haworth synthesis; physical properties, reactions – electrophilic substitution reaction, nitration, sulphonation, halogenation, Friedel – Crafts acylation & alkylation, preferential substitution at □ - position – reduction, oxidation – uses. Anthracene – synthesis by Elbs reaction, Diels – Alder reaction and Haworth synthesis; physical properties; reactions - Diels-Alder reaction, preferential substitution at C-9 and C-10; uses.	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	explain the concept of acids
CO2	discuss the periodic properties of sand p- block elements
CO3	classify hydrocarbons
CO4	explain theories of acids
CO5	assess the application of hard and soft acids indicators

Text Books (Latest Editions)

1. Madan R D, Sathya Prakash, (2003), Modern Inorganic Chemistry, 2nded, S.Chand and Company, New Delhi.
2. Sathya Prakash, Tuli G D,Basu S K and Madan R D, (2003), Advanced Inorganic Chemistry, 17th ed., S.Chand and Company, New Delhi.
3. Bahl B S, Arul Bhal, (2003), Advanced Organic Chemistry, 3rd ed., S.Chand and Company, New Delhi.
4. Tewari K S, Mehrothra S N and Vishnoi N K, (1998), Text book of Organic Chemistry, 2nd ed., Vikas Publishing House, New Delhi.
5. Puri B R, Sharma L R, (2002), Principles of Physical Chemistry,38th ed., Vishal Publishing Company, Jalandhar.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1. Maron S H and Prutton C P, (1972), Principles of Physical Chemistry, 4th ed., The Macmillan Company, Newyork.
2. Barrow G M, (1992), Physical Chemistry, 5th ed., Tata McGraw Hill, NewDelhi.
3. Lee J D, (1991), Concise Inorganic Chemistry, 4thed., ELBS WilliamHeinemann, London.
4. Huheey J E, (1993), Inorganic Chemistry: Principles of Structure andReactivity, 4th ed., Addison Wesley Publishing Company, India.
5. Gurudeep Raj, (2001), Advanced Inorganic Chemistry Vol – I, 26th ed.,Goel Publishing House, Meerut.
6. Agarwal O P, (1995), Reactions and Reagents in Organic Chemistry,8thed., Goel Publishing House,Meerut.

Web Resources
1. https://onlinecourses.nptel.ac.in 2. http://cactus.dixie.edu/smblack/chem1010/lec ture_notes/4B.html 3. http://www.auburn.edu/~deruija/pdareson.pdfhttps://swayam.gov.in/course/64 -atomic-structure-and-chemical-bonding **MOOC components** http://nptel.ac.in/courses/104101090/ Lecture 1: Classification of elements and periodic properties http://nptel.ac.in/courses/104101090/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**QUALITATIVE ORGANIC ANALYSIS AND PREPARATION OF ORGANIC COMPOUNDS - LAB**						
Part		**III**						
Category	Core 4	**Year**	I	**Credits**	2	**Course Code**	**232203202**	
		Semester	II					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		-	-	3	2	25	75	100

Learning Objectives

- laboratory safety
- handling glass wares
- analysis of organic compounds
- preparation of organic compounds

UNIT	**Details**	**No. of Periods for the Unit**
I	Safety rules, symbols and first-aid in chemistry laboratory Basic ideas about Bunsen burner, its operation and parts of the flame. Chemistry laboratory glassware –basis information and uses	
II	**Qualitative Organic Analysis** Preliminary examination, detection of special elements - nitrogen, sulphur andhalogens Aromatic and aliphatic nature, Test for saturation and unsaturation, identification of functional groups using solubility tests Confirmation of functional groups • monocarboxylic acid, dicarboxylic acid • monohydric phenol, polyhydric phenol • aldehyde, ketone, ester • carbohydrate (reducing and non-reducing sugars) • primary, secondary, tertiary amine • monoamide, diamide, thioamide • anilide, nitro compound Preparation of derivatives for functional groups	
III	**Preparation of Organic Compounds** i. Nitration - picric acid from Phenol ii. Halogenation - p-bromo acetanilide from acetanilide iii. Oxidation - benzoic acid from Benzaldehyde iv. Microwave assisted reactions in water: v. Methyl benzoate to Benzoic acid vi. Salicylic acid from Methyl Salicylate vii. Rearrangement - Benzil to Benzilic Acid Hydrolysis of benzamide to Benzoic Acid	
	1. Purificationof organic compounds by crystallization (from water / alcohol)and distillation 2. Determination of melting and boiling points of organic compounds. 3.**Steam distillation** - Extraction of essential oil from citrus fruits/eucalyptusleaves. **4. Chromatography (any one) (Group experiment)** (i) Separation of amino acids by Paper Chromatography (ii)Thin Layer Chromatography - mixture of sugars / plant pigments /permanganate dichromate. (iii) Column Chromatography - extraction of carotene, chlorophyll and xanthophyll from leaves / separation of anthracene - anthracene picrate.	

	5. **Electrophoresis –** Separation of amino acids and proteins. **(Demonstration)** Isolation of casein from milk/Determination of saponification value of oil orfat/Estimation of acetic acid from commercial vinegar. (Any one Group experiment) (4,5& 6–not for ESE)	

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	observe the physical state, odour, colour and solubility of the given organic compound.
CO2	identify the presence of special elements and functional group in an unknown organic compound performing a systematic analysis.
CO3	compare mono and dicarboxylic acids, primary, secondary and tertiary amines, mono and diamides, mono and polyhydric phenols, aldehyde and ketone, reducing and non- reducing sugars and explain the reactions behind it.
CO4	exhibit a solid derivative with respect to the identified functional group.
CO5	observe the physical state, odour, colour and solubility of the given organic compound.

References Books **(Latest editions, and the style as given below must be strictly adhered to)**	
	1. Venkateswaran, V.; Veeraswamy, R.; Kulandaivelu, A.R. *Basic Principlesof Practical Chemistry*, 2nd ed.; Sultan Chand: New Delhi, 2012. 2. Manna, A.K. *Practical Organic Chemistry*, Books and Allied: India,2018. 3. Gurtu, J. N; Kapoor, R. *Advanced Experimental Chemistry (Organic),*Sultan Chand: New Delhi, 1987. 4. Furniss,B. S.; Hannaford, A. J.; Smith, P. W. G.; Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry*, 5th ed.; Pearson: India,1989.
Web Resources	
	https://www.vlab.co.in/broad-area-chemical-sciences

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	S	S	S	S	S	S	M	S	M

3 – Strong, 2 – Medium , 1 - Low

CO-PO Mapping (Course Articulation Matrix)

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

Title of the Course	**DAIRY CHEMISTRY**						
PART	**IV**						
Category	SEC – II: NME	**Year**	I	**Credits**	2	**Course Code**	**234603222**
		Semester	II				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
	2	-	--	2	25	75	100

Prerequisites	Higher secondary chemistry
Objectives of the course	This course aims at providing an overall view of the • chemistry of milk and milk products • processing of milk • preservation and formation of milk products.
Course Outline	**UNIT I** **Composition of Milk** Milk-definition-general composition of milk- constituents of milk - lipids, proteins, carbohydrates, vitamins and minerals - physical properties of milk - colour, odour, acidity, specific gravity, viscosity and conductivity -Factors affecting the composition of milk - adulterants, preservatives with neutralizer-examples and their detection- estimation of fat, acidity and total solids in milk.
	Unit II **Processing of Milk** Microbiology of milk - destruction of micro - organisms in milk, physico – chemical changes taking place in milk due to processing - boiling, pasteurization – types of pasteurization -Bottle, Batch and HTST (High Temperature Short Time) – Vacuum pasteurization – Ultra High Temperature Pasteurization.
	UNIT III **Major Milk Products** Cream - definition - composition - chemistry of creaming process - gravitational and centrifugal methods of separation of cream - estimation of fatin cream. Butter - definition -composition - theory of churning – desi butter - salted butter, estimation of acidity and moisture content in butter. Ghee - major constituents - common adulterants added to ghee and their detection - rancidity- definition - prevention - antioxidants and synergists - natural and synthetic.
	UNIT IV **Special Milk** Standardised milk - definition - merits - reconstituted milk - definition - flow diagram of manufacture - Homogenised milk - flavoured milk – vitaminised milk - toned milk -Incitation milk - Vegetable toned milk - humanized milk – condensed milk-definition, composition and nutritive value.
	UNIT V **Fermented and other Milk Products** Fermented milk products – fermentation of milk - definition, conditions, cultured milk - definition of culture - example, conditions - cultured cream, butter milk - Bulgarious milk -acidophilous milk – Yoheer Indigeneous products- khoa and chhena definition - Ice cream -definition-percentagecomposition-types-ingredients-manufacture of ice–cream, stabilizers - emulsifiersandtheirrole-milkpowder-definition-needformakingmilkpowder- dryingprocess-types of drying.

Recommended Text	1. K. Bagavathi Sundari, Applied Chemistry, MJP Publishers, first edition,2006. 2. K. S. Rangappa and K.T. Acharya, Indian Dairy Products, Asia PublishingHouse New Delhi, 1974. 3.Text book of dairy chemistry, M.P. Mathur, D. Datta Roy, P. Dinakar, IndianCouncil of Agricultural Research, 1 st edition, 2008. 4. A Text book of dairy chemistry, Saurav Singh, Daya Publishing house, 1 stedition,2013. 5. Text book of dairy chemistry, P. L. Choudhary, Bio-Green book publishers,2021.
Reference Books	1. Robert Jenness and S. Patom, Principles of Dairy Chemistry, S.Wiley, NewYork, 2005. 2. F.P.Wond, Fundamentals of Dairy Chemistry,Springer,Singapore,2006. 3. Sukumar De, Outlines of Dairy Technology, Oxford University Press, NewDelhi, 1980. 4. P.F.Fox and P.L.H. Mcsweeney, Dairy Chemistry and Biochemistry, Springer, Second edition, 2016. 5. Dairy chemistry and biochemistry, P. F. Fox, T. Uniacke-Lowe, P.L.H. McSweeney, J.A. OMahony, Springer, Second edition, 2015.

Course Learning Outcomes (for Mapping with POs and PSOs) On completion of the course the students should be able to

CO 1: understand about general composition of milk – constituents and its physical properties.

CO 2: acquire knowledge about pasteurization of Milk and various types of pasteurization - Bottle, Batch and HTST Ultra High Temperature Pasteurization.

CO 3: learn about Cream and Butter their composition and how to estimate fat in cream and Ghee

CO 4: explain about Homogenized milk, flavoured milk, vitaminised milk and toned milk.

CO 5: have an idea about how to make milk powder and its drying process - types of drying process

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

CO-PO Mapping (Course Articulation Matrix)

CO /PO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

Title of the Course		**COSMETICS AND PERSONAL GROOMING**						
PART		**IV**						
Category	SEC – III	**Year**	I	**Credits**	2	**Course Code**	**234403222**	
		Semester	II					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		2	-	--	2	25	75	100

Prerequisites	Higher secondary Chemistry
Objectives ofthe course	This course aims at familiarizing the students with • formulations of various types of cosmetics and their significance • hair, skin and dental care • makeup preparations and personal grooming
Course Outline	**Uni I** **Skin care** Nutrition of the skin, skin care and cleansing of the skin; face powder – ingredients; creams and lotions – cleansing, moisturizing all purpose, shaving and sunscreen (formulation only); Gels – formulation and advantages; astringent and skin tonics – key ingredients, skin lightness, depilatories.
	Unit II **Hair care** Shampoos – types – powder, cream, liquid, gel – ingredients; conditioner –types – ingredients **Dental care** Tooth pastes – ingredients – mouth wash
	Unit III **Make up** Base – foundation – types – ingredients; lipstick, eyeliner, mascara, eye shadow, concealers, rouge
	Unit IV Perfumes Classification - Natural – plant origin – parts of the plant used, chief constituents; animal origin – amber gries from whale, civetone from civet cat, musk from musk deer; synthetic – classification emphasizing characteristics – esters – alcohols – aldehydes – ketones
	Unit V **Beauty treatments** Facials - types – advantages – disadvantages; face masks – types; bleach -types – advantages– disadvantages; shaping the brows; eyelash tinting; perming types; hair colouring and dyeing ; permanent waving – hair straightening; wax types – waxing; pedicure, manicure - advantages – disadvantages
Recommended Text	Thankamma Jacob, (1997) Foods, drugs and cometics – A consumer guide,Macmillan publication, London.
ReferenceBooks	1. Wilkinson J B E and Moore R J, (1997) Harry's cosmeticology, 7th ed.,Chemical Publishers, London. 2. George Howard, (1987) Principles and practiceof perfumes and cosmetics, Stanley Therones, Chettenham
Website ande-learning source	1. http://www.khake.com/page75.html 2. Net.foxsm/list/284

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

- **CO1:** know about the composition of various cosmetic products
- **CO2** understand chemical aspects and applications of hair care and dental care and skincare products.
- **CO3** understand chemical aspects and applications of perfumes and skin care products.
- **CO4** to understand the methods of beauty treatments their advantages and disadvantage
- **CO5** understand the hazards of cosmetic products.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

CO-PO Mapping (Course Articulation Matrix)

CO /PO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

Title of the Course		**CHEMISTRY FOR BIOLOGICAL SCIENCE I (For Zoology Major Students)**						
Part		**III**						
Category	EC – I Generic Elective	**Year**	I	**Credits**	3	**Course Code**	**232203121**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	-	--	4	25	75	100

Prerequisites	Higher seccondary chemistry
Objectives of the course	This course aims at providing knowledge on • basics of atomic orbitals, chemical bonds, hybridization and fundamentals of organic chemistry • nuclear chemistry and industrial chemistry • importance of speciality drugs and • separation and purification techniques.
Course Outline	**UNIT I** **Chemical Bonding and Nuclear Chemistry** Chemical Bonding: Molecular Orbital Theory-bonding, antibonding and non-bonding orbitals. M. O diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties. Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions- group displacement law. Nuclear binding energy - mass defect - calculations. Nuclear fission and nuclear fusion - differences – Stellar energy. Applications of radioisotopes – carbon dating, rock dating and medicinal applications.
	Unit II **Industrial Chemistry** Fuels: Fuel gases: Natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones: Synthesis, properties and uses of silicones. Fertilizers: Urea, ammonium sulphate, potassium nitrate NPK fertilizer, superphosphate, triple superphosphate.
	UNIT III **Fundamental Concepts in Organic Chemistry** Hybridization: Orbital overlap hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6. Polar effects: Inductive effect and consequences on Ka and K_b of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric-examples and explanation. Reaction mechanisms: Types of reactions- aromaticity-aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation. Heterocyclic compounds: Preparation, properties of pyrrole and pyridine.

	UNIT IV **Drugs and Speciality Chemicals** Definition, structure and uses: Antibiotics viz., Penicillin, Chloramphenicol and streptomycin; Anaestetics viz., Chloroform and ether; Antipyretics viz., aspirin, paracetamol and ibuprofen; Artificial Sweeteners viz., saccharin, Aspartame and cyclamate; Organic Halogen compounds viz., Freon, Teflon.
	UNIT V: **Analytical Chemistry** Introduction qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques: extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/ JAM /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
RecommendedText	1. V.Veeraiyan, Textbook of Ancillary Chemistry; High mountpublishing house, Chennai, first edition,2009. 2. S.Vaithyanathan, Text book of Ancillary Chemistry; PriyaPublications, Karur,2006. 3. ArunBahl, B.S.Bahl, Advanced Organic Chemistry; S.Chandand Company, New Delhi, twenty third edition,2012. 4. P.L.Soni, H.M.Chawla, Text Book of Inorganic Chemistry;Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.

Reference Books	1. P.L.Soni, Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition, 2007. 2. B.K,Sharma, Industrial Chemistry; GOEL publishing house,Meerut, sixteenth edition, 2014. 3. Jayashree gosh, Fundamental Concepts of Applied Chemistry; Sultan & Chand, Edition 2006.

Course Learning Outcomes (for Mapping with POs and PSOs)On completion of the course the students should be able to

CO1: state the theories of chemical bonding, nuclear reactions and its applications.

CO 2: evaluate the efficiencies and uses of various fuels and fertilizers.

CO 3: explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.

CO 4: demonstrate the structure and uses of antibiotics, anaesthetics, antipyretics and artificial sugars.

CO 5: analyse various methods to identify an appropriate method for the separation of chemical components.

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PO's and CO's

CO /PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution toPSOs	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

Title of the Course	**CHEMISTRY PRACTICAL FOR PHYSICAL AND BIOLOGICAL SCIENCE (for Zoology Students – I Year / I Semester ; for Physics Students – II Year / III Semester)**
Part	**III**

Category	EC –I	**Year**	I /II	**Credits**	1	**Course Code**	**232203122**
		Semester	I/III				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
	-	-	2	2	25	75	100

Prerequisites	
Objectives of the course	This course aims to provide knowledge on the • basics of preparation of solutions. • principles and practical experience of volumetric analysis
Course Outline	**VOLUMETRIC ANALYSIS** 1. Estimation of sodium hydroxide using standard sodium carbonate. 2. Estimation of hydrochloric acid using standard oxalic acid. 3. Estimation of ferrous sulphate using standard Mohr's salt. 4. Estimation of oxalic acid using standard ferrous sulphate. 5. Estimation of potassium permanganate using standardsodium hydroxide. 6. Estimation of magnesium using EDTA. 7. Estimation of ferrous ion using diphenyl amine as indicator.
Reference Books	V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic Principlesof Practical Chemistry; Sultan Chand & sons, Second edition, 1997.

Course Learning Outcomes (for Mapping with POs and PSOs)
On completion of the course the students should be able to
CO 1: gain an understanding of the use of standard flask and volumetric pipettes, burette.
CO 2: design, carry out, record and interpret the results of volumetric titration.
CO 3: apply their skill in the analysis of water/hardness.
CO4: analyze the chemical constituents in allied chemical products

CO /PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution to PSOs	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">CHEMISTRY FOR BIOLOGICAL SCIENCE II
(for Zoology Major Student – I year / II Semester)</td></tr>
<tr><td colspan="2"></td><td colspan="7"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC II</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">232203221</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td>Total</td><td>CIA</td><td>External</td><td>Total</td></tr>
<tr><td>4</td><td>-</td><td>--</td><td>4</td><td>25</td><td>75</td><td>100</td></tr>
<tr><td colspan="2">Prerequisites</td><td colspan="7">Chemistry for Biological Sciences I</td></tr>
<tr><td colspan="2">Objectives of the course</td><td colspan="7">This course aims to provide knowledge on
• nomenclature of coordination compounds and carbohydrates.
• Amino Acids and Essential elements of biosystem
• understand the concepts of kinetics and catalysis
• provide fundamentals of electrochemistry and photochemistry</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="7">UNIT I
Co-ordination Chemistry and Water Technology
Co-ordination Chemistry: Definition of terms - IUPAC Nomenclature - Werner’stheory - EAN rule - Pauling’s theory – Postulates - Applications to [Ni(CO)4], $[Ni(CN)4]^{2-}$,$[Co(CN)6]^{3-}$ Chelation - Biological role of Hemoglobin and Chlorophyll (elementary idea) - Applications in qualitative and quantitative analysis.
Water Technology: Hardness of water, determination of hardness of water using EDTA method, zeolite method-Purification techniques –BOD and COD.</td></tr>
<tr><td colspan="7">Unit II Carbohydrates
Classification, preparation and properties of glucose and fructose. Discussion of open chain ring structures of glucose and fructose. Glucose-fructose interconversion. Preparation and properties of sucrose, starch and cellulose.</td></tr>
<tr><td colspan="7">UNIT III
Amino Acids and Essential elements of biosystem
Classification - preparation and properties of alanine,preparation of dipeptides using Bergmann method - Proteins- classification – structure - Colour reactions – Biological functions – nucleosides -nucleotides – RNA and DNA – structure. Essentials of trace metals in biological system-Na, Cu, K, Zn, Fe, Mg.</td></tr>
<tr><td colspan="7">UNIT IV
Electrochemistry
Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials -electrochemical series. Strong and weak electrolytes - ionic product of water -pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method – buffer solutions and its biological applications - electroplating - Nickel and chrome plating – Types of cells -fuel cells-corrosion and its prevention.</td></tr>
<tr><td colspan="7">UNIT V
Photochemistry
Grothus - Drapper’s law and Stark-Einstein’s law of photochemical equivalence, Quantum yield - Hydrogen -chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be includedin the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/ JAM /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. V.Veeraiyan, Textbook of Ancillary Chemistry; High mountpublishing house, Chennai, first edition, 2009. 2. S.Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006. 3. Arun Bahl, B.S.Bahl, Advanced Organic Chemistry; S.Chandand Company, New Delhi, twenty third edition, 2012. 4. P.L.Soni, H.M.Chawla, Text Book of Organic Chemistry; SultanChand & sons, New Delhi, twenty ninth edition, 2007.
Reference Books	1. Arun Bahl, B.S.Bahl, Advanced Organic Chemistry; S.Chandand Company, New Delhi, twenty third edition, 2012. 2. P.L.Soni, H.M.Chawla, Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007. 3. P.L.Soni, Mohan Katyal, Text book of Inorganic chemistry;
	Sultan Chand and Company, New Delhi, twentieth edition, 2007. 4. B.R.Puri, L.R.Sharma, M.S.Pathania, Text book Physical Chemistry; Vishal Publishing Co., New Delhi, forty seventh edition, 2018. 5. B.K,Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.

Course Learning Outcomes (for Mapping with POs and PSOs)On completion of the course the students should be able to

CO 1: write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology.

CO 2: explain the preparation and property of carbohydrate.

CO 3: enlighten the biological role of transition metals, amino acids and nucleic acids.

CO 4: apply/demonstrate the electrochemistry principles in corrosion, electroplating andfuel cells.

CO 5: outline the various type of photochemical process.

CO /PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage ofCourse Contribution to PSOs	3.0	3.0	3.0	3.0	3.0

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">CHEMISTRY PRACTICAL FOR PHYSICAL AND BIOLOGICAL SCIENCE
(for Zoology Students – I Year / I Semester ;
for Physics Students – II Year / III Semester)</td></tr>
<tr><td colspan="2">Part</td><td colspan="8">III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC – II(Generic Elective)</td><td>Year</td><td>I/II</td><td rowspan="2">Credits</td><td rowspan="2">1</td><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">232203222</td></tr>
<tr><td>Semester</td><td>II/IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td>Total</td><td>CIA</td><td>External</td><td>Total</td></tr>
<tr><td>-</td><td>-</td><td>2</td><td>2</td><td>25</td><td>75</td><td>100</td></tr>
<tr><td colspan="2">Objectives of the course</td><td colspan="8">This course aims to provide knowledge on
• identification of organic functional groups
• different types of organic compounds with respect to theirproperties.
• determination of elements in organic compounds.</td></tr>
<tr><td colspan="2"></td><td colspan="8">SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS

The analysis must be carried out as follows:</td></tr>
<tr><td colspan="2"></td><td colspan="8">(a) Functional group tests [phenol, acids (mono & di) aromatic primary amine, amides (mono & di), aldehydeand glucose].
(b) Detection of elements (N, S, Halogens).
(c) To distinguish between aliphatic and aromatic compounds.
(d) To distinguish – Saturated and unsaturated compounds.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="8">V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic PrinciplesofPractical Chemistry; Sultan Chand & sons, Second edition, 1997.</td></tr>
<tr><td colspan="10">Course Learning Outcomes (for Mapping with POs and PSOs)On completion of the course the students should be able to
CO 1: gain an understanding of the use of standard flask and volumetric pipettes, burette.
CO 2: design, carry out, record and interpret the results of volumetric titration.
CO 3: apply their skill in the analysis of water/hardness.
CO4: analyze the chemical constituents in allied chemical products</td></tr>
</table>

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution to PSOs	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PO's and CO's

CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK	
Programme	**M.Sc.**
Programme Code	22
Duration	**2 years for PG**
Programme Outcomes (Pos)	**PO1: Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. **PO2: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3: Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6: Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society** Succeed in career endeavors and contribute significantly to society. **PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective. **PO 10: Moral and ethical awareness/reasoning** Ability to embrace moral/ethical values in conducting one's life.
Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. **PSO3 – Research and Development** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaborating

	with stakeholders for mutual benefit.

CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK

PG Chemistry

Semester I

Part		Course	Code	Cr.	Hrs
A	CC – 1	Organic Reaction Mechanism – I	232204101	4	5
	CC – 2	Structure and Bonding in Inorganic Compounds	232204102	4	5
	CC – 3	Organic Chemistry Practical	232204103	4	5
	EC –I (Generic/DS)	Pharmaceutical Chemistry	232204104	3	5
		Nano Materials and Nano Technology	232204105		
	Elective - II	Electro Chemistry	232204106	3	5
		Molecular Spectroscopy	232204107		
B	SEC I	Preparation of Consumer products Lab	232204108	2	3
	AECC 1 – Soft Skill	Chemistry in Consumer Products	232204109	2	2
	Total			**22**	**30**
SEMESTER II					
A	CC – 4	Organic Reaction Mechanism II	232204201	4	5
	CC – 5	Physical Chemistry – I	232204202	4	5
	CC – 6	Inorganic Chemistry Practicals	232204203	4	5
	EC – III	Medicinal Chemistry	232204204	3	5
		Green Chemistry	232204205		
	EC - IV	Bio Inorganic Chemistry	232204206	3	5
		Material Science	232204207		
B	SEC – II	Drugs and Cosmetics	232204208	2	3
	AECC 2	Food Preservation	232204209	2	2
				22	**30**
SEMESTER III					
A	CC – 7	Organic Synthesis and Photochemistry	232204301	4	5
	CC – 8	Coordination Chemistry – I	232204302	4	5
	CC – 9	Physical Chemistry Practical	232204303	4	5
	EC - V	Pharmacognosy and Phytochemistry	232204304	3	5
		Biomolecules and Heterocyclic compounds	232204305		
	Core	Core Industry Module	232204306	3	4
B	SEC – III	Professional Communication Skill (Term Paper & Seminar Presentation)	232204307	2	4
	AECC – 3	Research Tools and Techniques in Chemistry	232204308	2	2
	Internship	**Internship / Industrial Activity**	232204309	2	-
				24	**30**
SEMESTER IV					
A	CC – 10	Coordination Chemistry - II	232204401	4	5
	CC – 11	Physical Chemistry – II	232204402	4	5
	CC - 12	Analytical Instrumentation Technique Practicals	232204403	4	5
	CC – 13	Project with Viva Voce	232204404	3	4
B		Professional Competency Skill enhancement course	232204405	2	4
	AECC – 4	Soft Skill – Computational Skill Chemical Conservation	232204406	2	2

C	EA	Extension Activity	232204407	1	
	Total			**24**	**30**

Title of the Course		**ORGANIC REACTION MECHANISM - I**						
Category	Core - 1	**Year**	I	**Credits**	4	**Course Code**	**232204101**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	1	--	5	25	75	100

Learning Objectives

- ✍ To understand the feasibility and the mechanism of various organic reactions.
- ✍ To comprehend the techniques in the determination of reaction mechanisms.
- ✍ To understand the concept of stereochemistry involved in organic compounds.
- ✍ To correlate and appreciate the differences involved in the various types of organic reaction mechanisms.
- ✍ To design feasible synthetic routes for the preparation of organic compounds.

UNIT	Details	No. of Periods for the Unit
I	**UNIT-I: Methods of Determination of Reaction Mechanism:** Reaction intermediates, The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate. Methods of determining mechanism: non-kinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism. Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants.	**15**
II	**UNIT-II: Aromatic and Aliphatic Electrophilic Substitution:** Aromaticity: Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds and annulenes. Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions. Aliphatic electrophilic substitution Mechanisms: SE2 and SEi, SE1- Mechanism and evidences.	**15**
III	*UNIT-III: Aromatic and Aliphatic Nucleophilic Substitution: Aromatic nucleophilic substitution: Mechanisms - S_NAr, S_N1 and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attacking nucleophile. Reactions: Oxygen and Sulphur-nucleophiles, Bucherer and Rosenmund reactions, von Richter, Sommelet- Hauser and Smiles rearrangements. S_N1, ion pair, S_N2 mechanisms and evidences. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon.S_N1, S_N2, S_Ni, and S_E1 mechanism and evidences, Swain- Scott, Grunwald-Winstein relationship - Ambident nucleophiles.*	**15**

IV	**UNIT-IV: Stereochemistry-I:** Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers. Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shape, methods of determining theconfiguration. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation. D, L system, Cram's and Prelog's rules: R, S-notations, proR, proS, side phase and re phase Cahn-Ingold-Prelog rules, absolute and relative configurations. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds, exo-cyclic alkylidene-cycloalkanes. Topicity and prostereoisomerism, chiral shift reagents and chiral solvating reagents. Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, destruction. Stereoselective and stereospecific synthesis.	**15**
V	**UNIT-V: Stereochemistry-II:** Conformation and reactivity of acyclic systems, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium - Curtin-Hammett Principle. Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule. Optical rotation and optical rotatory dispersion, conformational asymmetry, ORD curves, octant rule, configuration and conformation, Cotton effect, axial haloketone rule and determination of configuration.	**15**

Course Outcomes

Course Outcomes	On completion of this course, students will;
CO1	To recall the basic principles of organic chemistry.
CO2	To understand the formation and detection of reaction intermediates of organic reactions.
CO3	To predict the reaction mechanism of organic reactions and stereochemistry of organic compounds.
CO4	To apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions.
CO5	To design and synthesize new organic compounds by correlating the stereochemistry of organic compounds.

Text Books (Latest Editions)

1. J. March and M. Smith, Advanced Organic Chemistry, 5th edition, John-Wiley and Sons.2001.
2. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959.
3. P.S.Kalsi, Stereochemistry of carbon compounds, 8th edition, New Age International Publishers, 2015.
4. P. Y. Bruice, Organic Chemistry, 7th edn, Prentice Hall, 2013.
5. J.Clayden, N. Greeves, S. Warren, Organic Compounds, 2nd edition, Oxford University Press, 2014.

References Books **(Latest editions, and the style as given below must be strictly adhered to)**
1. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th edition, Kluwer Academic / Plenum Publishers, 2007. 2. D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001. 3. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987. 4. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000. 5. I. L. Finar, Organic chemistry, Vol-1 & 2, 6th edition, Pearson Education Asia, 2004.
Web Resources
01. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic 02. https://www.organic-chemistry.org/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**STRUCTURE AND BONDING IN INORGANIC COMPOUNDS**						
Category	Core – 2	**Year**	I	**Credits**	4	**Course Code**	**232204102**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	1	--	5	25	75	100

Learning Objectives

- ✍ To determine the structural properties of main group compounds and clusters.
- ✍ To gain fundamental knowledge on the structural aspects of ionic crystals.
- ✍ To familiarize various diffraction and microscopic techniques.
- ✍ To study the effect of point defects and line defects in ionic crystals.
- ✍ To evaluate the structural aspects of solids.

UNIT	**Details**	**No. of Periods for the Unit**
I	**UNIT-I: Structure of main group compounds and clusters:** VB theory – Effect of lone pair and electronegativity of atoms (Bent's rule) on the geometry of the molecules; Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates. Structure of silicones, Structural and bonding features of B-N, S-N and P-N compounds; Poly acids – types, examples and structures; Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes; Wade's rule to predict the structure of borane cluster; main group clusters –zintl ions and mno rule.	**15**
II	**UNIT-II: Solid state chemistry – I:** Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Crystal systems and Bravis lattices, Symmetry operations in crystals, glide planes and screw axis; point group and space group; Solid state energetics: Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant.	**15**
III	**UNIT-III: Solid state chemistry – II:** Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels -normal and inverse types and perovskite structures. Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.	**15**
IV	**UNIT-IV: Techniques in solid state chemistry:** X-ray diffraction technique: Bragg's law, Powder diffraction method – Principle and Instrumentation; Interpretation of XRD data – JCPDS files, Phase purity, Scherrer formula, lattice constants calculation; Systematic absence of reflections; Electron diffraction technique – principle, instrumentation and application. Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM.	**15**
V	**UNIT-V: Band theory and defects in solids** Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors; Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser	**15**

	and phosphors; Linear defects and its effects due to dislocations.	

Course Outcomes	
Course Outcomes	On completion of this course, Students will be able
CO1	Predict the geometry of main group compounds and clusters.
CO2	Explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of cations.
CO3	Understand the various types of ionic crystal systems and analyze their structural features.
CO4	Explain the crystal growth methods.
CO5	To understand the principles of diffraction techniques and microscopic techniques.

Text Books (Latest Editions)

01. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014.
02. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.
03. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.
04. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunders company: Philadelphia, 1977.
05. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: NewYork, 1983.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994.
2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013.
3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199.
4. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982.
5. D. F. Shriver, P. W. Atkins and C.H. Langford; Inorganic Chemistry; 3rd ed.; Oxford University Press: London, 2001.

Web Resources

01.https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15

Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**ORGANIC CHEMISTRY PRACTICAL**						
Category	Core - 3	**Year**	I	**Credits**	4	**Course Code**	**232204103**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		-	1	4	5	25	75	100

Learning Objectives

- ✍ To understand the concept of separation, qualitative analysis and preparation of organic compounds.
- ✍ To develop analytical skill in the handling of chemical reagents for separation of binary and ternary organic mixtures.
- ✍ To analyze the separated organic components systematically and derivatize them suitably.
- ✍ To construct suitable experimental setup for the organic preparations involving two stages.
- ✍ To experiment different purification and drying techniques for the compound processing.

UNIT	Details	No. of Periods for the Unit
I	**Separation and analysis:** A. Two component mixtures. B. Three component mixtures.	
II	*Estimations:* a) Estimation of Phenol (bromination) b) Estimation of Aniline (bromination) c) Estimation of Ethyl methyl ketone (iodimetry) d) Estimation of Glucose (redox) e) Estimation of Ascorbic acid (iodimetry) f) Estimation of Aromatic nitro groups (reduction) g) Estimation of Glycine (acidimetry) h) Estimation of Formalin (iodimetry) i) Estimation of Acetyl group in ester (alkalimetry) j) Estimation of Hydroxyl group (acetylation) k) Estimation of Amino group (acetylation)	
III	**Two stage preparations:** a) *p*-Bromoacetanilide from aniline b) *p*-Nitroaniline from acetanilide c) 1,3,5-Tribromobenzene from aniline d) Acetyl salicyclic acid from methyl salicylate e) Benzilic acid from benzoin f) *m*-Nitroaniline from nitrobenzene g) *m*-Nitrobenzoic acid from methyl benzoate	

Course Outcomes

Course Outcomes	On completion of this course, students will;
CO1	To recall the basic principles of organic separation, qualitative analysis and preparation.
CO2	To explain the method of separation and analysis of separated organic mixtures and convert them as derivatives by suitable preparation method.
CO3	To determine the characteristics of separation of organic compounds by various

	chemical reactions.
CO4	To develop strategies to separate, analyze and prepare organic compounds.
CO5	To formulate a method of separation, analysis of organic mixtures and design suitable procedure for organic preparations.

Text Books (Latest Editions)
1. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014. 2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001. 3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.
References Books **(Latest editions, and the style as given below must be strictly adhered to)**
1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994. 2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013. 3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199.
Web Resources
01. https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**PHARMACEUTICAL CHEMISTRY**						
Category	EC – I	**Year**	I	**Credits**	3	**Course Code**	**232204104**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	1	--	5	25	75	100

Learning Objectives

- ✍ To understand the advanced concepts of pharmaceutical chemistry.
- ✍ To recall the principle and biological functions of various drugs.
- ✍ To train the students to know the importance as well the consequences of various drugs.
- ✍ To have knowledge on the various analysis and techniques.
- ✍ To familiarize on the drug dosage and its structural activities

UNIT	Details	No. of Periods for the Unit
I	**UNIT-I: Physical properties in Pharmaceuticals:** Physical properties of drug molecule: physical properties. Refractive index- Definition, explanation, formula, importance, determination, specific & molar refraction. Optical activity\rotation- monochromatic & polychromatic light, optical activity, angle of rotation, specific rotation examples, measurement of optical activity. Dielectric constant & Induced Polarization- Dielectric constant explanation & determination. Rheology of pharmaceutical systems: Introduction, Definition, Applications, concept of viscosity, Newton's law of flow, Kinematic, Relative, Specific, Reduced & Intrinsic viscosity. Newtonian system, non-Newtonian system- Plastic flow, Pseudoplastic flow, Dilatent flow. Viscosity measurements- selection of viscometer for Newtonian and non-Newtonian system.	**15**
II	**UNIT-II: Isotopic Dilution analysis:** principle and applications, Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning. Introduction to radiopharmaceuticals. Properties of various types of radiopharmaceuticals, Radiopharmaceuticals as diagnostics, as therapeutics, for research and sterilization. Physico Chemical Properties and drug action. Physico chemical properties of drugs (a) Partition coefficient, (b) solubility (c) surface activity, (d) degree of ionization.	**15**
III	**UNIT-III: Drug dosage and product development:** Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms. Drug dosage and product development. Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms.	**15**
IV	**UNIT-IV: Development of new drugs:** Introduction, procedure followed in drug design, the research for lead compounds, molecular modification of lead compounds. Structure-Activity Relationship (SAR): Factors effecting bioactivity, resonance, inductive effect, isoterism, bioisosterism, spatial considerations, biological properties of simple functional groups, theories of drug activity, occupancy theory, rate theory, induced-fit theory,4.3 Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions, the additivity of group contributions, physico-chemical parameters, lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator-variables.	**15**

V	**UNIT-V: Computers in Pharmaceutical Chemistry:** Need of computers for chemistry. Computers for Analytical Chemists-Introduction to computers: Organization of computers, CPU, Computer memory, I/O devices, information storage, software components. Application of computers in chemistry: Programming in high level language (C+) to handle various numerical methods in chemistry – least square fit, solution to simultaneous equations, interpolation, extrapolation, data smoothing, numerical differentiation and integrations.	**15**

Course Outcomes

Course Outcomes	On completion of this course, students will be able
CO1	To identify the suitable drugs for various diseases.
CO2	To apply the principles of various drug action and drug design.
CO3	To acquire the knowledge on product development based on SAR.
CO4	To apply the knowledge on applications of computers in chemistry.
CO5	To synthesize new drugs after understanding the concepts SAR.

Text Books (Latest Editions)

1. Physical Chemistry- Bahl and Tuli.
2. Text Book of Physical Pharmaceutics, IInd edition, Vallabh Prakashan-. C.V.S. Subramanyam.
3. Medicinal Chemistry (Organic Pharmaceutical Chemistry), G.R Chatwal, Himalaya Publishing house.
4. Instrumental method of Analysis: Hubert H, Willard, 7th edition.
5. Textbook of Pharmaceutical Chemistry by, Jayshree Ghosh, S. Chand & company Ltd. Pharmaceutical Chemistry by Dr. S. Lakshmi, Sultan chand & Sons.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

01. Computers in chemistry, K.V. Raman, Tata Mc.Graw-Hill, 1993.
02. Computers for Chemists, S.K Pundir, Anshu bansal, A pragate prakashan., 2 nd edition, New age international (P) limited, New Delhi.
03. Physical Pharmacy and Pharmaceutical Sciences by Martins, Patrick J. Sinko, Lippincott. William and Wilkins.
04. Cooper and Gunn's Tutorial Pharmacy ,6th edition by S.J. Carter, CBS Publisher Ltd.
05. Ansels pharmaceutical Dosage forms and Drug Delivery System by Allen Popvich and Ansel, Indian edition-B.I. Publication Pvt. Ltd.

Web Resources

https://www.ncbi.nlm.nih.gov/books/NBK482447/
https://training.seer.cancer.gov/treatment/chemotherapy/types.html

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15

Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course	**NANO MATERIALS AND NANO TECHNOLOGY**						
Category	EC - 1	**Year**	I	**Credits**	3	**Course Code**	**232204105**
		Semester	I				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
	4	1	--	5	25	75	100

Learning Objectives

- ✍ To understand the concept of nano materials and nano technology.
- ✍ To understand the various types of nano materials and their properties.
- ✍ To understand the applications of synthetically important nano materials.
- ✍ To correlate the characteristics of various nano materials synthesized by new technologies.
- ✍ To design synthetic routes for synthetically used new nano materials.

UNIT	**Details**	**No. of Periods for the Unit**
I	**UNIT-I:** Introduction of nanomaterials and nanotechnologies, Introduction-role of size, classification-0D, 1D, 2D, 3D. Synthesis-Bottom –Up, Top–Down, consolidation of Nano powders. Features of nanostructures, Background of nanostructures. Techniques of synthesis of nanomaterials, Tools of the nanoscience. Applications of nanomaterials and technologies.	**15**
II	**UNIT-II:** Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance crystal structure. Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties. Synthesis- Physical and chemical methods - inert gas condensation, arc discharge, laser ablation, sol-gel, solvothermal and hydrothermal-CVD-types, metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis.	**15**
III	**UNIT-III:** Mechanical properties of materials, theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials Nanoparticles: gold and silver, metal oxides: silica, iron oxide and alumina - synthesis and properties.	**15**
IV	**UNIT-IV:** Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials. Classification of magnetic phenomena. Semiconductor materials – classification-Ge, Si, GaAs, SiC, GaN, GaP, CdS,PbS. Identification of materials as p and n –type semiconductor-Hall effect - quantum and anomalous, Hall voltage - interpretation of charge carrier density. Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell.	**15**
V	**UNIT-V:** Nano thin films, nanocomposites. Application of nanoparticles in different fields. Core-shell nanoparticles - types, synthesis, and properties. Nanocomposites - metal-, ceramic- and polymer-matrix composites-applications. Characterization – SEM, TEM and AFM - principle, instrumentation and applications.	**15**

Course Outcomes

Course Outcomes	On completion of this course, students will be able
CO1	To explain methods of fabricating nanostructures.
CO2	To relate the unique properties of nanomaterials to reduce dimensionality of the material.

CO3	To describe tools for properties of nanostructures.
CO4	To discuss applications of nanomaterials.
CO5	**CO5**: To understand the health and safety related to nanomaterial.

Text Books (Latest Editions)
1. S.Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016. 2. Arumugam, Materials Science, Anuradha Publications,2007. 3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010 4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012. 5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.
References Books **(Latest editions, and the style as given below must be strictly adhered to)**
1. S.Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016. 2. Arumugam, Materials Science, Anuradha Publications,2007. 3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010 4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012. 5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.
Web Resources
1. http://xrayweb.chem.ou.edu/notes/symmetry.html. 2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**ELECTRO CHEMISTRY**						
Category	EC - II	**Year**	I	**Credits**	3	**Course Code**	**232204106**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	1	--	5	25	75	100

Learning Objectives

- To understand the behavior of electrolytes in terms of conductance, ionic atmosphere, interactions.
- To familiarize the structure of the electrical double layer of different models.
- To compare electrodes between current density and over potential.
- To discuss the mechanism of electrochemical reactions.
- To highlight the different types of over voltages and its applications in electro analytical techniques.

UNIT	Details	No. of Periods for the Unit
I	**Ionics**: Arrhenius theory -limitations, van't Hoff factor and its relation to colligative properties. Deviation from ideal behavior. Ionic activity, mean ionic activity and mean ionic activity coefficient-concept of ionic strength, Debye Huckel theory of strong electrolytes, activity coefficient of strong electrolytes Determination of activity coefficient ion solvent and ion-ion interactions. Born equation. Debye-Huckel Bjerrum model. Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications. Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte-qualitative and quantitative verification and limitations. Evidence for ionic atmosphere. Ion association and triple ion formations.	**15**
II	**Electrode-electrolyte interface:** Interfacial phenomena -Evidences for electrical double layer, polarizable and non-polarizable interfaces, Electrocapillary phenomena - Lippmann equation electro capillary curves. Electro-kinetic phenomena electro-osmosis, electrophoresis, streaming and sedimentation potentials, colloidal and poly electrolytes. Structure of double layer: Helmholtz -Perrin, Guoy- Chapman and Stern models of electrical double layer. Zeta potential and potential at zero charge. Applications and limitations.	**15**
III	**Electrodics of Elementary Electrode Reactions:** Behavior of electrodes: Standard electrodes and electrodes at equilibrium. Anodic and Cathodic currents, condition for the discharge of ions. Nernst equation, polarizable and non-polarizable electrodes. Model of three	**15**

	electrode system, over potential. Rate of electro chemical reactions: Rates of simple elementary reactions. Butler-Volmer equation-significance of exchange current density, net current density and symmetry factor. Low and high field approximations. symmetry factor and transfer coefficient Tafel equations and Tafel plots.	
IV	**Electrodics of Multistep Multi Electron System:** Rates of multi-step electrode reactions, Butler - Volmer equation for a multi-step reaction. Rate determining step, electrode polarization and depolarization. Transfer coefficients, its significance and determination, Stoichiometric number. Electro-chemical reaction mechanisms-rate expressions, order, and surface coverage. Reduction of I^{3-}, Fe^{2+}, and dissolution of Fe to Fe^{2+}. Overvoltage - Chemical and electro chemical, Phase, activation and concentration over potentials. Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan's diagrams.	**15**
V	**Concentration Polarization, Batteries and Fuel cells:** Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes. Polarography-principle and applications. Principle of square wave polarography. Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. Sodium and lithium-ion batteries and redox flow batteries. Mechanism of charge storage: conversion and alloying. Capacitors- mechanism of energy storage, charging at constant current and constant voltage. Energy production systems: Fuel Cells: classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells.	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able
CO1	To understand the behaviour of electrolytes in solution and compare the structures of electrical double layer of different models.
CO2	To predict the kinetics of electrode reactions applying Butler-Volmer and Tafel equations
CO3	To study different thermodynamic mechanism of corrosion,
CO4	To discuss the theories of electrolytes, electrical double layer, electrodics and activity coefficient of electrolytes
CO5	To have knowledge on storage devices and electrochemical reaction mechanism.

Text Books (Latest Editions)

1. D. R. Crow, Principles and applications of electrochemistry, 4thedition, Chapman & Hall/CRC, 2014.
2. J. Rajaram and J.C. Kuriakose, Kinetics and Mechanism of chemical transformations Macmillan India Ltd., New Delhi, 2011.
3. S. Glasstone, Electro chemistry, Affiliated East-West Press, Pvt., Ltd., New Delhi, 2008.
4. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan,

Electrochemistry-Principles and applications, S. Viswanathan Printers, Chennai,2007.
5. Joseph Wang, Analytical Electrochemistry, 2nd edition, Wiley, 2004.

References Books **(Latest editions, and the style as given below must be strictly adhered to)**
1. J.O.M. Bockris and A.K.N. Reddy, Modern Electro chemistry, vol.1 and 2B, Springer, Plenum Press, New York, 2008. 2. J.O.M. Bockris, A.K.N. Reddy and M.G. Aldeco Morden Electro chemistry, vol. 2A, Springer, Plenum Press, New York, 2008. 3. Philip H. Rieger, Electrochemistry, 2nd edition, Springer, New York, 2010. 4. L.I. Antropov, Theoretical electrochemistry, Mir Publishers, 1977. 5. K.L. Kapoor, A Text book of Physical chemistry, volume-3, Macmillan, 2001.
Web Resources
1. https://www.pdfdrive.com/modern-electrochemistry-e34333229.

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**MOLECULAR SPECTROSCOPY**						
Category	EC - II	**Year**	I	**Credits**	3	**Course Code**	**232204107**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	1	--	5	25	75	100

Learning Objectives

- ✍ To understand the influence of rotation and vibrations on the spectra of the polyatomic molecules.
- ✍ To study the principle of Raman spectroscopy, ESR spectroscopy, EPR spectroscopy and fragmentation patterns in Mass spectroscopy.
- ✍ To highlight the significance of Franck-Condon principle to interpret the selection rule, intensity and types of electronic transitions.
- ✍ To interpret the first and second order NMR spectra in terms of splitting and coupling patterns using correlation techniques such as COSY, HETCOR, NOESY.
- ✍ To carry out the structural elucidation of molecules using different spectral techniques.

UNIT	**Details**	**No. of Periods for the Unit**
I	**UNIT-I: Rotational and Raman Spectroscopy:** Rotational spectra of diatomic and polyatomic molecules. Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators. Classical theory of the Raman effect, polarizability as a tensor, polarizability ellipsoids, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines. Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches, Polarization of Raman scattered photons.	**15**
II	**UNIT-II: Vibrational Spectroscopy:** Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution. Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation. Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies. Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules.	**15**
III	**UNIT-III: Electronic spectroscopy:** Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation and predissociation spectra. $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules. Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, Xray photoelectron spectroscopy (XPS). Lasers: Laser action, population inversion, properties of laser radiation, examples of simple laser systems.	**15**

IV	**UNIT-IV: NMR and ESR spectroscopy:** Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding. Spin systems: First order and second order coupling of AB systems, Simplification of complex spectra. Spin-spin interactions: Homonuclear coupling interactions - AX, AX2, AB types. Vicinal, germinal and long-range coupling-spin decoupling. Nuclear Overhauser effect (NOE), Factors influencing coupling constants and Relative intensities. 13CNMR and structural correlations, Satellites. Brief introduction to 2D NMR – COSY, NOESY. Introduction to 31P, 19F NMR. ESR spectroscopy Characteristic features of ESR spectra, line shapes and line widths; ESR spectrometer. The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction. Interpretation of ESR spectra and structure elucidation of organic radicals using ESR spectroscopy; Spin orbit coupling and significance of g-tensors, zero/non-zero field splitting, Kramer's degeneracy, application to transition metal complexes (having one to five unpaired electrons) including biological molecules and inorganic free radicals. ESR spectra of magnetically dilute samples.	**15**
V	**UNIT-V: Mass Spectrometry, EPR and Mossbauer Spectroscopy:** Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI), isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution. Effect of isotopes on the appearance of mass spectrum. EPR spectra of anisotropic systems - anisotropy in g-value, causes of anisotropy, anisotropy in hyperfine coupling, hyperfine splitting caused by quadrupole nuclei. Zero-field splitting (ZFS) and Kramer's degeneracy. Applications of EPR to organic and inorganic systems. Structural elucidation of organic compounds by combined spectral techniques. Principle of Mossbauer spectroscopy: Doppler shift, recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications: Mossbauer spectra of high and low-spin Fe and Sn compounds.	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	To understand the importance of rotational and Raman spectroscopy.
CO2	To apply the vibrational spectroscopic techniques to diatomic and polyatomic molecules.
CO3	To evaluate different electronic spectra of simple molecules using electronic spectroscopy.
CO4	To outline the NMR, ^{13}C NMR, 2D NMR – COSY, NOESY, Introduction to ^{31}P, ^{19}F NMR and ESR spectroscopic techniques.
CO5	To develop the knowledge on principle, instrumentation and structural elucidation of simple molecules using Mass Spectrometry, EPR and Mossbauer Spectroscopy

	techniques.

Text Books (Latest Editions)
1. C. N. Banwell and E. M. McCash, *Fundamentals of Molecular Spectroscopy*, 4th Ed., Tata McGraw Hill, New Delhi, 2000. 2. R. M. Silverstein and F. X. Webster, *Spectroscopic Identification of Organic Compounds*, 6th Ed., John Wiley & Sons, New York, 2003. 3. W. Kemp, *Applications of Spectroscopy*, English Language Book Society, 1987. 4. D. H. Williams and I. Fleming, *Spectroscopic Methods in Organic Chemistry*, 4th Ed., Tata McGraw-Hill Publishing Company, New Delhi, 1988. 5. R. S. Drago, *Physical Methods in Chemistry*; Saunders: Philadelphia, 1992.
References Books **(Latest editions, and the style as given below must be strictly adhered to)**
1. P.W. Atkins and J. de Paula, *Physical Chemistry*, 7th Ed., Oxford University Press, Oxford, 2002. 2. I. N. Levine, *Molecular Spectroscopy*, John Wiley & Sons, New York, 1974. 3. A. Rahman, *Nuclear Magnetic Resonance-Basic Principles*, Springer-Verlag, New York,1986. 4. K. Nakamoto, *Infrared and Raman Spectra of Inorganic and coordination Compounds*, PartB: 5th ed., John Wiley& Sons Inc., New York, 1997. 5. J. A. Weil, J. R. Bolton and J. E. Wertz, *Electron Paramagnetic Resonance*; Wiley Interscience, 1994.
Web Resources
https://onlinecourses.nptel.ac.in/noc20_cy08/preview2. https://www.digimat.in/nptel/courses/video/104106122/L14.html

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**PREPARATION OF CONSUMER PRODUCTS - LAB**						
Category	SEC - I	**Year**	I	**Credits**	2	**Course Code**	**232204108**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		--	1	2	3	25	75	100
Prerequisites		Basic concepts of organic chemistry						

Learning Objectives

- ✍ To understand the concept of Preparation of useful consumer products.
- ✍ To develop analytical skill in the handling of chemical reagents forpreparation.
- ✍ To experiment different purification and drying techniques for thecompound processing.

UNIT	**Details**	
	Preparation of following consumer products: 1. Preparation of Shampoo 2. Preparation of Soap 3. Preparation of Phenoyls 4. Preparation of sanitizers 5. Preparation of Scented oils **6.** Preparation of Dish wash Liquid	

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	To recall the basic principles of consumer products, qualitative analysis and preparation.
CO2	To explain the method of separation and analysis of separated by suitable preparation method.

Text Books (Latest Editions)

Creative Cosmetics Lab – Thames and Kosmos

Web Resources

1. https://www.thamesandkosmos.com/manuals/full/646518_Creative_Cosmetics_Lab_Manual.pdf

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15

Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**CHEMISTRY IN CONSUMER PRODUCTS**						
Category	AECC - I	**Year**	I	**Credits**	2	**Course Code**	**232204109**	
		Semester	I					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		2	-	--	2	25	75	100
Prerequisites		Basic knowledge of spectroscopy						

Learning Objectives

- ✍ To understand the preparation of soap and mechanism of its action.
- ✍ To study the principle of surface active agent and mechanism of action of detergent.
- ✍ To highlight the significance of shampoo and its classification.
- ✍ To understand the preparation and uses of face cream and Nail polish.
- ✍ To carry out the nodes of perfumes and preparation of flavors.

UNIT	**Details**	**No. of Periods for the Unit**
I	Soaps: Saponification of oils and fats – Manufacture of soaps formulation of toilet soaps, Herbal soaps, Mechanism of action of soap.	**6**
II	Detergents: Surface active agents – classification of surface active agents – Different ingredients in the formulation of detergent powder and soaps – Mechanism of action of detergents – comparison of soaps and detergents.	**6**
III	Shampoos: Manufacture of Sodium Lauryl Sulfate and SLS free kadhi product Johnson baby soap and shampoos. Different kind of shampoo – anti dandruff, herbal and baby shampoo.	**6**
IV	Face cream and Nail Polish: Ingredients – functions – different types of snows and face creams. Nail polishes – Nail polish preparation – Nail Polish removers.	**6**
V	Perfumes and falvours: Definition – Manufacture of perfume and flavouring materials – production of Natural perfume and flower perfume – fruit flavours – artificial flavours.	**6**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	To understand the importance using of soap.
CO2	To apply the cleaning action of soap and detergent.
CO3	To evaluate different type of Shampoo.
CO4	To outline the preparation and use of face cream and nail polish.
CO5	To develop the knowledge on principle, preparation of perfumes and flavors.

Text Books (Latest Editions)

1. Gobal Rao S., Outlines of Chemical technology, Affiliated East West Press, 1998.
2. Kafaro, Wasteless Chemical processing, Mir Publishers, 1995

References Books
(Latest editions, and the style as given below must be strictly adhered to)

01. Sawyer W., Experimental cosmetics, Dover Publishers, New York, 2000.
02. Sharma B.K, Industrial Chemistry, Goel Publishing house,1995.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	S	S	S	M	S	S	S	S	M
CO 2	M	S	S	S	S	M	S	S	S	S
CO 3	S	S	M	S	S	S	S	M	S	S
CO 4	M	S	S	S	S	M	S	S	S	S
CO 5	M	S	M	S	S	M	S	M	S	S

S – Strong ; M – Medium; L – Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of CourseContribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**ORGANIC REACTION MECHANISM - II**						
Category	Core - 4	**Year**	I	**Credits**	4	**Course Code**	**232204201**	
		Semester	II					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	1	--	5	25	75	100

Learning Objectives

- ✍ To understand the concept of aromaticity in benzenoid, non-benzenoid, heterocyclic and annulene compounds.
- ✍ To understand the mechanism involved in various types of organic reactions with evidences.
- ✍ To understand the applications of synthetically important reagents.
- ✍ To correlate the reactivity between aliphatic and aromatic compounds.
- ✍ To design synthetic routes for synthetically used organic reactions.

UNIT	**Details**	**No. of Periods for the Unit**
I	**UNIT-I: Elimination and Free Radical Reactions:** Mechanisms: E2, E1, and E1cB mechanisms. Syn- and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules. Reactivity: Effect of substrate, attacking bases, leaving group and medium. Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination. Long lived and short-lived radicals – Production of radicals by thermal and photochemical reactions, Detection and stability of radicals, characteristics of free radical reactions and free radical, reactions of radicals; polymerization, addition, halogenations, aromatic substitutions, rearrangements. Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.	**15**
II	*UNIT-II: Oxidation and Reduction Reactions: Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition-elimination, oxidative and reductive coupling reactions. Mechanism of oxidation reactions: Dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate lead tetraacetate, permanganate, manganese dioxide, osmium tetroxide, oxidation of saturated hydrocarbons, alkyl groups, alcohols, halides and amines. Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allylic oxidation, oxidation by chromium trioxide-pyridine, DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation, dimethyl sulphoxide- dicyclohexyl carbodiimide (DMSO-DCCD). Mechanism of reduction reactions: Wolff-Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyltin hydrides, McFadyen-Steven's reduction, Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault-Blanc reduction.*	**15**
III	**UNIT-III: Rearrangements:** Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements - applications and stereochemistry, Wagner-Meerwein, Demjanov,	**15**

	Dienone-phenol, Baker-Venkataraman, Benzilic acid and Wolff rearrangements. Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann and abnormal Beckmann rearrangements. Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements. Rearrangements to electron rich atom: Favorskii, Quasi-Favorskii, Stevens, [1,2]-Wittig and [2,3]-Wittig rearrangements. Fries and Photo Fries rearrangement. Intramolecular rearrangements – Claisen, abnormal Claisen, Cope, oxy-Cope Benzidine rearrangements.	
IV	*UNIT-IV: Addition to Carbon Multiple Bonds: Mechanisms: (a) Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanisms-Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen; (b) Addition to carbon-hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction, Prins reaction. Stereochemical aspects of addition reactions. Addition to Carbon-Hetero atom Multiplebonds: Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates –Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.*	**15**
V	**UNIT-V: Reagents and Modern Synthetic Reactions:** Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride ($NaBH_3CN$), *meta*-Chloroperbenzoic acid (m-CPBA), Dimethyl aminiopyridine (DMAP), n-Bu_3SnD, Triethylamine (TEA), Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), *N*-bromosuccinimide (NBS), Trifluoroacetic acid (TFA), Tetramethyl piperiridin-1-oxyl (TEMPO), Phenyltrimethylammonium tribromide (PTAB). Diazomethane and Zn-Cu, Diethyl maleate (DEM), Copper diacetylacetonate ($Cu(acac)_2$), $TiCl_3$, $NaIO_4$, Pyridinium chlorochromate (PCC), Pyridinium dichromate (PDC), Meisenheimer complex**.** Suzuki coupling, Heck reaction, Negishi reaction, Baylis-Hillman reaction.	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	To recall the basic principles of aromaticity of organic and heterocyclic compounds.
CO2	To understand the mechanism of various types of organic reactions.
CO3	To predict the suitable reagents for the conversion of selective organic compounds.
CO4	To correlate the principles of substitution, elimination, and addition reactions.
CO5	To design new routes to synthesis organic compounds.

Text Books (Latest Editions)

1. J. March and M. Smith, *Advanced Organic Chemistry*, 5th ed., John-Wiley and Sons.

2001.
2. E. S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc., 1959.
3. P. S. Kalsi, *Stereochemistry of carbon compounds*, 8thedn, New Age International Publishers, 2015.
4. P. Y.Bruice, *Organic Chemistry*, 7thedn.,Prentice Hall, 2013.
5. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee*Organic Chemistry*, 7th edn., Pearson Education, 2010.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1. S. H. Pine, *Organic Chemistry*, 5thedn, McGraw Hill International Editionn, 1987.
2. L. F. Fieser and M. Fieser, *Organic Chemistry*, Asia Publishing House, Bombay, 2000.
3. E.S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc., 1959.
4. T. L. Gilchrist, *Heterocyclic Chemistry*, Longman Press, 1989.
5. J. A. Joule and K. Mills, *Heterocyclic Chemistry*, 4thed., John-Wiley, 2010.

Web Resources

1.https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic
2. https://www.organic-chemistry.org/

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**PHYSICAL CHEMISTRY - I**						
Category	Core - 5	**Year**	I	**Credits**	4	**Course Code**	**232204202**	
		Semester	II					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	1	--	5	25	75	100

Learning Objectives

- ✍ To recall the fundamentals of thermodynamics and the composition of partial molar quantities.
- ✍ To understand the classical and statistical approach of the functions
- ✍ To compare the significance of Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein
- ✍ To correlate the theories of reaction rates for the evaluation of thermodynamic parameters.
- ✍ To study the mechanism and kinetics of reactions.

UNIT	Details	No. of Periods for the Unit
I	**UNIT-I: Classical Thermodynamics:** Partial molar properties-Chemical potential, Gibb's- Duhem equation-binary and ternary systems. Determination of partial molar quantities. Thermodynamics of real gases - Fugacity- determination of fugacity by graphical and equation of state methods-dependence of temperature, pressure and composition. Thermodynamics of ideal and non-ideal binary mixtures, Duhem - Margulus equation applications of ideal and non-ideal mixtures. Activity and activity coefficients-standard states - determination-vapour pressure, EMF and freezing point methods.	**15**
II	**UNIT-II: Statistical thermodynamics:** Introduction of statistical thermodynamics concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles. Assemblies, ensembles, canonical particles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics- comparison and applications. Partition functions-evaluation of translational, vibrational and rotational partition functions for monoatomic, diatomic and polyatomic ideal gases. Thermodynamic functions in terms of partition functions-calculation of equilibrium constants. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function residual entropy, equilibrium constants and equipartition principle. Heat capacity of mono and di atomic gases-ortho and para hydrogen. Heat capacity of solids-Einstein and Debye models.	**15**
III	**UNIT-III: Irreversible Thermodynamics:** Theories of conservation of mass and energy entropy production in open systems by heat, matter and current flow, force and flux concepts. Onsager theory-validity and verification- Onsager reciprocal relationships. Electro kinetic and thermo	**15**

	mechanical effects-Application of irreversible thermodynamics to biological systems.	
IV	**UNIT-IV: Kinetics of Reactions:** Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions -Lindeman and Christiansen hypothesis- molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces. Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules, time and true order-kinetic parameter evaluation. Factors determine the reaction rates in solution - primary salt effect and secondary salt effect, Homogeneous catalysis- acid- base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law, enzyme catalysis-Michelis-Menton catalysis.	**15**
V	**UNIT-V: Kinetics of complex and fast reactions:** Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions. Chain reactions-chain length, kinetics of $H_2 – Cl_2$ & $H_2 – Br_2$ reactions (Thermal and Photochemical reactions) - Rice Herzfeld mechanism. Study of fast reactions-relaxation methods- temperature and pressure jump methods electric and magnetic field jump methods -stopped flow flash photolysis methods and pulse radiolysis. Kinetics of polymerization-free radical, cationic, anionic polymerization - Poly condensation.	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able
CO1	To explain the classical and statistical concepts of thermodynamics.
CO2	To compare and correlate the thermodynamic concepts to study the kinetics of chemical reactions.
CO3	To discuss the various thermodynamic and kinetic determination.
CO4	To evaluate the thermodynamic methods for real gases ad mixtures.
CO5	To compare the theories of reactions rates and fast reactions.

Text Books (Latest Editions)

1. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, 2nd edition,S.L.N.Chand and Co., Jalandhar, 1986.
2. I.M. Klotz and R.M. Rosenberg, Chemical thermodynamics, 6th edition, W.A. BenjaminPublishers, California, 1972.
3. M.C. Gupta, Statistical Thermodynamics, New Age International, Pvt. Ltd., New Delhi, 1995.
4. K.J. Laidler, Chemical Kinetics, 3rd edition, Pearson, Reprint - 2013.
5. J. Rajaram and J.C. Kuriokose, Kinetics and Mechanisms of chemical transformation,M acmillan India Ltd, Reprint - 2011.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1. D.A. Mcqurrie And J.D. Simon, Physical Chemistry - A Molecular Approach, Viva Books Pvt. Ltd., New Delhi, 1999.
2. R.P. Rastogi and R.R. Misra, Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi, 1990.

3. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Publishers, New York, 1974
4. K.B. Ytsiimiriski, "Kinetic Methods of Analysis", Pergamom Press,1996.
5. Gurdeep Raj, Phase rule, Goel Publishing House, 2011.

Web Resources
01. https://nptel.ac.in/courses/104/103/104103112/ 02. https://bit.ly/3tL3GdN

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**INORGANIC CHEMISTRY PRACTICAL**						
Category	Core - 6	**Year**	I	**Credits**	4	**Course Code**	**232204203**	
		Semester	II					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		-	1	4	5	25	75	100

Learning Objectives

- ✍ To understand and enhance the visual observation as an analytical tool for the quantitative estimation of ions.
- ✍ To recall the principle and theory in preparing standard solutions.
- ✍ To train the students for improving their skill in estimating the amount of ion accurately present in the solution
- ✍ To estimate metal ions, present in the given solution accurately without using instruments.
- ✍ To determine the amount of ions, present in a binary mixture accurately.

UNIT	Details	No. of Periods for the Unit
I	**UNIT-I: Analysis of mixture of cations:** Analysis of a mixture of four cations containing two common cations and two rare cations. Cations to be tested. Group-I : W, Tl and Pb. Group-II : Se, Te, Mo, Cu, Bi and Cd. Group-III : Tl, Ce, Th, Zr, V, Cr, Fe, Ti and U. Group-IV : Zn, Ni, Co and Mn. Group-V : Ca, Ba and Sr. Group-VI : Li and Mg.	
II	**UNIT-II: Preparation of metal complexes:** Preparation of inorganic complexes: a. Preparation of tristhioureacopper(I)sulphate b. Preparation of potassium trioxalate chromate(III) c. Preparation of tetramminecopper(II) sulphate d. Preparation of Reineck's salt e. Preparation of hexathioureacopper(I) chloridedihydrate f. Preparation of *cis*-Potassium tri oxalate diaquachromate(III) g. Preparation of sodium trioxalatoferrate(III) h. Preparation of hexathiourealead(II) nitrate	
III	**UNIT-III: Complexometric Titration:** 1. Estimation of zinc, nickel, magnesium, and calcium. 2. Estimation of mixture of metal ions-pH control, masking and demasking agents. 3. Determination of calcium and lead in a mixture (pH control). 4. Determination of manganese in the presence of iron. 5. Determination of nickel in the presence of iron.	

Course Outcomes

Course Outcomes	On completion of this course, students will;
CO1	To identify the anions and cations present in a mixture of salts.
CO2	To apply the principles of semi micro qualitative analysis to categorize acid radicals and basic radicals.
CO3	To acquire the qualitative analytical skills by selecting suitable confirmatory tests and spot tests.
CO4	To choose the appropriate chemical reagents for the detection of anions and

	cations.
CO5	To synthesize coordination compounds in good quality.

Text Books (Latest Editions)
01. A. JeyaRajendran, Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis, United global publishers, 2021. 02. V. V. Ramanujam, *Inorganic Semimicro Qualitative Analysis*; 3rded., The National Publishing Company, Chennai, 1974. *03. Vogel's Text book of Inorganic Qualitative Analysis,* 4thed., ELBS, London.
References Books **(Latest editions, and the style as given below must be strictly adhered to)**
01. G. Pass, and H. Sutcliffe, *Practical Inorganic Chemistry*; Chapman Hall, 1965. 02. W. G. Palmer, Experimental *Inorganic Chemistry*; Cambridge University Press, 1954.

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**MEDICINAL CHEMISTRY**						
Category	EC - III	**Year**	I	**Credits**	3	**Course Code**	**232204204**	
		Semester	II					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		1	4	--	5	25	75	100

Learning Objectives

- ✍ To study the chemistry behind the development of pharmaceutical materials.
- ✍ To gain knowledge on mechanism and action of drugs.
- ✍ To understand the need of antibiotics and usage of drugs.
- ✍ To familiarize with the mode of action of diabetic agents and treatment of diabetes.
- ✍ To identify and apply the action of various antibiotics.

UNIT	Details	No. of Periods for the Unit
I	**UNIT-I: Introduction to receptors:** Introduction, targets, Agonist, antagonist, partial agonist. Receptors, Receptor types, Theories of Drug – receptor interaction, Drug synergism, Drug resistance, physicochemical factors influencing drug action.	
II	**UNIT-II: Antibiotics:** Introduction, Targets of antibiotics action, classification of antibiotics, enzyme-based mechanism of action, SAR of penicllins and tetracyclins, clinical application of penicillins, cephalosporin.Current trends in antibiotic therapy.	
III	**UNIT-III: Antihypertensive agents and diuretics:** Classification of cardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride.	
IV	**UNIT-IV: Antihypertensive agents and diuretics:** Classification of cardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride.	
V	**UNIT-V: Analgesics, Antipyretics and Anti-inflammatory Drugs:** Introduction, Mechanism of inflammation, classification and mechanism of action and paracetamol, Ibuprofen, Diclofenac, naproxen, indomethacin, phenylbutazone and meperidine. Medicinal Chemistry of Antidiabetic Agents Introduction, Types of diabetics, Drugs used for the treatment, chemical classification, Mechanism of action, Treatment of diabetic mellitus. Chemistry of insulin, sulfonyl urea.	

Course Outcomes

Course Outcomes	On completion of this course, students will be able
CO1	Predict a drugs properties based on its structure.
CO2	Describe the factors that affect its absorption, distribution, metabolism, and excretion, and hence the considerations to be made in drug design.
CO3	Explain the relationship between drug's chemical structure and its therapeutic properties.
CO4	Designed to give the knowledge of different theories of drug actions at molecular

	level.
CO5	To identify different targets for the development of new drugs for the treatment of infectious and GIT.

Text Books (Latest Editions)

01. Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry,
02. Wilson, Charles Owens: Beale, John Marlowe; Block, John H, Lipincott William, 12th edition, 2011.
03. Graham L. Patrick, An Introduction to Medicinal Chemistry, 5th edition, Oxford University Press, 2013. Jayashree Ghosh, A text book of Pharmaceutical Chemistry, S. Chand and Co. Ltd, 1999,1999 edn.
04. O. LeRoy, Natural and synthetic organic medicinal compounds, Ealemi, 1976.
05. S. Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, New Delhi, 1993, New edn.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

01. Foye's Princles of Medicinal Chemistry, Lipincott Williams, Seventh Edition, 2012
02. Burger's Medicinal Chemistry, Drug Discovery and Development, Donald J. Abraham, David P. Rotella, Alfred Burger, Academic press, 2010.
03. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, John M. Beale Jr and John M. Block, Wolters Kluwer, 2011, 12th edn.
04. P. Parimoo, A Textbook of Medical Chemistry, New Delhi: CBS Publishers.1995.
05. S. Ramakrishnan, K. G. Prasannan and R. Rajan, Textbook of Medical Biochemistry, Hyderabad: Orient Longman. 3rd edition, 2001.

Web Resources

1. https://www.ncbi.nlm.nih.gov/books/NBK482447/
2. https://training.seer.cancer.gov/treatment/chemotherapy/types.html
3. https://www.classcentral.com/course/swayam-medicinal-chemistry-12908

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**GREEN CHEMISTRY**						
Category	EC - III	**Year**	I	**Credits**	3	**Course Code**	**232204205**	
		Semester	II					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	1	--	5	25	75	100

Learning Objectives

- To discuss the principles of green chemistry.
- To propose green solutions for chemical energy storage and conversion
- Propose green solutions for industrial production of Petroleum and Petrochemicals.
- Propose solutions for pollution prevention in Industrial chemical and fuel production, Automotive industry and Shipping industries.
- Propose green solutions for industrial production of Surfactants, Organic and inorganic chemicals.

UNIT	**Details**	**No. of Periods for the Unit**
I	**UNIT-I:** Introduction- Need for Green Chemistry. Goals of Green Chemistry. Limitations/ of Green Chemistry. Chemical accidents, terminologies, Internationall green chemistry organizations and Twelve principles of Green Chemistry with examples.	**15**
II	**UNIT-II:** Choice of starting materials, reagents, catalysts and solvents in detail, Green chemistry in day today life. Designing green synthesis-green reagents: dimethyl carbonate. Green solvents: Water,Ionic liquids-criteria, general methods of preparation, effect on organic reaction. Supercritical carbon dioxide- properties, advantages, drawbacks and a few examples of organic reactions in $scCO_2$. Green synthesis-adipic acid and catechol.	**15**
III	**UNIT-III:** Environmental pollution, Green Catalysis-Acid catalysts, Oxidation catalysts, Basic catalysts, Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts, Poly supported photosensitizers.	**15**
IV	**UNIT-IV:** Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction. Applications in organic synthesis.	**15**
V	**UNIT-V:** Micro wave induced green synthesis-Introduction, Instrumentation, Principle and applications. Sonochemistry – Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and Applications.	**15**

Course Outcomes

Course Outcomes	On completion of this course, students will be able;
CO1	To recall the basic chemical techniques used in conventional industrial preparations and in green innovations.
CO2	To understand the various techniques used in chemical industries and in laboratory.
CO3	To compare the advantages of organic reactions assisted by renewable energy sources and non-renewable energy sources.
CO4	To apply the principles of PTC, ionic liquid, microwave and ultrasonic assisted

	organic synthesis.
CO5	To design and synthesize new organic compounds by green methods.

Text Books (Latest Editions)

1. Ahluwalia, V.K. and Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005.
2. W. L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, 7thedition, McGraw-Hill, NewDelhi,2005.
3. J. M. Swan and D. St. C. Black, Organometallics in Organic Synthesis, Chapman Hall,1974.
4. V. K. Ahluwalia and R. Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, New Delhi,2001.
5. A. K. De, Environmental Chemistry, New Age Publications, 2017.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1. Anastas, P.T. and Warner, J.K. Oxford Green Chemistry -Theory and Practical, University Press, 1998
2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001
3. Cann, M.C. and Connely, M.E. Real-World Cases in Green Chemistry, American Chemical Society, Washington, 2000
4. Ryan, M.A. and Tinnesand, M., Introduction to Green Chemistry, American Chemical Society Washington, 2002.
5. Chandrakanta Bandyopadhyay, An Insight into Green Chemistry, Books and Allied (P) Ltd, 2019.

Web Resources

01. https://www.organic-chemistry.org/
02. https://www.studyorgo.com/summary.php

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**BIO INORGANIC CHEMISTRY**						
Category	EC - IV	**Year**	I	**Credits**	3	**Course Code**	**232204206**	
		Semester	II					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	1	--	5	25	75	100
Prerequisites		**Basic knowledge of chemistry**						

Learning Objectives

- ✍ To understand the role of trace elements.
- ✍ To understand the biological significance of iron, sulpur.To study the toxicity of metals in medicines.
- ✍ To have knowledge on diagnostic agents.
- ✍ To discuss on various metallo enzymes properties.

UNIT	**Details**	**No. of Periods for the Unit**
I	**Essential trace elements:** Selective transport and storage of metal ions: Ferritin, Transferrin and sidorphores; Sodium and potassium transport, Calcium signalling proteins. Metalloenzymes: Zinc enzymes– carboxypeptidase and carbonic anhydrase. Iron enzymes– catalase, peroxidase. Copper enzymes – superoxide dismutase, Plast ocyanin, Ceruloplasmin, Tyrosinase. Coenzymes - Vitamin-B12 coenzymes.	**15**
II	**Transport Proteins:** Oxygen carriers -Hemoglobin and myoglobin - Structure and oxygenation Bohr Effect. Binding of CO, NO, CN– to Myoglobin and Hemoglobin. Biological redox system: Cytochromes-Classification, cytochrome a, b and c. Cytochrome P-450. Non-heme oxygen carriers-Hemerythrin and hemocyanin. Iron-sulphur proteins- Rubredoxin and Ferredoxin- Structure and classification.	**15**
III	**Nitrogen fixation**-Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase-redox property - Dinitrogen complexes transition metal complexes of dinitrogen - nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia. Photosynthesis: photosystem-I and photosystem-II-chlorophylls structure and function.	**15**
IV	**Metals in medicine:** Metal Toxicity of Hg, Cd, Zn, Pb, As, Sb. Therapeutic Compounds: Vanadium-Based Diabetes Drugs; Platinum-Containing Anticancer Agents.Chelation therapy; Cancer treatment. Diagnostic Agents: Technetium Imaging Agents; Gadolinium MRI Imaging Agents. temperature and critical magnetic Field.	**15**
V	**Enzymes** -Introduction and properties -nomenclature andclassification. Enzyme kinetics, free energy of activation and the effects of catalysis. Michelis - Menton equation - Effect of pH, temperature on enzyme reactions. Factors contributing to the efficiency of enzyme.	**15**

Course Outcomes

Course Outcomes	On completion of this course, students will be able;
CO1	The students will be able to analyses trace elements.
CO2	Students will be able to explain the biological redox systems.
CO3	Students will gain skill in analyzing the toxicity in metals.
CO4	Students will have experience in diagnosis.
CO5	Learn about the nitrogen fixation and photosynthetic mechanism.

Text Books (Latest Editions)
1. Williams,D.R. –Introdution to Bioinorganic chemistry. 2. F.M. Fiabre and D.R. Williams– The Principles of Bioinorganic Chemistry,RoyolSoceity of Chemistry, Monograph for Teachers-31 3. K.F. Purcell and Kotz., Inorganic chemistry, WB Saunders Co.,USA. 4. G.N. Mugherjea and Arabinda Das, Elements of BioinorganicChemistry - 1993. 5. R. Gopalan, V. Ramalingam, *Concise Coordination Chemistry*, S. Chand, **2001**.
References Books **(Latest editions, and the style as given below must be strictly adhered to)**
1. M.Satake and Y.Mido, Bioinorganic Chemistry- Discovery PublishingHouse, New Delhi (1996) 2. M.N. Hughes, 1982, The Inorganic Chemistry of Biological processes,II Edition, Wiley London. 3. R. W. Hay, Bio Inorganic Chemistry, Ellis Horwood, 1987. 4. R. M. Roat-Malone, Bio Inorganic Chemistry, John Wiley, 2002. 5. T. M. Loehr, Iron carriers and Iron proteins, VCH, 1989.
Web Resources
1. https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry- the-instant-notes-chemistry-series-d162097454.html 2. https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry- 5th-edition-d161563417.html

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**MATERIAL SCIENCE**						
Category	EC - IV	**Year**	I	**Credits**	3	**Course Code**	**232204207**	
		Semester	II					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	1	--	5	25	75	100
Prerequisites		**Basic knowledge of solid-state chemistry**						

Learning Objectives

- ✍ To understand the crystal structure, growth methods and X-rayscattering.
- ✍ To explain the optical, dielectric and diffusion properties of crystals.
- ✍ To recognize the basis of semiconductors, superconductivity materialsand magnets.
- ✍ To study the synthesis, classification and applications of nanomaterials.
- ✍ To learn about the importance of materials used for renewable energy conversion.

UNIT	Details	No. of Periods for the Unit
I	**ystallography:** symmetry - unit cell and Miller indices -crystal systems - Bravais lattices - point groups and space groups - X-ray diffraction-Laue equations-Bragg's law-reciprocal lattice and its application to geometrical crystallography. Crystal structure–powderand single crystal applications. Electron charge density maps, neutrondiffraction-method and applications.	**15**
II	**Crystal growth methods: N**ucleation–equilibrium stability and metastable state. Single crystal –Low and high temperature, solution growth– Gel and sol-gel. Crystal growth methods- nucleation–equilibrium stability and metastable state. Single crystal–Low and high temperature, solution growth– Gel and sol-gel. Melt growth - Bridgeman-Stockbarger,Czochralski methods. Flux technique, physical and chemical vapour transport. Lorentz andpolarization factor - primary and secondary extinctions.	**15**
III	**Properties of crystals:** Optical studies - Electromagnetic spectrum (qualitative) refractive index – reflectance – transparency, translucency and opacity. Types of luminescence – photo-, electro-, and injection luminescence, LEDs – organic, Inorganic and polymer LED materials - Applications. Dielectric studies- Polarisation - electronic, ionic, orientation, and space charge polarisation. Effect of temperature. dielectric constant, dielectric loss. Types of dielectric breakdown–intrinsic, thermal, discharge, electrochemical and defect breakdown	**15**
IV	**Special Materials:** Superconductivity: Meissner effect, Critical temperature and critical magnetic Field, Type I and II superconductors, BCS theory-Cooper pair, Applications. Soft and hard magnets – Domain theory Hysteresis Loop-Applications. Magneto and gian magneto resistance. Ferro, ferri and antiferromagnetic materials- applications, magnetic parameters for recording applications. Ferro-, Piezo-, and pyro electric materials – properties and applications. Shape memory Alloys-characteristics and applications, Non-linear optics- Second Harmonic Generators, mixing of Laser wavelengths by quartz, ruby and $LiNbO_3$.	**15**
V	**Materials for Renewable Energy Conversion:** Solar Cells: Organic, bilayer, bulk heterojunction, polymer, perovskite based. Solar energy conversion: lamellar solids and thin films, dye-sensitized photo voltaic cells, coordination compounds anchored onto semiconductor surfaces - Ru(II) and Os(II) polypyridyl complexes. Photochemical activation and splitting of water, CO2 and N2. Manganese based photo systems for water-splitting. Complexes of Rh, Ru, Pd and Pt - photochemical generation of hydrogen from alcohol.	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	To understand and recall the synthesis and characteristics of crystal structures, semiconductors, magnets, nanomaterials and renewable energy materials.
CO2	To integrate and assess the structure of different materials and their properties.
CO3	To analyse and identify new materials for energy applications.
CO4	To explain the importance of crystal structures, piezoelectric and pyroelectric materials, nanomaterials, hard and soft magnets, superconductors, solar cells, electrodes, LED uses, structures and synthesis.
CO5	To design and develop new materials with improved property for energy applications

Text Books (Latest Editions)

01. S. Mohan and V. Arjunan, Principles of Materials Science, MJPPublishers, 2016.
02. Arumugam, Materials Science, Anuradha Publications, 2007.
03. Giacavazzo et. al., Fundamentals of Crystallography, InternationalUnion of Crystallography. Oxford Science Publications, 2010
04. Woolfson, An Introduction to Crystallography, Cambridge UniversityPress, 2012.
05. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1. Suggested Readings 1. M.G. Arora, Solid State Chemistry, AnmolPublications, New Delhi, 2001.
2. R.K. Puri and V.K. Babbar, Solid State Physics, S Chand and CompanyLtd, 2001.
3. C. Kittel, Solid State Physics, John-Wiley and sons, NY, 1966.
4. H.P. Meyers, Introductory Solid State Physics, Viva Books PrivateLimited, 1998.
5. A.R. West, Solid State Chemistry and Applications, John-Wiley andsons, 1987.

Web Resources

1. http://xrayweb.chem.ou.edu/notes/symmetry.html.
2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.
3. https://bit.ly/3QyVg2R

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15

Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**DRUGS AND COSMETICS**						
Category	SEC - II	**Year**	I	**Credits**	2	**Course Code**	**232204208**	
		Semester	II					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		3	-	--	3	25	75	100
Prerequisites		Basic knowledge of Drugs and Cosmetics in chemistry						

Learning Objectives

- ✍ To understand the briefly outlines the bacteria and virus, various synthetic methods of drugs.
- ✍ To also deals with miscellaneous applications drugs and its types.
- ✍ To learn about various therapeutic action of drugs
- ✍ To learn the concepts of the components and chemicals used in the cosmetics.
- ✍ To know about assorted applications of cosmetics.

UNIT	**Details**	**No. of Periods for the Unit**
I	**DRUGS, BACTERIA AND VIRUS:** Significance of drugs - lethal dosage - bacteria - types of bacteria - gram positive - gram negative - examples - viruses - differences between bacteria and virus - fungi - drawbacks of drugs.	**9**
II	**ANALGESICS, ANTIPYRETICS AND VITAMINS** Analgesics - types - narcotic and non-narcotic analgesics - salicylate - ibuprofen (structure not necessary) antipyretics - paracetamol (structure not necessary).Vitamins - types - functions of A, B6, B12, C, D, E vitamins only (structure not necessary).	**9**
III	**ANTIBIOTICS AND ANTIMALARIAL DRUGS** Antibiotics - types - tetracycline - rifomycin only (structure not necessary) - mechanism of drug action (PABA) - antimalarial drugs - quinine only (structure not necessary).	**9**
IV	**WASHING AND CLEANING POWDER, PHENOYLS** Preparation of washing powder - cleaning powder - white, black, yellow coloured phenoyls.	**9**
V	**COSMETICS, SHAMPOO AND FACEPOWDER** Characteristics of good cosmetics – demerits of artificial cosmetics - preparation shampoo, bathing soap, basic composition of face powder.	**9**

Course Outcomes

Course Outcomes	On completion of this course, students will be able;
CO1	To recall the basic principles of the briefly outlines the bacteria and virus, various synthetic methods of drugs.
CO2	To understand the deals with miscellaneous applications drugs and its types.
CO3	To learn about various therapeutic action of drugs
CO4	To learn the concepts of the components and chemicals used in the cosmetics.
CO5	To know about assorted applications of cosmetics.

Text Books (Latest Editions)

1. Pharmaceutical Chemistry - Lakshmi
2. Medicinal Chemistry - Gurdeep R. Chatwal

3. Textbook of cosmetics – Rajesh Kumar Nema, Kamal Singh Rathore, Balkrishna Dubey.
References Books **(Latest editions, and the style as given below must be strictly adhered to)**
Medicinal Chemistry - Albert Burger

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course		**FOOD PRESERVATION**						
Category	AECC - II	**Year**	I	**Credits**	2	**Course Code**	**232204209**	
		Semester	II					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		2	-	--	2	25	75	100
Prerequisites		Basic knowledge of food processing and preservation						

Learning Objectives

- ✍ To understand the briefly outlines the food processing method.
- ✍ To also deals with food preservation in industry.
- ✍ To learn about various food products of dairy and milk products.
- ✍ To learn the concepts of the Sea and meat and egg products.
- ✍ To know about assorted food quality and sensory evaluation of products.

UNIT	**Details**	**No. of Periods for the Unit**
I	**Food Processing:** Aims of food science and technology – Constituents of food, food as a source of energy. Preparative operations in food industry - cleaning, sorting and grading of food raw materials.	**6**
II	**Food Preservation:** Commercial heat preservation methods - sterilization, pasteurization and Balancing - Evaporation and drying – Types of evaporators, Types of driers. Low–temperature food processing and preservation methods – Refrigeration and cold storage only.	**6**
III	**Milk and Dairy Products Preservation:** Milk production and quality control milk processing operations. Types of milk and milk products – Butter making – Manufacture of ice cream.	**6**
IV	**(a) Vegetables and Fruits and their Products Preservation:** Storage of vegetables, vegetable products, storage of fruits, fruit products, fruit juice production. **(b) Meat, Sea Food and Eggs Preservation:** Types of meat, preservation, cooking of meat, storage and processing of fish and fish products. Egg and Egg products.	**6**
V	**Food Quality:** Sensory Evaluation of Food Quality - Appearance factors - Textural factors - Flavour factors - Quality factors for consumer safety - Nutritional quality - Sanitary Quality - Food Safety standards.	**6**

Course Outcomes

Course Outcomes	On completion of this course, students will be able;
CO1	To understand the briefly briefly outlines the food processing method.
CO2	To also deals with food preservation in industry.
CO3	To learn about various food products of dairy and milk products.
CO4	To learn the concepts of the Sea and meat and egg products.
CO5	To know about assorted food quality and sensory evaluation of products.

Text Books (Latest Editions)

1. Varzakas. T., Tzia. C., Handbook of Food Processing: Food Preservation, 2nd Edition, CRS Press, Delhi, 2015.
2. ShakuntalManay. N., Food Facts and Principles, AA Press, Delhi, 2008.
3. Desukumar., Outline of Dairy Technology, 2nd Edition, CBS Publication, Delhi, 2001.
4. Hui. H.Y., Ozgul.E., Handbook of Vegetable Preservation and Processing, 2nd Edition,

CRS Press, Nov. 2015.
5. Huang. Y., Whittakers.D.A., Lacey. R.E., Automation for Food Engineering, Food Quality, Quantization and Process Control, 1st Edition, CRC Press, 2001.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1. Siva Sankar B., Food Processing and Preservation, Prentice Hall of India Private Limited.
2. Srivastava., Fruit Vegetable Preservation, Principles and Practices, CRS Press, 2014.
3. Varzakas.T., Tzia.C., Handbook of Food Processing: Food Safety, Quality and Manufacturing Processes, CRC Press, 2015.

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0