PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

PERIYAR MANIAMMAI
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University)
Established Under Sec. 3 of UGC Act, 1956 • NAAC Accredited
think • innovate • transform

Criterion 1 – Curricular Aspects

Key Indicator	1.1	Curriculum Design and Development
Metric	1.1.3	Average percentage of courses having focus on employability/ entrepreneurship/ skill Development offered by the department.

DEPARTMENT OF CHEMISTRY

SYLLABUS COPY OF THE COURSES HIGHLIGHTING THE FOCUS ON EMPLOYABILITY/ ENTREPRENEURSHIP/ SKILL DEVELOPMENT

1. List of courses for the programmes in order of

S. No.	Programme Name
i.	Master of Science (Chemistry) (Full Time)
ii.	Bachelor of Science (Chemistry) (Full Time)
iii.	Master of Philosophy (Chemistry) (Full Time)
iv.	Master of Philosophy (Chemistry) (Part Time)
v.	Doctor of Philosophy (Full Time)
vi.	Doctor of Philosophy (Part Time)

2. Syllabus of the courses as per the list.

Legend : Words highlighted with **Blue Color** - Entrepreneurship

Words highlighted with **Red Color** - Employability

Words highlighted with **Purple Color** - Skill Development

1. **List of Courses**

Name of the Course	Course Code	Year of introduction	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development
M.Sc. –FT			
Organic Chemistry I	YCY101	2018-19	Employability-Tutorials and Assignments
Inorganic Chemistry I	YCY102	2018-19	Employability-Tutorials and Assignments
Physical Chemistry I	YCY103	2018-19	Employability-Tutorials and Assignments
Inorganic Chemistry II	YCY201	2018-19	Employability-Tutorials and Assignments
Physical Chemistry II	YCY202	2018-19	Employability-Tutorials and Assignments
Organic Chemistry II	YCY301	2018-19	Employability-Tutorials and Assignments
Pharmaceutical Chemistry	YCY304A	2018-19	Employability-Tutorials and Assignments
Analytical Chemistry	YCY305	2018-19	Employability-Tutorials and Assignments
Industrial Chemistry	YCY403B	2018-19	Employability-Tutorials and Assignments
Chemistry of Nanoscience and Nanotechnology	YCY404B ZQCY401	2018-19	Employability-Tutorials and Assignments
Organic Chemistry II	YCY301	2019-20	Employability-Tutorials and Assignments
Physical Methods in Chemistry-I	YCY302	2019-20	Employability-Tutorials and Assignments
Organic Chemistry Practical -I	YCY303	2019-20	Employability-Tutorials and Assignments
Pharmaceutical Chemistry	YEC304A/	2019-20	Entrepreneurship-Case study
Analytical Chemistry	YEC305	2019-20	Employability-Tutorials and Assignments
Physical Methods in Chemistry-II	YCY401	2019-20	Employability-Tutorials and Assignments
Organic Chemistry Practical -II	YCY402	2019-20	Employability-Tutorials and Assignments
IndustrialChemistry	YEC403B	2019-20	Employability-Tutorials and Assignments
Chemistry of nanoscience andnanotech.	YEC404B	2019-20	Employability-Tutorials and Assignments
Dissertation –Project work	YCY405	2019-20	Employability-Tutorials and Assignments

BSc FT			
Study Skills	XCY101	2017-18	Skill Developement- Group discussion
Fundamental Concepts of Chemistry	XCY104	2017-18	Employability-Tutorials and Assignments
Inorganic Chemistry I	XCY105	2017-18	Employability-Tutorials and Assignments
Human Ethics, Values, Rights and Gender Equality	XUM106	2017-18	Skill Development - Group discussion
Volumetric Analysis Practical -I	XCY107	2017-18	Employability-Tutorials and Assignments
Speech and Business Communication	XCY202	2017-18	Skill Development - Group discussion
Organic Chemistry I	XCY204	2017-18	Employability-Tutorials and Assignments
Physical Chemistry I	XCY205	2017-18	Employability-Tutorials and Assignments
Volumetric Analysis Practical- II	XCY206	2017-18	Employability-Tutorials and Assignments
Communication Skills in English	XGL101	2018-19	Skill Development - Group discussion
English for Effective Communication	XGL201	2018-19	Skill Development - Group discussion
Water Quality Analysis	XCY301	2018-19	Entrepreneurship-Case study
Inorganic Chemistry II	XCY303	2018-19	Employability-Tutorials and Assignments
Organic Chemistry II	XCY304	2018-19	Employability-Tutorials and Assignments
Disaster Management	XUM306	2018-19	Skill Development - Group discussion
Semi Micro Inorganic Qualitative Analysis Practical III	XCY307	2018-19	Employability-Tutorials and Assignments
Pharmaceutical Chemistry	XCY401	2018-19	Entrepreneurship-Case study
Modern Physics	XCY402	2018-19	Employability-Tutorials and Assignments
Physical Chemistry II	XCY403	2018-19	Employability-Tutorials and Assignments
Inorganic Chemistry III	XCY404	2018-19	Employability-Tutorials and Assignments
Modern Physics Practical	XPH405	2018-19	Employability-Tutorials and Assignments
Inorganic Quantitative Analysis PracticalIV	XCY406	2018-19	Employability-Tutorials and Assignments
Clinical Chemistry	XCY501	2019-20	Entrepreneurship-Case study
Phyto Chemistry	XCY502A	2019-20	Employability-Tutorials and Assignments

Analytical Methods in Chemistry	XCY503A	2019-20	Employability-Tutorials and Assignments
Programming in C	XCY504B	2019-20	Employability-Tutorials and Assignments
Organic Qualitative Analysis PracticalVA	XCY505	2019-20	Employability-Tutorials and Assignments
Physical Chemistry Practical VB	XCY506	2019-20	Employability-Tutorials and Assignments
Renewable Energy	XCY601	2019-20	Employability-Tutorials and Assignments
Industrial Chemistry	XCY602A	2019-20	Entrepreneurship-Case study
Polymer Chemistry	XCY603B	2019-20	Employability-Tutorials and Assignments
Organic Qualitative Analysis PracticalVI	XCY604	2019-20	Employability-Tutorials and Assignments
Physical Chemistry Practical VIA	XCY605	2019-20	Employability-Tutorials and Assignments
Project	XCY606	2019-20	Employability-Tutorials and Assignments
M.Phil			
Teaching Learning Skills	ZSW202	2015-16	Skill Development - Group discussion
Ph.D FT			
Organic Solar Cells - Theory and Practice	RCY010	2016-17	Employability-Tutorials and Assignments
Physical Methods in Chemistry	RCY002	2016-17	Employability-Tutorials and Assignments
Crystallography and Structural Chemistry	RCY011	2016-17	Employability-Tutorials and Assignments
Ph.D PT			
Coursera Online Course-Material Behavior	RCY010	2019-20	Employability-Tutorials and Assignments
Research and Publication Ethics	RM002	2019-20	Skill Development - Group discussion

B.Sc Chemistry

COURSE CODE	XCY104	L	T	P	SS	C
COURSE NAME	FUNDAMENTAL CONCEPTS OF CHEMISTRY	3	1	0	0	4
C: P: A	3.2:0:0.8	L	T	P	SS	H
		3	1	0	0	4

COURSE OUTCOMES:		Domain	Level
CO1	*Explain* the principle of atomic structure and basics of quantum mechanism	Cognitive	Understand
CO2	*Describe* the periodic properties of various elements	Cognitive	Remember
CO3	*Interpret* IUPAC nomenclature of compounds.	Cognitive Affective	Apply Receiving
CO4	*Describe* the physical properties of dipole moment, polarizability and magnetic properties.	Cognitive Affective	Remember Responding
CO5	*Apply* and *Identify* the various analytical methods for quantitative analysis.	Cognitive	Remember Apply

UNIT - IATOMIC STRUCTURE AND BASIC QUANTUM MECHANICS **10+3**

Atom, constituents of an atom – Bohr's postulates – Bohr's atom model – limitations of the Bohr's atom model - Sommerfeld atom model. Particle and wave character of electron – de-Broglie's equation and its derivation – The Davisson and Germer experiment – Heisenberg's uncertainity principle. Photoelectric effect - Einstein photoelectric equation – Compton effect. Quantum theory – postulates of quantum mechanics – The Schrodinger wave equation-Quantum numbers. Aufbau principle – Hund's rule of maximum spin multiplicity – Pauli's exclusion principle – n + l rule – electronic configurations of elements.

UNIT - II PERIODIC TABLE **6+3**

Modern periodic law – modern periodic table – classification of elements based on electronic configuration. Fundamental properties like atomic size, valency, ionization energy, ionic radius, electron affinity, electronegativity, metallic and nonmetallic character - variation of the above fundamental properties – explanation for the periodic variation of the fundamental properties – diagonal relationship.

UNIT – III FUNDAMENTALS OF ORGANIC CHEMISTRY **9+3**

IUPAC Nomenclature of organic compounds Molecular weight determination of simple organic acid and bases – Silver salt and platonic chloride methods. Calculation of empirical and molecular formula using percentage composition of elements and molecular weight. Fundamental concepts - Homolytic fission and Heterolytic fission of carbon-carbon bonds - Reaction intermediates: Formation and stability of Free radicals, carbonium ions and carbanions – nucleophilic and electrophilic reagents. Types of reactions-Substitution, addition, elimination, rearrangement and polymerization with suitable examples.Inductive effect and electromeric effect: explanation with suitable examples.

UNIT –IV PHYSICAL PROPERTIES AND CHEMICAL CONSTITUTIONS. **10+3**

Dipole moment: Definition – Experimental determination - Calculation of percentage of ionic character of HF and HCl –Dipole moment and molecular structure: CO2, H_2O,NH3 and CH4.

Polarizability: Definition – polarization of a molecule – molar polarization – Clausius-Mosotti equation. Magnetic properties: Paramagnetic, diamagnetic and ferromagnetic substances and their characteristics – magnetic permeability – magnetic susceptibility – specific and molar magnetic susceptibilities – determination of magnetic susceptibility by Gouy's method.

UNIT –V ANALYTICAL METHODS **10+3**

Qualitative Inorganic Analysis – Dry Test, flame test, cobalt nitrate test–wet confirmatory test for acid radicals, interfering acid radicals – elimination of interfering acid radicals. Solubility product, common ion effect, complexation, oxidation reduction reactions involved in identification of anions and cations – separation of cations into groups – Volumetric analysis – preparation of standard solutions –normality, molarity and molality by titrimetric reactions – acid base, redox, precipitation and complex metric titrations –indicators – effect of change in pH – selection of suitable indicators.

LECTURE	TUTORIALS	PRACTICALS	SELF STUDY	TOTAL
45	15	0	0	60

TEXT BOOKS

1. Puri B.R..,Sharma L.R., Kalia K.K.,Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., (1993).
2. Lee J.D., Concise Inorganic Chemistry, UK, Black well science (2006).
3. Puri B.R..,Sharma L.R., Pathania M.S.,Principles of Physical Chemistry, (23rdedition), New Delhi, Shoban Lal Nagin Chand & Co., (1993).
4. Glasstone S., Lewis D.,Elements of Physical Chemistry, London, Mac Millan & Co.Ltd.

REFERENCES

1. Morrison R.T. and Boyd R.N., Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., (1976).
2. Bahl B.S. and Arun Bahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).
3. Frank J. Welcher and Richard B. Hahn, Semi micro Qualitative Analysis, New Delhi, Affiliated East-west Press Pvt. Ltd. (1969).
4. G.D. Tuli, R.D. Madan, S.K. Basu, Satya Prakash, Advanced Inorganic Chemistry,Volume 1, (5th edition), New Delhi, S. Chand & Company Ltd, (2014

E RESOURCES

1. http://www.mooc-list.com/course/chemistry-minor-saylororg
2. https://www.canvas.net/courses/exploring-chemistry
3. http://freevideolectures.com/Course/3001/Chemistry-I
4. http://freevideolectures.com/Course/3167/Chemistry-II

COURSE CODE	XCY105	L	T	P	SS	C
COURSE NAME	INORGANIC CHEMISTRY I	3	1	0	0	4
C: P: A	2.8:0.4:0.8	L	T	P	SS	H
		3	1	0	0	4

COURSE OUTCOMES:		Domain	Level
CO1	***Recall*** and ***Explain*** the basic concepts of ionic bonding; Display the shapes of simple inorganic molecules usingVSEPR theory	Cognitive Psychomotor	Remember Understand Set
CO2	***Summarize*** and ***Report*** extraction, properties and uses of I A and IIA group s-block elements.	Cognitive Affective	Understand Responding
CO3	***Explain*** the extraction and purification process of various metals and Interpret their physical and chemical properties.	Cognitive Affective	Understand Apply Responding
CO4	***Describe*** the concept of acids and bases and the application of various concepts.	Cognitive Psychomotor	Analysis Perception
CO5	***Identify*** the various radioactive process and their consequences	Cognitive	Remember

UNIT - ICHEMICAL BONDING **10+3**

Ionic bond – Lattice Energy – Born – Haber Cycle – Pauling and Muliken's scales of electro negativity – Polarizing power and Polarisability – partial ionic character from electro negativity –
Transitions from ionic to covalent character and vice versa – Fajan's rule. VSEPR Theory – Shapes of simple inorganic molecules ($BeCl_2$, $SiCl_4$, PCl_5, SF_6,IF_7, NH_3, XeF_6, BF_3,H_2O) - VB Theory – Principles of hybridization – $BeCl_2$ – MO Theory – Bonding and antibonding orbitals – Application of MO Theory to H_2,He_2,N_2,O_2,HF and CO – Comparison of VB and MO theories.

UNIT - II CHEMISTRY OF S-BLOCK ELEMENTS **6+3**

Position of Hydrogen in the Periodic Table, atomic hydrogen, nascent hydrogen, occluded hydrogen and uses of hydrogen. General characteristics of s-block elements – General characteristics of Group IA – diagonal relationship between Li and Mg – Physical and Chemical properties – Uses – Preparation of NaOH, Na_2CO_3, $NaHCO_3$ (Laboratory and Industrial methods) – Properties – Uses. General characteristics of Elements of Group II A – diagonal relationship between Be and Al —Physical and Chemical properties –Uses – Preparation and uses of Mg: $MgCO_3$, $MgSO_4$.

UNIT – III BASIC PRINCIPLES OF METALLLURGY **9+3**

Ores and minerals – concentrating the ore by gravity separation, froth flotation and magnetic
separation – Types of furnaces -Roasting– Calcination – Smelting – Flux – Purification by electrolytic refining, zone refining and Van-Arkel vapour phase refining with suitable examples– Alumino thermic process. Group–IA: Extraction of lithium and its uses - Diagonal relationship of Lithium with Magnesium Group–IIA: Extraction of Beryllium and its uses –Diagonal relationship of Beryllium with Aluminium Group–

IB: Extraction of copper and its uses – Extraction of silver and its uses. Group-VA: Nitrogen: Ammonia – manufacture, properties, uses and structure.
Nitric Acid: Manufacture of Nitric acid – Action of nitric acid on metals

UNIT –IV ACIDS AND BASES	**10+3**

Lewis concept – Classification of Lewis acids – Lux-Flood concept – Hard-Soft acid base concept and its applications. Non- aqueous solvents- Classification of solvents- Neutralization reaction and solvolysis in liquid ammonia- Metal- ammonia solutions. Neutralisation, solvolysis and redox reactions.

UNIT –V NUCLEAR CHEMISTRY	**10+3**

Constitution of nuclei – stability of nuclei and (n-p) ratio – magic number– mass defect and binding energy – mass – energy relationship. Radioactivity: Natural radioactivity — Soddy's group displacement law – Radioactivity equilibrium – Rate of radioactive disintegration – half -life period and average life period– radioactive disintegration series. Nuclear fission: Theory – applications – principle of atom bomb. **Nuclear fusion: Theory – Solar and Stellar energy – principle of hydrogen bomb Applications of radioactivity: medicine – agriculture – industry – structural elucidations– carbon dating– cyclotron.**

LECTURE	TUTORIALS	PRACTICALS	SELFSTUDY	TOTAL
45	15	0	0	60

TEXT BOOKS

1. Lee J.D.,Concise Inorganic Chemistry, UK, Black well science (2006).
2. Bahl B.S. and Arun Bahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2007).

REFERENCES

1. Puri B.R..,Sharma L.R., Kalia K.K.,Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., (2003).
2. Puri B.R..,Sharma L.R., Pathania M.S.,Principles of Physical Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., (2005).
3. Glasstone S., Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co. Ltd.
4. Morrison R.T. and Boyd R.N., Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., (2003).

COURSE	XCY204	L	T	P	SS	C

CODE						
COURSE NAME	**ORGANIC CHEMISTRY I**	**3**	**1**	**0**	**0**	**4**
C:P:A	**2.8:0.4:0.8**	**L**	**T**	**P**	**SS**	**H**
		3	**1**	**0**	**0**	**4**

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO1	***Explain*** the preparation, properties and applications of alkenes,alkynes and their derivatives.	Cognitive	Understand
CO2	***Describe*** the preparation with mechanism, properties and applications of alkocols, ethers and their derivatives. ***Estimate*** hydroxy and alkoxy groups.	Cognitive	Remember
CO3	***Explain*** the preparation with mechanism, properties and naming reactions of aldehydes, ketones & carboxylic acid and their derivatives.	Cognitive Affective	Apply Receiving
CO4	***Describe*** the concepts of covalent bonding and ***explain*** *the structure of hyb*ridization.	Cognitive	Remember Responding
CO5	***Apply*** and ***Identify*** the various stereo chemical concepts.	Cognitive	Apply Remember

UNIT I - COVALENT BONDING ANDSTRUCTURE	**9+3**
Covalentbonding–Conceptofhybridization–Structureoforganicmoleculesbasedon sp^3,sp^2 andsp hybridization– Covalentbondpropertiesoforganicmolecules:bondlength,bondangle,bondenergy, bondpolarity,dipolemoment,inductive,mesomeric,electromeric,resonanceandhyperconjugativ eeffects.	

UNIT II - ALIPHATIC HYDROCARBONS AND ALKYL HALIDES	**9+3**
Alkenes: Ozonolysis, Hydroboration and polymerization with suitable examples. Dienes: Classification – preparation, properties and uses of Butadiene Alkynes: Acidity of alkynesAlkyl halides: S_N1 and S_N2 Mechanism – E_1 and E_2 Mechanism – Hofmann and Saytzeff's rule. Poly halogen derivatives: Halogen derivatives of unsaturated hydrocarbons: Preparation and uses of vinyl chloride, allyl chloride and allyl iodide. Synthetic applications of Grignard reagents.	

UNIT III - CHEMISTRYOFCYCLOALKANES AND STREO ISOMERISM	**10+3**
Alicyclic compounds – general methods of preparation of cycloalkanes – Baeyer's strain theory and its modifications. Conformational analysis: differences between configuration and conformation Fischer and Sawhorse and Newman projection formulae – conformational analysis of ethane, n-butane and 1,2-dichloro ethane Geometrical isomerism – maleic acid and fumaric acid – aldoximes and ketoximes E-Z notations. Optical isomerism: definition: optical activity and optical isomerism – optical isomerism of compounds containing asymmetric carbon atom – tartaric acid – enantiomers and diastereoisomers – racemic and meso forms – racemisation – resolution of racemic mixture – Walden inversion – asymmetric synthesis – chirality – specifications of absolute configurations by R and S notations.	

UNIT IV - ALIPHATIC ALCOHOLS	**7+3**
Definition: Rectified spirit – Absolute alcohol – **Methylated spirit – Power alcohol.Preparation, properties and uses of allyl alcohol**. Polyhydric alcohol: Estimation of number of hydroxyl groups in a polyhydric alcohol.Ethers:Estimation of alkoxy groups – Zeisel's method – preparation of chlorex and vinyl ether. **Thioalcohols and**	

thioethers: Preparation and uses of ethyl mercaptan, diethyl ether, sulphonal and mustard gas. Phosphorous ylides – preparation and properties–Wittig reaction.

UNIT V - ALDEHYDES, KETONES AND CARBOXYLIC ACID | **10+3**

Preparation of aldehydes and ketones from fatty acids – Rosenmund reduction – Stephen's method – Mechanism of nucleophilic addition to Carbonyl compounds – Hemiacetal and Acetal formations – Cyanohydrin formation – Meerwein-Pondorf-Varleyreduction – Oppaenaur idation – preparation of Acrolein, Crotonaldehyde, Chloral , Hydroxy acetone and Acetylacetone Carboxylic acids and their derivatives: Structure of carboxylic acids – acidity of carboxylic acids – effect of subsituents on acidity – preparation of acrylic acid and crotonic acid. Halogensubstituted acids: **Preparation and properties of mono, di and tri chloro carboxylic acids – Hydroxy acids. Dicarboxylic acids: Preparation of Malonic acid and Malonic ester – Synthetic applications of diethyl malonate**– Action of heat on dicarboxylic acids

	LECTURE	TUTORIAL	PRACTICAL	SELF STUDY	TOTAL
HOURS	**45**	**15**	**0**	**0**	**60**

TEXT BOOKS

a. MorrisonR.T. and BoydR.N., OrganicChemistry(6th edition),NewYork,Allyn&BaconLtd.,(1976).
b. BahlB.S. andArunBahl, AdvancedOrganicChemistry,(12th edition),NewDelhi,SultanChand&Co., (1997).
c. Organic Chemistry – Volume I", I.L.Finar
d. Organic Chemistry – Volume II", I.L.Finar
e. Organic Chemistry – J.Clayden
f. Organic Chemistry – Jerry March
g. Organic Chemistry – Mc muray
h. Organic Chemistry", P.L.Soni
i. Advanced Organic Chemistry", B.S.Bahl and Arun Bahl
j. Organic Chemistry", R.T.Morrison and R.W.Boyd

REFERENCES

1. Organic Chemistry, Paula, Yurkanis and Bruice

2.Mukul C. RayReaction Mechanisms in Organic Chemistry

3. P.L. Kalsi, Organic Reactions and Their Mechanisms

E RESOURCES

https://www.mooc-list.com/course/organic-chemistry-i-saylororg
https://www.canvas.net/courses/exploring-chemistry
https://www.youtube.com/watch?v=nB9yqj-ZcAk
http://freevideolectures.com/Course/3001/Chemistry-I/3
https://ocw.mit.edu/courses/chemistry/5-12-organic-chemistry-i-spring-2005/
http://freevideolectures.com/Course/3001/Chemistry-I
http://freevideolectures.com/Course/2384/Freshman-Organic-Chemistry

COURSE CODE	XCY205	L	T	P	SS	C
COURSE NAME	PHYSICAL CHEMISTRY I	3	1	0	0	4
PRERQUISITE	NIL	L	T	P	SS	H
C:P:A	2.8:0.4:0.8	3	1	0	0	4

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Classify*** the types of Molecular velocity of gases and kinetic theory of gases; ***Derive*** vanderwalls equation of real gases.	Cognitive	Understand
CO2	***Apply*** and ***Identify*** the structure and properties of solid state.	Cognitive	Remember Apply
CO3	***Apply*** and ***Identify*** the structure and properties of liquid crystals and colloids	Cognitive Affective	Remember Apply
CO4	***Describe*** the concepts of colloidal state and ***explain*** *the types of Emulsions.*	Cognitive	Remember Responding
CO5	***Identify*** the principles of chemical equlibrium and ***explain*** the theory behind the catalysis.	Cognitive Affective	Remember Receive

UNIT I - GASEOUS STATE	**9+3**

Kinetic theory of gases – equation of kinetic theory of gases – derivation of gas laws from the equation of kinetic theory of gases. Ideal gases and real gases – deviations of real gases from ideal behaviour – Van der waal's equation (Derivation) – Significances of van der Waal's constants. P-V isotherms – Andrew'sexperiment–critical states of gases – Definition and determination of the critical constants – relation between van der Waal's constants and critical constants, Kinetic theory of gases: Mean free path – collision frequency – Definition and problems involving RMS velocity, Most probable velocity and Average velocity – Boltzman distribution of molecular velocities (No derivation)

UNIT II - SOLID STATE	**9+3**

Crystallography — Definition: unit cell, crystal lattice and interfacial angle Crystallographic systems: Bravis lattices – simple, cubic, face-centered cubic and body-centered cubic systems. Types of crystals: Ionic crystal – Structure of NaCl – Molecular crystals: Structure of Ice – Covalent crystals: structure of diamond and graphite – metallic crystals.Bonding in crystals – electrical properties - Conductors, semiconductors and insulators – super conductors – simple explanation with examples – Defects in crystals.

UNIT III - LIQUID STATE, LIQUID CRYSTALS –AND ADSORPTION	**9+3**

Theory of liquids – free volume of liquids – Vapour pressure – Surface ension, effect of temperature on surface tension, parachor – Viscosity,effect of temperature on viscosity – hole theory – Reynolds number – structure of liquids.Trouton's rule and its significance
Classification of Liquid crystals– Transformation into the mesomorphic states –
Definitions – Adsorbate, adsorbent and interface – Distinction between physisorption and chemisorption – Surfactants.Adsorption of gases on solids – Freundlich, Langmuir and BET adsorption isotherms Applications of adsorptions.

UNIT IV - COLLOIDAL STATE	**10+3**

types of colloids – sols – Lyophilic sols and lyophobic sols – properties of colloids – optical property (Tyndall effect) – kinetic property (Brownian movement) – Electrical properties like electrical double layer, zeta potential, electrophoresis and electro-osmosis – stability of colloids – Coagulation – protective colloids – Gold number – flocculation values – Hofmeister series.
GELS: Elastic and non-elastic gels – imbibition – syneresis – thixotropyEmulsions: Definition – types of emulsions – emulsifiers – Bancroft's rule HLB number. Applications of colloids: Cottrel precipitator – Sewage disposals – detergent action of soaps – artificial rain – formation of delta – smoke screens.

UNIT V - CHEMICAL EQUILIBRIUM	**8+3**

Reversible and irreversible reactions – statement of law of mass action – Derivation of law of mass action from kinetic theory – Relationship between Kp and Kc (derivation). Applications of Law of mass action to the equilibria involving the formation of NH_3, dissociation of $CaCO_3$ and the dehydration of $CuSO_4.5H_2O$. Lechatelier's principle: statement – application to the formation of NH_3.

CATALYSIS: Homogeneous and heterogeneous catalysis – promoters and catalytic poisons – auto catalysis – Acid-base catalysis – Enzyme catalysis –Kinetics of enzymed catalysed reaction.

	LECTURE	TUTORIAL	PRACTICAL	SELF STUDY	TOTAL
HOURS	**45**	**15**	**0**	**0**	**60**

TEXT BOOKS

1. GlasstoneS.,LewisD., ElementsofPhysicalChemistry, London,MacMillan&Co.Ltd.
2. Principles of Physical Chemistry", B.R.Puri and L.R.Sharma
3. Principles of Physical Chemistry", B.R.Puri, L.R.Sharma and M.S.Pathania
4. Physical Chemistry", N.Kundu and SN.Jain
5. Physical Chemistry", Peter Atkins Julio de paula

REFERENCES

1.Physical Chemistry: A Molecular Approach Donald A. McQuarrie

2.Physical Chemistry.G.W.Ball

3.Solid state and its applications, Anthony. R. West.

4.Physical Chemistry Volume-1, A. K. Nag.

E RESOURCES

1. https://www.youtube.com/watch?v=A1p4j_aHdbw
2.https://www.youtube.com/watch?v=gvq2QZ38n9U
3.https://www.mooc-list.com/course/Physical-chemistry-i-saylororg

COURSE CODE	**XCY303**	**L**	**T**	**P**	**SS**	**C**
COURSE NAME	**INORGANIC CHEMISTRY II**	**3**	**1**	**0**	**0**	**4**
PREREQUISITE	**NIL**	**L**	**T**	**P**	**SS**	**H**
C:P:A	**3.2:0:0.8**	**3**	**1**	**0**	**0**	**4**

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO1	***Explain*** the various compounds of halogens and carbon.	Cognitive	Understanding
CO2	***Describe*** the properties structure of peracids.	Cognitive	Remember
CO3	***Recognize*** the general characteristics and properties of transition elements.	Cognitive Affective	Apply Receiving
CO4	***Identify*** the general characteristics and properties of Lanthanides and Actinides.	Cognitive Affective	Remember Responding
CO5	***Apply*** and ***Identify*** the various properties and bonding of organo metallic compounds.	Cognitive	Apply Remember

UNIT I - HALOGENS, CARBON AND NOBLE GAS COMPOUNDS **10+3**

Halogens -General trends in the properties of halogens – deviation of fluorine from other elements of the group. Preparation of fluorine – properties of fluorine – hydrogen fluoride – oxides of halogens – preparation properties and uses of hydrogen halides, oxy acids of halogens – freons. Interhalogen Compounds**:** XY, XY_3, XY_5 and XY_7 types and their

structure. Pseudohalogens and pseudohalides definition with exmples.

Inorganic Carbon Compounds: Types of **c**arbides - Covalent, ionic and interstitial carbides with suitable examples – oxides of carbon – oxy acids of carbon – carbonates – fullerenes.

Noble gas compounds: preparation and properties of xenon fluorides and oxyfluoride and kryptonfluoride.

UNIT II - PERACIDS AND PERSALTS	**6+3**

Preparation, properties and structure of permonosulphuric acid, perdisulphuric acid and potassium perdisulphate. Preparation and properties of permonocarbonic acid, perdicarbonic acid and perdicarbonates.

UNIT III - TRANSITION ELEMENTS - GROUP STUDY	**9+3**

Transition elements-position in the periodic table General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu. Chemistry of titanium dioxide, titanium tetrachloride, vanadium penta oxide-ammonium vanadate, ammonium molybdate, molybdenum blue, tungsten oxide, tungsten bronze, zirconium halide.

UNIT IV - LANTHANIDES AND ACTINIDES	**10+3**

Position of lanthanides actinides in the periodic table – Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction – actinide contraction.

Occurrence and general methods of extraction of lanthanides by reducing the trihalides, ion exchange and valence exchange methods. Isolation of thorium from monazite – Preparation properties and uses of oxides, oxy acids, hydrides and halides of cerium and lanthanum.

Organometallic compounds of lanthanoides – optical properties – magnetic properties of lanthanides - Applications of lanthanides and actinides.

UNIT V - ORGANO METALLIC COMPOUNDS	**10+3**

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).

	LECTURE	**TUTORIAL**	**PRACTICAL**	**SELF STUDY**	**TOTAL**
HOURS	**45**	**15**	**0**	**0**	**60**

TEXT BOOKS

1. “Inorganic Chemistry”, P.L.Soni
2. “Inorganic Chemistry”, Puri and Sharma
3. “Advanced Inorganic Chemistry”, R.D.Madan

REFERENCES

1. “Basic Inorganic Chemistry”, F.A. Cotton and Wilkinosn
2. “In-organic Chemistry”, Shriver and Atkins
3. “Inorganic Chemistry”, James E.Huheey
4. “Concise Inorganic Chemistry”, J.D.Lee
5. “Fundamentals of Inorganic Chemistry”, Gilreath

COURSE CODE	XCY304	L	T	P	SS	C
COURSE NAME	ORGANIC CHEMISTRY II	3	1	0	0	4
C:P:A	3.2:0:0.8	L	T	P	SS	H
		3	1	0	0	4

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Explain*** the principle of atomic structure and and its substitution reaction.	Cognitive	Understanding
CO2	***Describe*** the phenol, ethers and aryl halides reacrtions with some naming reactions.	Cognitive	Remember
CO3	***Identify*** the compounds of amines and diazonium salts.	Cognitive Affective	Apply Receiving
CO4	***Recognise*** the various structures of amino acids, peptides and proteins	Cognitive Affective	Understanding Responding
CO5	***Describe*** the general properties of carbohydrates.	Cognitive	Remember

UNIT I - AROMATIC COMPOUNDS	**9+3**

Aromatic compounds: Aromatic hydrocarbons – aromaticity and Huckel's rule – Simple applications.Aromatic substitution: Electrophilic substitution with suitable examples – Mechanism of Halogenation, Nitration, Sulphonation and Friedel-Craft's reactions – nucleophilic and free radical substitution with suitable examples.

Directive influence of substituents: Orientation – Effect of substituents – activating and deactivating groups – Rules of disubstitution and trisubstitution in benzene – steric hinderance.

UNIT II - PHENOLS, ETHERS AND ARYL HALIDES	**10+3**

(Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. ReimerTiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction. Ethers (aromatic): Cleavage of ethers with HI.

Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides. preparation and uses of DDT.

UNIT III - AMINES AND DIAZONIUM SALTS	**9+3**

Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2. Electrophilic substitution (case aniline): nitration, bromination, sulphonation. Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes. Derivatives of phthalic acid: preparation and properties of phthalic anhydride and phthalimide. Preparation of the following compounds and their uses – phenylacetic acid, mandelic acid, cinnamic acid, aspirin and methyl salicylate.

UNIT IV - AMINO ACIDS, PEPTIDES AND PROTEINS	**9+3**

Amino Acids, Peptides and Proteins: Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis. Reactions of Amino acids: ester of –COOH group, acetylation of –NH2 group, complexation with Cu^{2+} ions, ninhydrin test. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C activating groups and Merrifield solid-phase synthesis.

UNIT V - CARBOHYDRATES	**8+3**

Classification, and General Properties, Glucose and Fructose (open chain and cyclic

structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation. Oils and fats: definition – determination and application – saponification value – iodine value – Reichert-Meissel value – acid value.

	LECTURE	TUTORIAL	PRACTICAL	SELF STUDY	TOTAL
HOURS	**45**	**15**	**0**	**0**	**60**

TEXT BOOKS

1. "Organic Chemistry", P.L.Soni
2. "Advanced Organic Chemistry", B.S.Bahl and Arun Bahl
3. "Organic Chemistry", R.T.Morrison and R.W.Boyd

REFERENCES

1. "Organic Chemistry – Volume I", I.L.Finar
2. "Organic Chemistry – Volume II", I.L.Finar
3. "Reaction Mechanism of Organic Compounds" – Jerry March
4. "Organic Chemistry" – J. Clayden
5. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
6. Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998).
7. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).
8. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed.,

9.W. H. Freeman. Berg, J.M., Tymoczko, J.L.& Stryer, L. Biochemistry, W.H. Freeman, 2002.

COURSE CODE	**XCY403**	**L**	**T**	**P**	**SS**	**C**
COURSE NAME	**PHYSICAL CHEMISTRY II**	**3**	**1**	**0**	**0**	**4**
C:P:A	**3.6:0:0.4**	**L**	**T**	**P**	**SS**	**H**
		3	**1**	**0**	**0**	**4**

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO1	***Explain*** the principle thermodynamics and its laws applications.	Cognitive	Understanding
CO2	***Apply*** the rate and its half life for the chemical reactions..	Cognitive Affective	Apply Receiving
CO3	***Describe*** the various concepts and laws of solutions.	Cognitive	Understanding
CO4	***Identify*** the various component system and its equilibrium.	Cognitive Affective	understanding
CO5	***Describe*** the basic concepts in electro chemistry and ***application*** of conductance andfor finding the emf of the cell**..**	Cognitive	Apply Remember

UNIT I - THERMODYNAMICS **9+3**

Chemical Energetics **-**Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

UNIT II - CHEMICAL KINETICS **9+3**

Rate of reactions – rate constant – order and molecularity of reactions – first order and pseudo unimolecular reactions (definition and examples) – derivation of rate constant for the inversion of cane sugar. Second order reactions – definition – examples – derivation of rate constant (same concentration and different concentration) and half life period – application to saponification of ester.

Third order reactions: definition and examples. Methods of determination of order of reactions.Zero order reactions – definition and examples – derivation of rate constant. Theory of reaction rates – collision theory of bimolecular reactions – unimolecular reactions – Lindemann's hypothesis – theory of absolute reaction rates.

UNIT III - SOLUTIONS	**8 +3**

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature, composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

UNIT IV - IONIC EQUILIBRIUM AND PHASE EQUILIBRIUM	**9+3**

Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, Solubility and Solubility product-common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions.

Phase Equilibrium Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver only).

UNIT V - ELECTROCHEMISTRY AND CONDUCTANCE	**9+3**

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. **Concentration cells with transference and without transference. Liquid junction potential and salt bridge. Potentiometric titrations**

Conductance Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte. Conductometric titrations (only acid base).

	LECTURE	**TUTORIAL**	**PRACTICAL**	**SELF STUDY**	**TOTAL**
HOURS	**45**	**15**	**0**	**0**	**60**

TEXT BOOKS

1. "Principles of Physical Chemistry", B.R.Puri and L.R.Sharma
2. "Principles of Physical Chemistry", B.R.Puri, L.R.Sharma and M.S.Pathania
3. "Physical Chemistry", N.Kundu and SN.Jain

REFERENCES

1. "Textbook of Physical Chemistry", S.Glasstone
2. "Physical Chemistry", G.M.Barrow
3. "Advanced Physical Chemistry", P.W. Atkins
4. "Chemical Kinetics ", K.J.Laidler
5. Glasstone S.,Lewis D.,Elements ofPhysical Chemistry, London,MacMillan & Co. Ltd
6. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).

7. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
8. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
9. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
10. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
11. Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley.
12. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
13. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.

COURSE CODE	**XCY404**	**L**	**T**	**P**	**SS**	**C**
COURSE NAME	**INORGANIC CHEMISTRY III**	**3**	**1**	**0**	**0**	**4**
C:P:A	**3.6:0:0.4**	**L**	**T**	**P**	**SS**	**H**
		3	**1**	**0**	**0**	**4**

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO1	***Identify*** the stability of complexes and its isomerism.	Cognitive	Understanding
CO2	***Describe*** the various bonding and theroies of metal and ligands.	Cognitive Affective	Understanding Receiving
CO3	***Apply*** the concept of stability in metal carbonyls and understand the principle of complexometric titrations.	Cognitive Affective	Apply Receiving
CO4	***Identify*** the role of alkali, alkaline earth and transition metals in bio inorganic chemistry.	Cognitive Affective	Understanding
CO5	***Describe*** the properties and applications of silicones and zeolites.	Cognitive	Apply Remember

UNIT I	**CO-ORDINATION CHEMISTRY**	**9+3**

Ligands, classification of ligands,IUPAC nomenclature of coordination compounds, Co-ordination number, Sidgwick's electronic interpretation of coordination compounds and the concept of effective atomic number (EAN).

Isomerism – geometric isomerism in coordination number 4 and 6 compounds, optical isomerism and conditions for optical isomerism, optical isomerism in coordination number 4 and 6 compounds.

Stability of complexes – definition of labile and inert complexes – factors affecting stability of complexes. Postulates- sp^3, dsp^2& sp^3d^2 hybridisation with example and limitation.

UNIT II	**THEORIES OF METAL – LIGAND BONDING IN COMPLEXES**	**10+3**

Werner's coordination theory, limitations of Werner's theory.

Valence bond theory (VBT) – formation of inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). – application of VBT to octahedral complexes, square planar and tetrahedral complexes, limitations of VBT.

crystal field theory (CFT) – crystal field splitting in tetrahedral, square planar and octahedral complexes, strong and weak ligands, spectrochemical series – high – spin and low – spin complexes, magnetic properties of octahedral and tetrahedral complexes, crystal field stabilization energy (CFSE) and its uses Comparison of CFSE for Oh and Td complexes, limitations of CFT - comparison of VBT and CFT. Ligand field theory – application of LFT to octahedral and tetrahedral complexes – metal ligand π – bonding. Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

UNIT III	**METAL CARBONYLS, COMPLEXOMETRIC TITRATIONS AND CLUSTER COMPOUNDS**	**8+3**

Metal carbonyls – classification with suitable examples – metal carbonyls and EAN rule – stability of metal carbonyls – applications.
Chelates – application of chelates.
Applications of co- ordination compounds in qualitative and quantitative analysis: Separation of silver and mercury ions, copper and cadmium ions, identification of aluminium, chromium, nickel, zinc, manganese and potassium, Complexometric titrations – principle and applications – quantitative estimation of nickel using DMG, aluminium using oxine – structure of EDTA complexes.
Cluster compounds: Boranes – carbaboranes – carbonyl clusters.

UNIT IV	BIO – INORGANIC CHEMISTRY	9+3

ıtiality (significance) of metal and metal ions in biological systems. Role of alkaline and alkaline earth metal ions in biological systems.Na/K pump.
Role of iron in biological systems – structure of haemoglobin (structural elucidation not required) – oxygen transportation by haemoglobin (elementary study) Structure of chlorophyll – photosynthesis. Role of zinc in biological systems. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones). Hydrogenase-Metal poisoning – cadmium and mercury poisoning.

UNIT V	SILICONES (POLYSILOXANES) AND SILICATES	9+3

Types of silicones – structure of silicones – versatile properties of silicones.Preparation and properties of dimethyl, methylphenyl and diphenyl siliconesanes.
Applications of silicones – desired properties – sealants and adhesives – rubber – paints and coatings – health care – Automotive – aerospace – household – defoaming drycleaning electronics lubricants personalcare – construction.
Zeolites – types of zeolites - uses like ion- exchangers water softeners, molecular sieves dehydrating agents, adsorbents and catalysts.

	LECTURE	TUTORIAL	PRACTICAL	SELF STUDY	TOTAL
HOURS	45	15	0	0	60

TEXT BOOKS

1. “Inorganic Chemistry”, P.L.Soni
2. “Advanced Inorganic Chemistry”, R.D.Madan
3. “Inorganic Chemistry”, Puri and Sharma

REFERENCES

1. “Basic Inorganic Chemistry”, F.A. Cotton and Wilkinosn
2. “A Textbook of quantitative Inorganic Analysis”, Arthur.I.Vogel
3. “Inorganic Chemistry”, James E.Huheey
4. “Concise Inorganic Chemistry”, J.D.Lee
5. “Fundamentals of Inorganic Chemistry”, Gilreath
6. “Engineering Chemistry”, B.C.Jain and Monica Jain
7. “In-organic Chemistry”, Shriver and Atkins

COURSE CODE	XCY501	L	T	P	SS	C
COURSE NAME	CLINICAL CHEMISTRY	1	0	2	1	2
		L	T	P	SS	H
		1	0	2	1	4

COURSE OUTCOMES: *On the successful completion of the course, students will be able to*		DOMAIN	LEVEL
CO1	***Identify*** the mechanism of different types of metabolism.	Cognitive	Remember
CO2	***Explain*** the important concepts of various techniques used in clinical chemistry.	Cognitive	Understand
CO3	***Analyse*** the various molecular entities known as vitamins and nutrition values.	Cognitive	Analyze
CO4	***Interpret*** the methods of testing of various organs of body and the diagnostic roles of related enzymes.	Cognitive	Understand
CO5	***Illustrate*** the various methods for cardiac profile, glucose and cholesterol estimation.	Cognitive	Analyze

SYLLABUS:

UNIT - IMETABOLISM **3+3**

Distribution of fluids in the body, ECF & ICF, water metabolism, de hydration, mineral metabolism, macronutrients (principal mineral elements) & trace elements. Carbohydrate metabolism, Protein metabolism, Lipid metabolism, Bile pigment metabolism.

UNIT - II TECHNIQUES USED IN CLINICAL CHEMISTRY **3+3**

Photometry- Definition, laws of photometry, absorbance, transmittance, absorption maxima, instruments, parts of photometer, types of photometry–colorimetry, spectrophotometry, flame photometry, fluorometry, choice of appropriate filter, measurements of solution, calculation of formula, applications.

UNIT – III VITAMINS AND NUTRITION **2+3**

Classification of vitamins, Chemistry, properties, biological importance and deficiency manifestations of fat soluble vitamins. Chemistry, properties, biological importance, deficiency manifestations and coenzyme functions of water soluble vitamins.

UNIT –IV ORGAN FUNCTION TESTS AND DIAGNOSTIC ENZYMES **5+3**

Organ function tests: Evaluation of organ function tests: Assessment and clinical manifestations of renal, pancreatic, gastric and intestinal functions. Clinical importance of bilirubin.

Enzyme tests in determination of myocardial infarction. Enzymes of pancreatic origin and biliary tract.

UNIT –V APPLICATIONS OF CLINICAL CHEMISTRY **2+3**

Cardiac Profile - In brief Hypertension, Angina, Myocardial Infarction, Pattern of Cardiac Enzymes in heart diseases, Different methods of Glucose Estimation and Cholesterol Estimation, Principle advantage and disadvantage of different methods.

PRACTICALS	**30hrs**
Estimation of glucose using Fehling's solution Estimation of cholesterol using ferric chloride Estimation of ferric ion by colorimetric method Iodometric determination of vitamin C Estimation of carbohydrate in mixture by qualitative method.	
TEXT BOOKS	
1. Lehninger Principles of Biochemistry 4th Ed By David L. Nelson and Michael M.Cox,WH Freeman and Company. 2. Principles of Biochemistry (Hardcover) By Geoffrey Zubay. Publisher: McGraw HillCollege. 3. Harper's Biochemistry (Lange Medical Books) (Paperback) By Robert K. Murray,Daryl 4. K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton andLange. 5. Bioenergetics By David G. Nicholls and Stuart J. Ferguson. AcademicPress. 6. Bioenergetics at a Glance: An Illustrated Introduction (At a Glance) By D.A. Harris.Publisher: WileyBlackwell	
REFERENCE BOOKS	
1. Biochemistry By Lubert Stryer. WH Freeman andCo. 2. Principles of Biochemistry By Robert Horton, Laurence A Moran, Gray Scrimgeour, Marc Perry and David Rawn. PearsonEducation. 3. Harper's Biochemistry By RK Murray, DK Granner, PA Mayes and VW Rodwell.Appeltonand Lange,Stanford.	

LECTURE	**TUTORIAL**	**SELF-STUDY**
15	**----**	**15**

COURSE CODE	**XCY503A**	**L**	**T**	**P**	**C**
COURSE NAME	**ANALYTICAL METHODS IN CHEMISTRY**	**3**	**1**	**0**	**4**
		L	**T**	**P**	**H**
		3	**1**	**0**	**4**

COURSE OUTCOMES: ***On the successful completion of the course, students will be able to***		**DOMAIN**	**LEVEL**
CO1	***Identify*** the concepts of qualitative and quantitative analysis and also to find out the errors, accuracy and precision in data analysis.	Cognitive	Remember
CO2	***Explain*** the principles and methods of analyzing chemical compounds with the help of various spectroscopies.	Cognitive	Understand
CO3	***Analyse*** the various types of thermal methods of analysis including TGA, DTA, DSC etc.	Cognitive	Analyze

CO4	***Interpret*** the importance of electroanalytical techniques in analysis of different parameters of chemical compounds and solutions..	Cognitive	Understand
CO5	***Illustrate*** the significance of separation techniques in visualizing trace elements and comparing it with control samples.	Cognitive	Analyze

SYLLYBUS:

UNIT - I QUALITATIVE AND QUANTITATIVE ASPECTS OF ANALYSIS **5+3**

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

UNIT-II OPTICAL METHODS OFANALYSIS **15+3**

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules,validity of Beer-Lambert's law.

UV-Visible Spectrometry: **Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;**

Infrared Spectrometry: **Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution.**

Flame Atomic Absorption and Emission Spectrometry: **Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.**

UNIT – III THERMAL METHODS OF ANALYSIS **5+3**

Theory of thermogravimetry (TG), basic principle of instrumentation. Principles, instrumentation and applications of TGA, DTA, DSC. Techniques for quantitative estimation of Ca and Mg from their mixture.

UNIT –IV ELECTROANALYTICAL METHODS **5+3**

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric
titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

UNIT –V SEPARATION TECHNIQUES **15+3**

Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction:
extraction by solvation and chelation.Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.
Chromatography: Classification, principle and efficiency of the technique.
Mechanism of separation: adsorption, partition & ion exchange. Paper, column, Thin layer chromatography and HPLC

TEXT BOOKS

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of QuantitativeChemical Analysis*, John Wiley & Sons, 1989.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA,1988.
3. Christian, G.D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York,2004.
4. Harris, D. C. *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman,2001.

REFERENCE BOOKS

1. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age, International Publisher,2009.
2. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
3. Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Serieson Analytical Chemistry, John Wiley & Sons, 1979.

E Resources - MOOCs:

1. https://www.mooc-list.com/course/basic-analytical-chemistry-edx
2. https://www.mooc-list.com/course/analytical-chemistry-instrumental-analysis-coursera
3. https://www.mooc-list.com/course/analytical-chemistry-saylororg

COURSE CODE	**XCY602A**	**L**	**T**	**P**	**SS**	**C**
COURSE NAME	**INDUSTRIAL CHEMISTRY**	**3**	**1**	**0**	**0**	**4**
PREREQUISITE	**NIL**	**L**	**T**	**P**	**SS**	**H**
C:P:A	**3.2:0:0.8**	**3**	**1**	**0**	**0**	**4**

COURSE OUTCOMES: : *On the successful completion of the course, students will be able to*		**DOMAIN**	**LEVEL**
CO1	***Describe*** the utilization of the raw materials in chemical industry.	Cognitive	Remember
CO2	***Explain*** the manufacturing process of cement, ceramics, glass and fertilizers.	Cognitive	Understand
CO3	***Recognize*** the technologies used in small scale chemical industries.	Cognitive	Understand
CO4	***Interpret*** the various toxic chemicals used in agro industries and synthesis of sugar	Cognitive Affective	Remember Receive
CO5	***Examine*** the various pollutants and gain awareness about industrial pollution.	Cognitive Affective	Analyze Respond

UNIT I	**RAW MATERIALS AND ENERGY FOR CHEMICAL INDUSTRY**	**9+3**

Raw materials – Characteristics of raw materials and their resources – methods of raw material concentrations – integral utilization of raw materials.Energy for chemical industry – Fuels – classification of fuels – coal – fuel gases and liquid fuels – petroleum – cracking – Octane number – cetane number – composition and uses of coal gas, water gas, producer gas, oil gas and gobar gas.		
UNIT II	**CEMENT, CERAMICS, GLASS AND FERTILIZERS**	**9+3**
Cement: Manufacture – Wet Process and Dry process. Types, Analysis of major constituents, setting of cement, reinforced concrete. Cement industries in India. Ceramics: Important clays and feldspar, glazing and verification.Glass: Types, Composition, manufacture of Optical glass, colored glasses, lead glass and neutron absorbing glass. Fertilizers: Fertilizer industries in India, Manufacture of ammonia, ammonium salts, urea, superphosphate, triple superphosphate and nitrate salts.		
UNIT III	**SMALL SCALE CHEMICAL INDUSTRIES**	**9+3**
Electrothermal and electrochemical industries: electroplating – surface coating industries – oils, fats and waxes – Textiles industry-soaps and detergents – cosmetics. Match industries and fire works: manufacture of some industrially important chemicals like potassium chlorate, and red phosphorus – metal powders.		
UNIT IV	**SUGAR AND AGRO CHEMICAL**	**9+3**
Sugar: Cane sugar manufacture, recovery of sugar from molasses, sugar estimation, sugar industries in India. Agrochemical industries: Important categories of insecticides, fungicides, herbicides. Mode of action and synthesis of common pesticides like Gammexane, DDT, alathrin, Parathion, Malathion, Baygon, DDVP, Warfarin.		
UNIT V	**INDUSTRIAL POLLUTION & CHEMICAL TOXICOLOGY**	**9+3**
Introduction – causes of industrial pollution – thermal power plants – nuclear power reactors– fertilizers and chemical industry – pulp and paper industries – agro based industries – cement industry.Toxic Chemicals in the environment – biochemical effects of arsenic, cadmium, lead, mercury andcyanide.		

COURSE CODE	XCY603B	L	T	P	SS	C
COURSE NAME	POLYMER CHEMISTRY	3	1	0	0	4
PREREQUISITES	NIL	L	T	P	SS	H
C:P:A	3.4:0:0.6	3	1	0	0	4

COURSE OUTCOMES: *On the successful completion of the course, students will be able to*		DOMAIN	LEVEL
CO1	***Explain*** the chemistry of polymerization.	Cognitive	Understand
CO2	***Describe*** the preparation of individual polymers	Cognitive Affective	Understand Respond
CO3	***Interpret*** their physical properties of polymers and explain the molecular weight and size of polymers.	Cognitive Affective	Understand Apply Respond
CO4	***Recognize*** the polymerization techniques and ***Classify*** the uses of polymers.	Cognitive	Analyze
CO5	***Summarize*** the processing of polymers	Cognitive	Remember Understand

UNIT I	CLASSIFICATION OF POLYMERS AND CHEMISTRY OF POLYMERISATION	10+3

Classification of Polymers, linear polymers, non-linear or branched polymers, cross – linked polymers, homo chain hetero chain, homopolymers co-polymers block polymers and graft polymers.

Chemistry of polymerization: Types of polymerization – mechanism – chain, growth, co-ordination, ring opening, metathetical, group transfer, polyaddition and polycondensation polymerizations.

UNIT II	INDIVIDUAL POLYMERS	10+3

Individual Polymers: Monomers required general methods of preparation, repeat units and uses of

the following polymers and resins, polystyrene, polyacrylonitrile, polymethyl, methacrylate, Polytetra – fluoroethylene, polybutadienes and polychloroprene, polyesters, polycarbonates, polyimides, polyamides (Kevlar), polyurethanes, polyethylene, glycols, phenol – formaldehyde, urea – formaldehyde, melamine – formaldehyde and epoxy resins.

UNIT III	PROPERTIES OF POLYMERS	10+3

Intrinsic properties – processing properties – basic idea of isomerism of polymers – configuration

of polymer chain – geometrical structure – syndiotatic, isotatic and atatic polymers.

Glass transition temperature: Definition – factors affecting glass transition temperature – relationships between glass transition temperature and (a) molecular weight, (b) melting pointand

(c) plasticizer – importance of glass transition temperature – heat distortion temperature.

Molecular weight and size of polymers: Number average, weight average, sedimentation and viscosity average molecular weights – molecular weights and degree of polymerization – poly dispersity – molecular weight distribution in polymers – size of polymer molecules – kinetics of polymerization.

UNIT IV	POLYMERISATION TECHNIQUES DEGRADATION AND USES OF POLYMERS	8+3

Polymerisation Techniques: Bulk, solution, suspension, emulsion, melt condensation and interfacial polycondensation polymerizations, Degradation: Types of degradation – thermal, mechanical, ultrasonic and photodegradation – photo stabilizers – oxidative degradation – antioxidants – hydrolytic degradation. Uses of polymers in electronics and

biomedicine.

UNIT V	POLYMER PROCESSING	7+3

Polymer processing: Plastics (thermo and thermosetting), elastomers, fibres,compounding, plasticizers, colorants, flame retardants. Compression and injection moudlings – film extrusion and calendaring – die casting and rotational casting – thermofoaming – reinforcing.

LECTURE	TUTORIAL	SELF STUDY	PRACTICAL	TOTAL
45	15	0	0	60

TEXT BOOKS

1. Seymour, R.B. & Carraher, C.E. Polymer Chemistry: An Introduction, Inc. New York,(1981).
2. Odian, G. Principles of Polymerization, 4th Ed. Wiley,(2004).
3. Billmeyer, F.W. Textbook of Polymer Science, 2nd Ed. Wiley Interscience,(1971)..
4. Ghosh, P. Polymer Science & Technology, Tata McGraw-Hill Education,(1991).
5. Lenz, R.W. Organic Chemistry of Synthetic High Polymers, Interscience Publishers, New York, (1967).

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1. M.P.Stevens,*PolymerChemistry:AnIntroduction*,3rdEdition,OxfordUniversityPress, (1991).
2. H.R. Allcock, F.W. Lampe & J.E. Mark, *Contemporary Polymer Chemistry,* 3rd edition, (2003).
3. F.W. Billmeyer, *Textbook of Polymer Science*, 3rd ed. Wiley-Interscience,(1984).
4. J.R. Fried, *Polymer Science and Technology*, 2nd ed. Prentice-Hall(2003)
5. P. Munk & T.M. Aminabhavi, *Introduction to Macromolecular Science*, 2nd ed. John Wiley & Sons(2002).
6. L. H. Sperling, *Introduction to Physical Polymer Science*, 4th ed. John Wiley & Sons (2005).
7. M.P. Stevens, *Polymer Chemistry: An Introduction* 3rd ed. Oxford University Press,(2005).
8. Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr.(2013).

M.Sc. Chemistry

COURSE CODE	YCY101	L	T	SS	P	C
COURSE NAME	ORGANIC CHEMISTRY- I	4	1	1	0	5
PREREQUISITE	NIL	L	T	SS	P	H
C:P:A	4.5: 0 : 0.5	4	1	1	0	6

COURSE OUTCOMES- On the successful completion of the course, students will be able to		DOMAIN	LEVEL
CO1	***Recognize*** the various basic concepts of aromaticity.	Cognitive	Remember
CO2	***Identify*** the oxidation and reducing reagents for organic synthesis.	Cognitive	Understand
CO3	***Describe*** and ***give examples*** of stereochemistry of organic compounds.	Cognitive	Remember Understand
CO4	***Recognize*** the effect of light in organic reactions and ***understand*** the mechanism of photochemistry.	Cognitive and Affective	Understand and Receiving
CO5	***Recall*** and ***explain*** the mechanism of pericyclic reactions.	Cognitive	Remember Understand

UNIT I	AROMATICITY	16

Aromatic character: Five-, six-, seven-, and eight-membered rings – other systems with aromatic sextets – Huckel's theory of aromaticity, concept of homoaromaticity and anti-aromaticity.

Electron occupancy in MO's and aromaticity – NMR concept of aromaticity and antiaromaticity, systems with 2,4,8 and 10 electron s, systems of more than 10 electrons (annulenes), Mobius aromaticity. Bonding properties of systems with $(4n+2)\pi$-electron s and $4n\pi$-electrons, alternant and non-alternant hydrocarbons (azulene type) – aromaticity in heteroaromatic molecules, sydnones and fullerenes.

UNIT II	REAGENTS IN ORGANIC SYNTHESIS	19

Oxidation: Baeyer-Villiger, Jacobsen epoxidation, Shi epoxidation, Jones reagent, NOCl, $Mn(OAc)_3$, $Cu(OAC)_2$, Bi_2O_3, Swern oxidation, Sommelet reaction, Elbs reaction, Oxidative coupling of phenols, Prevost reaction and Woodward modification. Reduction: palladium / platinum / rhodium / nickel based heterogeneous catalysts for hydrogenation, Wilkinson's catalyst, Noyori asymmetric hydrogenation – reductions using Li/Na/Ca in liquid ammonia. Hydride transfer reagents from group III and group IV in reductions. (i) triacetoxyborohydride, L-selectride, K-selectride, Luche reduction, Red-Al, $NaBH_4$ and $NaCNBH_3$, trialkylsilanes and trialkylstannane, (ii) stereo/enantioselectivity reductions (Chiral Boranes, Corey-Bakshi-Shibata).

UNIT III	STEREOCHEMISTRY AND CONFORMATIONAL ANALYSIS	19

Stereoisomerism – symmetry – enantiomers and diastereomers – R and S nomenclature – optical activity and chirality – types of molecules exhibiting optical activity – absolute configuration – chirality in molecules with non- carbon stereocenters (N, S and P) – molecules with more than one chiral centre – atropisomerism. Molecular chirality – allenes, spiranes, biphenyls, helicenes and cyclophanes – methods of determining configuration – E and Z nomenclature – determination of configuration of geometrical isomers – stereochemistry of addition and elimination reactions – stereospecific and stereoselective

synthesis [elementary examples]. Basic concepts of conformational analysis – conformations of cyclopentane, cyclohexane, cyclohexene and fused (decalin) and bridged (norbornane type) ring systems – anomeric effect in cyclic compounds.

UNIT IV	ORGANIC PHOTOCHEMISTRY	18

Organic photochemistry – fundamental concepts – energy transfer – characteristics of photoreactions – photoreduction and photooxidation, photosensitization.Photoreactions of ketones and enones – Norrish Type I and II reactions – Paterno-Büchi reaction – photo-Fries rearrangement – photochemistry of alkenes, dienes and aromatic compounds – di-π-methane rearrangement.Reactions of unactivated centres – photochemistry of α,β-unsaturated carbonyl compounds – photolytic cycloadditions and photolytic rearrangements – photo additions – Barton reaction

UNIT V	PERICYCLIC REACTIONS	18

Concerted reactions – orbital symmetry and concerted symmetry – Woodward and Hoffmann rules – selection rules for electrocyclic reactions – frontier molecular orbital approach – correlation diagram – examples. Selection rules for cycloaddition reactions – frontier molecular orbital approach – correlation diagram – examples – chelotropic and ene reactions.Sigmatropic rearrangements – 1,3, 1,5 and 1,7-hydrogen shifts – examples – Cope and Claisen rearrangements – 1,3-dipolar cycloaddition reactions: types of dipoles, selectivity, scope and applications.

	LECTURE	TUTORIAL	PRACTICAL	SELF STUDY	TOTAL
HOURS	**60**	**15**	**-**	**15**	**90**

TEXT BOOKS

1. J. March and M. B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure; 7th Ed., Wiley, New York, 2013.
2. L. Finar, Organic Chemistry; Vol.II, 7th Ed., Pearson education Ltd, New Delhi, 2009.
3. R. T. Morrison and R. N. Boyd, Organic Chemistry, 7th Ed., Pearson, New Delhi, 2011.
4. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry; Parts A and B, 5th Ed., Springer, Germany, 2007.
5. T. H. E. Lowry and K. S. Richardson, Mechanism and Theory in Organic Chemistry; Addison-Wesley, USA, 1998.
6. P. S. Kalsi, Stereochemistry; Wiley eastern limited; New Delhi, 1993.
7. D. Nasipuri, Stereochemistry of Organic Compounds - Principles and Applications; 2nd Ed., New Age International, New Delhi, 1994.
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9. J. D. Coyle, Organic Photochemistry; Wiley, New York, 1998.
10. J. M. Coxon, and B. Halton, Organic Photochemistry; 2nd Ed., Cambridge, University Press, UK, 1987

REFERENCE BOOKS

1. R. K. Bansal, Organic Reaction Mechanisms; 11th Ed., Tata McGraw Hill, Noida, 2006.
2. R. K. Bansal, Organic Reaction Mechanisms; 11th Ed., Tata McGraw Hill, Noida, 2006.
3. J. Clayden, N. Greeves, S. Warren, and P. Wothers, Organic Chemistry; 1st Ed., Oxford University Press, UK, 2000.
4. G. R. Chatwal, Organic Phtochemistry; 1st Ed., Himalaya Publications house, Bangalore, 1998.

5. S. Sankararaman, Pericyclic Reactions - A Textbook: Reactions, Applications and Theory; Wiley-VCH, New York, 2005.

E RESOURCES

1. http://nptel.ac.in/courses/104103071/21
2. https://www.youtube.com/watch?v=Ih7tQ7rY2Wc
3. http://nptel.ac.in/courses/104101005/
4. https://www.youtube.com/watch?v=12hmgzeiGo4
5. https://www.youtube.com/watch?v=WEeFhsjn-lo

COURSE CODE	COURSE NAME	L	T	SS	P	C
YCY102	INORGANIC CHEMISTRY- I	4	1	1	0	5
PREREQUISITE	NIL	L	T	SS	P	H
C:P:A	4.5: 0 : 0.5	4	1	1	0	6

COURSE OUTCOMES- On the successful completion of the course, students will be able to		DOMAIN	LEVEL
CO1	***Describe*** the basic concepts of main group elements.	Cognitive	Remember
CO2	***Explain*** the reactions of coordination compounds and ***estimate*** the physical constants of the reactions.	Cognitive	Understand
CO3	***Summarize*** the theories and bonding nature of coordination compounds.	Cognitive	Understand
CO4	***Identify*** and ***understand*** the reaction mechanism of four and six coordinated compounds.	Cognitive and Affective	Understand
CO5	***Rewrite*** the basic concepts of photochemistry and its applications to coordinated compounds.	Cognitive	Understand

UNIT I	MAIN GROUP CHEMISTRY	17

Chemistry of boron – borane, higher boranes, carboranes, borazines and boron nitrides – chemistry of silicon – silanes, higher silanes, multiple bonded systems, disilanes, silicon nitrides. P-N compounds, cyclophosphazanes and cyclophosphazenes – S-N compounds – S_2N_2, S_4N_4, (SN)x, polythiazyl S_xN_4 compounds – S-N cations and anions, S-P compounds – molecular sulphides such as P_4S_3, P_4S_7, P_4S_9 and P_4S_{10} – homocyclic inorganic systems – oxocarbon anion. Ionic model – lattice energy – Born-Lande equation – Kapustinskii equation – high Tc superconductors – solid state reactions – tarnish reaction decomposition, solid-soild reaction and photographic process – factors affecting reaction rate.

UNIT II	PRINCIPLES OF COORDINATION CHEMISTRY	17

Studies of coordination compounds in solution – detection of complex formation in solution – stability constants – stepwise and overall formation constants. **Simple methods (potentiometric, pH metric and photometric methods) of determining the formation constants.**Factors affecting stability – statistical and chelate effects – forced configurations.

UNIT III	THEORIES OF METAL-LIGAND BOND	18

Crystal field theory – splitting of d-orbitals under various geometries – factors affecting splitting – CFSE and evidences for CFSE (structural and thermodynamic effects). Spectrochemical series – Jahn-Teller distortion – spectral and magnetic properties of complexes – site preferences.Limitations of CFT – ligand field theory – MO theory – sigma- and pi-bonding in complexes – Nephelauxetic effect – the angular overlap model.

UNIT IV	REACTION MECHANISM IN COORDINATION COMPLEXES	18

Kinetics and mechanism of reactions in solution – labile and inert complexes – ligand displacement reactions in octahedral and square planar complexes – acid hydrolysis, base hydrolysis and anation reactions. Trans effect – theory and applications – electron transfer reactions – electron exchange reactions – complementary and non-complementary types – inner sphere and outer sphere processes – application of electron transfer reactions in inorganic complexes – isomerisation and racemisation reactions of complexes. Molecular rearrangements of four- and six-coordinate complexes – interconversion of stereoisomers – reactions of coordinated ligands – template effect and its applications for the synthesis of macrocyclic ligands – unique properties.

UNIT V	INORGANIC PHOTOCHEMISTRY	20

Electronic transitions in metal complexes, metal-centered and charge-transfer transitions – various photophysical and photochemical processes of coordination compounds. Unimolecular charge-transfer photochemistry of cobalt(III) complexes – mechanism of CTTM, photoreduction – ligand-field photochemistry of chromium(III) complexes – Adamson's rules, photoactive excited states, V-C model – photophysics and photochemistry of ruthenium – polypyridine complexes, emission and redox properties. Photochemistry of organometallic compounds – metal carbonyl compounds – compounds with metal-metal bonding – Reinecke's salt chemical actinometer.

	LECTURE	TUTORIAL	PRACTICAL	SELF STUDY	TOTAL
HOURS	60	15	-	15	90

TEXT BOOKS

1. M. C. Day, J. Selbin and H. H. Sisler, Theoretical Inorganic Chemistry; Literary Licensing (LLC), Montana, 2012.
2. F. A. Cotton and G. Wilkinson, C. A. Murillo and M. Bochmann, Advanced Inorganic Chemistry; 6th Ed., A Wiley - Interscience Publications, John Wiley and Sons, USA, 1999.
3. J. E. Huheey, Inorganic Chemistry; 4th Ed., Harper and Row publisher, Singapore, 2006.
4. W. Adamson, Concept of Inorganic Photochemistry; John Wiley and Sons, New York, 1975.
5. S. F. A. Kettle, Physical Inorganic Chemistry – A Coordination Chemistry Approach, Spectrum; Academic Publishers, Oxford University Press, New York, 1996.

REFERENCE BOOKS

1. A. W. Adamson and P. D. Fleischauer, Concepts of Inorganic Photochemistry; R. E. Krieger Pubs, Florida, 1984.

2. J. Ferraudi, Elements of Inorganic Photochemistry; Wiley, New York, 1988.

3. F. Basolo and R. G. Pearson, Mechanism of Inorganic Reactions; 2nd Ed., John Wiley, New York, 1967.

4. R. K. Sharma, Inorganic Reactions Mechanism; Discovery Publishing House, New Delhi, 2007.

E RESOURCES

1. https://www.youtube.com/watch?v=YChUH_XSZJ0
2. https://www.youtube.com/watch?v=7gNByyjaYrY
3. https://www.youtube.com/watch?v=Ox3pnVN47gw
4. https://www.youtube.com/watch?v=wq4XHcNBBgg

COURSE CODE	YCY103	L	T	SS	P	C
COURSE NAME	PHYSICAL CHEMISTRY- I	4	1	1	0	5
PREREQUISITE	NIL	L	T	SS	P	H
C:P:A	4.5: 0 : 1.5	4	1	1	0	6

COURSE OUTCOMES- On the successful completion of the course, students will be able to		DOMAIN	LEVEL
CO1	***Identify*** the basic concept of symmetry elements and the corresponding point groups of given molecules.	Cognitive	Remember
CO2	***Describe*** the theories of classical mechanics and quantum mechanics of a microscopic particles and ***predict*** the energy of the particles.	Cognitive	Understand
CO3	***Recognize*** the various theories of chemical kinetics of reactions.	Cognitive	Remember
CO4	***Explain*** the fundamentals of thermodynamic and ***Label*** the various thermodynamic parameters.	Cognitive and Affective	Understand Receive
CO5	***Generalized*** the photo physical properties of chemical reactions.	Cognitive	Understand

UNIT I	CONCEPTS OF GROUP THEORY	18

Symmetry elements and operations – point groups – assignment of point groups to molecules – group postulates and types of groups – group multiplication tables, sub groups, similarity transformations – conjugate elements and classes.Matrix representation of symmetry operations and point groups – reducible and irreducible representations – properties of irreducible representation. The great orthogonality theorem – construction of character table – direct product – projection operators – symmetry of hybrid orbitals.

UNIT II	QUANTUM CHEMISTRY – I	19

Inadequacy of classical mechanics – black body radiation – Planck's quantum concept – photoelectric effect – Bohr's theory of hydrogen atom – hydrogen spectra – wave-particle dualism – uncertainty principle – decline of old quantum theory. Schrödinger equation – postulates of quantum mechanics – operator algebra: linear operator, Hermitian operators, eigen functions and eigenvalues, angular momentum operator – commutation relations and related theorems – orthogonality and normalization. Applications of wave mechanics to simple systems – particle in a box, one and three dimensional, particle with finite potential barrier – the quantum mechanical tunneling.

UNIT III	CHEMICAL KINETICS - I	17

Theories of reaction rate – absolute reaction rate theory (ARRT) – transmission coefficient, reaction coordinate – potential energy surfaces – kinetic isotope effect – Hinshelwood theory – Kassel, Rice and Ramsperger theory (KRRT) – Slater's treatment. Principle of microscopic reversibility – steady-state approximation – chain reactions: thermal and photochemical reactions between hydrogen and halogens – explosions and hydrogen-oxygen reactions.

UNIT IV	STATISTICAL THERMODYNAMICS	18

Thermodynamic probability – probability theorems – relation between entropy and probability (Boltzmann-Planck equation), ensembles, phase space, Ergodic hypothesis, microstates and macrostates, Maxwell-Boltzmann distribution law– partition functions – translational, rotational, vibrational and electronic partition functions.Relationship between

partition functions and thermodynamic properties – calculation of equilibrium constants from partition functions – heat capacities of monatomic crystals – Einstein theory and Debye theory. Quantum statistics – Bose-Einstein (B.E.) and Fermi-Dirac (F.D.) distribution equations – comparison of B.E. and F.D. statistics with Boltzmann statistics – applications of quantum statistics to liquid helium, electrons in metals and Planck's radiation law – concept of negative Kelvin temperature.

UNIT V	FAST REACTION TECHNIQUES, PHOTOCHEMISTRY AND RADIATION CHEMISTRY	18

Introduction – flow methods (continuous and stopped flow methods) – relaxation methods (T and P jump methods) – pulse techniques (pulse radiolysis, flash photolysis) – shock tube method – molecular beam method – lifetime method. Photophysical processes of electronically excited molecules – Jablonski diagram. – Stern-Volmer equation and its applications – experimental techniques in photochemistry – chemical actinometers – lasers and their applications. Differences between radiation chemistry and photochemistry – sources of high energy radiation and interaction with matter – radiolysis of water, solvated electrons – definition of G value, Curie, linear energy transfer (LET) and Rad – scavenging techniques – use of dosimetry and dosimeters in radiation chemistry – applications of radiation chemistry.

	LECTURE	TUTORIAL	SELF STUDY	TOTAL
HOURS	60	15	15	90

TEXT BOOKS

1. F. A. Cotton, Chemical Applications of Group Theory; 3rd Ed., John Wiley and Sons, Singapore, 2003.
2. K. Chandra, Introductory Quantum Chemistry; 4th Ed., Tata McGraw Hill, Noida, 1994.
3. D. A. Mcquarrie, Quantum Chemistry; University Science Books, Sausalito, 2008.
4. K. J. Laidler, Chemical Kinetics; 3rd Ed., Tata McGraw Hill, Noida, 1987.
5. J. W. Moore and R. G. Pearson, Kinetics and Mechanism; 3rd Ed., John Wiley and Sons, New York, 1981.
6. M. Mortimer and P. G. Taylor, Chemical Kinetics and Mechanism; 1st Ed., Royal Society of Chemistry, UK, 2002.
7. J. N. Gurtu and A. Gurtu, Advanced Physical Chemistry; 5th Ed., Pragathi Prakashan, Meerut, 2006.
8. J. I. Steinfeld, J. S. Francisco and W. L. Hase, Chemical Kinetics and Dynamics; 2nd Ed., Prentice Hall, New Jersey, 1999.
9. P. W. Atkins, Physical Chemistry; 7th Ed., Oxford University Press, Oxford, 2001.
10. J. Rajaram and J. C. Kuriacose, Thermodynamics for Students of Chemistry - Classical, Statistical and Irreversible; Pearson Education, New Delhi, 2013.
11. Horia Metiu, Physical Chemistry, Thermodynamics; Taylor and Francis, Singapore, 2006.
12. K. K. Rohatgi-Mukherjee, Fundamentals of Photochemistry; 3rd Ed., New Age International Pvt. Ltd., New Delhi, 2014.

REFERENCE BOOKS

1. R. L. Flurry, Jr, Symmetry Groups: Theory and Chemical Applications; Prentice Hall, New Jersy, 1980.
2. S. F. A. Kettle, Symmetry and Structure; 2nd Ed., John Wiley and Sons, Chichester, 1995.
   I. N. Levine, Quantum Chemistry; 5th Ed., Prentice Hall, New Jersey, 2000.
3. R. K. Prasad, Quantum Chemistry; 4th Ed., New Age International Publishers, New

Delhi, 2014
4. K. S. Gupta, Chemical Kinetics and Reaction Mechanism; RBSA Publishers, Jaipur, India, 1992.
5. J. W. T. Spinks and R. J. Woods, Introduction to Radiation Chemistry; 3rd Ed., John Wiley and Sons, New York, 1990.

E RESOURCE

1. https://www.youtube.com/watch?v=pGerRhxNQJE
2. https://www.youtube.com/watch?v=R-x9KdNjQmo
3. https://www.youtube.com/watch?v=F_NmS-Wy2lE
4. https://www.youtube.com/watch?v=6QXtnmB1vqk
5. https://www.youtube.com/watch?v=1zZ6rvh1cgw

COURSE CODE	COURSE NAME	L	T	SS	P	C
YCY201	INORGANIC CHEMISTRY-II	4	1	1	0	5
PREREQUISITE	NIL	L	T	SS	P	H
		4	1	1	0	6

COURSE OUTCOMES: *On the successful completion of the course, students will be able to*		DOMAIN	LEVEL
CO1	***Recall*** and ***Explain***the basic concepts of structure and bonding of organometallic compounds; ***Display***the geometries of organometallic molecules using 18 electron rule.	Cognitive Psychomotor	Remember Understand Set
CO2	***Summarize and Report***reaction mechanism of inorganic and organometallic compounds.	Cognitive Affective	Understand Respond
CO3	***Explain*** the physical and chemical properties of carbenes and***Interpret*** the mechanism of their chemical reactions.	Cognitive Affective	Understand Apply Respond
CO4	***Describe*** the principles of bioinorganic chemistry and the application of various concepts.	Cognitive Psychomotor	Analyze Perception
CO5	***Identify*** the various metalloenzymes/ metalloporphyrins and their chemical properties.	Cognitive	Remember

UNIT I	**STRUCTUREANDBONDINGINORGANOMETALLICS** The 18 electron rule – applications and limitations – isolobal concept and its usefulness – uses of typical organometallics such as metal alloys and organometallic hydrides in organic synthesis. Nitrosyl complexes – bridging and terminal nitrosyls, bent and linear nitrosyls – dinitrogen complexes – metallocene and arene complexes – metal carbenes, carbenes, carboxylate anions. Classification based on captivity and polarity of M-C bond, organometallic compounds of lanthanides and actinides – fluxional organometallic compounds – organometallics in medicine, agriculture, horticulture and industry.	**15+6**

UNIT II	**REACTIONMECHANISMANDCATALYSIS** Ligand substitution-oxidative addition and reductive elimination-1,1 and 1,2-insertion-addition and elimination reactions-alkene isomerization - hydroboration hydrocyanation – hydrogenation of olefins -Wilkinson's catalyst - hydroformylation of olefins- Wacker-Schmidt synthesis- Monsanto acetic acid process- Eastman Halcon process- Fischer-Tropsch process- hydrosilylation.	**10+6**
UNIT III	**CARBENES** Fischer and Schrock carbenes –bonding & reactivity- Grubbs catalyst-carbines structure,synthesis and reactions- alkene meta thesis–mechanism- C-H and C- Cactivation –agnostic bonds-Ziegler-Natta polymerization of olefins -Heck reaction- The Pauson Khand reaction-Ene reaction.	**10+6**
UNIT IV	**GENERAL PRINCIPLES OF BIOINORGANIC CHEMISTRY** **Occurrence and availability of inorganic elements in biological systems– bio mineralization–control and assembly of advanced materials in biology– nucleation and crystal growth–various bio minerals–calcium phosphate– calcium carbonate–amorphous silica,iron bio minerals–strontium and barium sulphate.** Function and transport of alkali and alkaline earth metal ions: characterization of K^+,Na^+,$Ca^{2+}$and Mg^{2+}–complexes of alkali and alkaline earth metal ions with macro cycles–ion channels–ion pumps, catalysis and regulation of bio energetic processes by the alkaline earth metal ions – $Mg^{2+}$and Ca^{2+}.	**15+6**
UNIT V	**METALLOPORPHYRINS/METALLOENZYMES** **Dioxygen transport and storage-hemoglobin and myo globin:electronic and spatial structures-hemeythrin and hemocyanine- syntheticoxygen carriers, model systems-blue copper proteins (Cu)-iron-sulfur proteins (Fe)-cyto chromeselectron transport chain-carbon monoxide poisoning-iron enzymes-peroxidase, catalase and cytochrome P-450, copper enzymes-super oxide dismutase, vitamin B12 and B12 co enzymes, photo synthesis-photo system- I &II, nitrogen fixation, cisplatin.**	**10+6**

	LECTURE	TUTORIAL	PRACTICAL	SELF STUDY	TOTAL HOURS
HOURS	**60**	**15**	**-**	**15**	**90**

REFERENCES

1. J. E. Huheey, Inorganic Chemistry; 4th Ed., Harper and Row Publishers, Singapore, 2006.
2. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; Thomson Learning, Boston, 1980.
3. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry; Panima Publishing Company, New Delhi, 1997.
4. W. Kaim and B. Schewederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life; 2nd Ed., John Wiley and Sons, New York, USA, 2013.
5. G. L. Eichhorn, Inorganic Biochemistry; Volumes 1 and 2, 2nd Ed., Elsevier Scientific Publishing Company, New York, 1975.
6. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry; 6th Ed., John Wiley and Sons, New York, 1999.
7. R. C. Mehrotra and A. Singh, Organometallic Chemistry; 2nd Ed., New Age International Ltd. New Delhi, 2014.
8. R. H. Crabtree, The Organometallic Chemistry of the Transition Metals; 3rd Ed., John Wiley and Sons, New York, 2001.
9. S. E. Kegley and A. R. Pinhas, Problems and Solutions in Organometallic Chemistry; 2nd Ed., University Science Books, Oxford University Press, 1986.
10. A. J. Pearson, Advances in Metal-Organic Chemistry, Vol. 1; Jai Press, Inc., Greenwich, 1989.
11. A. W. Parkins and R. C. Poller, An Introduction to Organometallic Chemistry; 1987, Oxford University Press, Chennai.
12. I. Haiduc and J. J. Zuckerman, Basic Organometallic Chemistry; Walter De Gruyter Inc, USA, 1985.
13. P. Powell, Principles of Organometallic Chemistry; 2nd Ed., Chapman and Hall, London, 1988.
14. B. Douglas, D. H. McDaniel and J. J. Alexander, Concepts and Models of Inorganic Chemistry; 3rd Ed., John Wiley and sons, New York, 1994.
15. M. Bochmann, Organometallics 1: Complexes with transition metal-carbon bonds; Oxford Chemistry Primers Series, No. 12, and M. Bochmann, Organometallics 2: Complexes with transition metal-carbon bonds; No. 13, 1994.
16. J. P. Collman, L. S. Hegedus, J. R. Norton and R. G. Finke, Principles and Applications of Organotransition Metal Chemistry, University Science Books, California, 1987

COURSE CODE	**YCY202**	**L**	**T**	**SS**	**P**	**C**
COURSE NAME	**PHYSICAL CHEMISTRY-II**	**4**	**1**	**1**	**0**	**5**
PREREQUISITE	**NIL**	**L**	**T**	**SS**	**P**	**H**
		4	**1**	**1**	**0**	**6**

COURSE OUTCOMES: ***On the successful completion of the course, students will be able to***		**DOMAIN**	**LEVEL**
CO1	***Explain*** the principle of electrochemistry and basics of conductivity of electrolytes and related concepts.	Cognitive	Understanding
CO2	***Describe*** the physical aspects of molecular spectroscopy and interaction of electromagnetic radiation with monoatomic and diatomic molecules.	Cognitive	Remember
CO3	***Interpret*** third law of thermodynamics and	Cognitive Affective	Apply

	thermodynamicpropertiesofrealgases		Receiving
CO4	***Describe*** the principle of kinetics of chain, photochemical, acid-base catalysis, reversible and irreversible reactions.	Cognitive Affective	Remember Responding
CO5	***Apply*** and ***Identify*** the various concepts of adsorption and free energy reaction at interphase.	Cognitive	Apply Remember
UNIT I	**ELECTROCHEMISTRY-I** Ion transport in solution - migration, convention and diffusion -Fick's laws of diffusion conduction - influence of ionic atmosphere on the conductivity of electrolytes-The Debye Huckel-Onsager equation for the equivalent conductivity of electrolytes - experimental verification of the equation - conductivity at high field and at high frequency - conductivity of non aqueous solutions-effect of ion association on conductivity. The electrode-electrolyte interface-electrical double layer-electro capillary phenomena-Lippmann equation - the Helmholtz-Perrin - Guoy-Chapmann and Stern models, electrokinetic phenomena Tiseiius method of separation of protons of proteins - membrane potential.		**12+6**
UNIT II	**MOLECULAR SPECTROSCOPY** Einstein coefficient of absorption and transition probabilities -basis of selection rules -Representation of spectra -the width and intensity of spectra transitions oscillator strength. Electronic spectra -electronic spectra of molecules -Born Oppenheimer approximation -vibrational coarse structure -Franck-condon principle -dissociation energy -fortrat diagram -Pre-dissociation -various types of transitions -solvent effect on spectra. Infra red spectra -vibrational spectra -selection rules -harmonic and anharmonic oscillators -vibration and rotation spectra of diatomic molecules -vibration spectra of polyatomic molecules -normal vibration and normal coordinates -Influence of rotation on the spectra of polyatomic molecules -parallel and perpendicular bands -FTIR. Laser Raman spectra -rotational Raman spectra of linear molecules -vibrational Raman spectra -rotational fine structure -Fermi resonance.		**12+6**
UNIT III	**CLASSICAL THERMODYNAMICS** Thirdlaw,thermodynamics,needforit,Nernstheattheoremandother formsofstatingthethirdlaw.Thermodynamicquantitiesatabsolutezero,apparent exceptionstothethirdlaw-thermodynamicsofsystemsofvariablecomposition,partial molarproperties,chemicalpotential,relationshipbetweenpartialmolarquantities,Gibbs Duhemequationanditsapplications(theexperimentaldeterminationofpartialmolar propertiesnotincluded)-thermodynamicpropertiesofrealgases,fugacityconcept, calculationoffugacityofrealgas,activityandactivitycoefficient,concept,definition, standardstatesandexperimentaldeterminationsofactivityandactivitycoefficientof electrolytes.		**12+6**
UNIT IV	**CHEMICAL KINETICS** Theories of reaction rate -Absolute reaction rate theory (ARRT) -significance of reaction coordinate -Potential energy surfaces -Kinetic isotopic effect -molecular dynamics -Marcus theory of electron transfer		

	processes -Principle of microscopic reversibility -Steady-state approximation. Chain reactions-thermal and photochemical reactions between hydrogen and halogens -explosions and hydrogen-oxygen reactions. Factors influencing reaction rates in solution -application of ARRT to solution kinetics -effect of solvent and ionic strength influence of pressure on rates in solution -significance of volume of activation. Acid-base catalysis -Hammett's acidity function -Bronsted relation LFER -Hammett and Taft equations.	**12+6**
UNIT V	**SURFACE PHENOMENA** Adsorption and free energy reaction at interphase -potential energy diagram -Lennard-Jones plot -surface area determination -heats of adsorption -determination -adsorption from solution -Gibbs adsorption theorem -solid-liquid interface -Wetting and contact angle -solid-gas interfaces -soluble and insoluble films. **Surface tension: methods of measuring surface tension -electrical phenomena at interface including electro kinetic phenomenon -Micelles and reverse micelles -solubilisation -micro emulsion or micellar emulsions. Role of surface in catalysis: semiconductor catalysis -n-and p-type surfaces -kinetics of surface reaction involving adsorbed species.** Langmuir-Hinshelwood mechanism of bimolecular reaction -Langmuir-Rideal mechanism -Rideal-Eley mechanism.	**12+6**

HOURS	**LECTURE**	**TUTORIAL**	**PRACTICAL**	**TOTAL HOURS**
	60	**30**	**-**	**90**

REFERENCES

1. K. Chandra, Introductory Quantum Chemistry, 4th ed., Tata McGraw Hill, 1994.
2. R. K. Prasad, Quantum Chemistry, 2nd ed., New Age International Publishes (2000),
3. I. N. Levine, Quantum Chemistry, 4th ed., Prentice Hall of India Pvt Ltd., (1994),
4. D. A. McQuarrie, Quantum Chemistry, University Science Books (1998),
5. S. Glasstone, Introduction to Theoretical Chemistry, Affiliated East-West Press
6. G. N. Barrow, Introduction to Molecular Spectroscopy, International Mc.Graw Hill Edition (1993),
7. G. N. Barrow, Introduction to Molecular Spectroscopy, International McGraw Hill Student Edition (1984),
8. B. P. Straughan and S. Walker, Spectroscopy, Vol.I to III, Chapman Hall, London (1976),
9. S. Glasstone, Thermodynamics for Chemists, East-west Affiliated Pvt Ltd, New Delhi (1969),
10. R. P. Rastogi and R. R. Misra, An Introduction to Chemical Thermodynamics Vikas Publishing House Pvt Ltd., (1992),
11. Kloz and P. M. Rosenberg, Chemiscal Thermodynamics: Basics Theory and Methods, 3rd ed., W. A. Benjamin, NY (1974),
12. K. J. Laidler, Chemical Kinetics,2nd ed, Tata McGraw Hill (1975),
13. A. A. Frost and R. G. Pearson, Kinetics and Mechanisms, John Wiley & Sons (1953),
14. J. C. Kuriacose and J. Rajaram, Kinetics and Mechanisms Transformations, Macmillan & Co., (1993).
15. P. W. Atkins, Advanced Physical Chemistry, 7th ed., Clarendon (2002)

COURSE CODE	YCY301	L	T	P	C
COURSE NAME	ORGANIC CHEMISTRY II	4	1	0	5
		L	T	P	H
C: P: A	4.5:0:0.5	4	1	0	5

COURSE OUTCOMES:		Domain	Level
CO1	***Recall*** and ***summarize*** the nucleophilic substitution reactions of aliphatic and aromatic compounds.	Cognitive	Remember Understand
CO2	***Outline*** the reaction mechanism ofelectrophilic substitution reactions and explain the structure and orientation of the substituted products.	Cognitive	Remember Understand
CO3	***Identify***the reagents of various rearrangement reaction and***illustrate***the mechanism of the addition and elimination reactions	Cognitive	Apply Understand
CO4	***Recognize*** and ***Interpret*** the preparation and properties ***of*** various heterocyclic compounds	Cognitive Affective	Understand Receive
CO5	***Understand*** and ***Examine*** the structural components of various of natural products.	Cognitive Affective	Analyze Receive

UNIT I - NUCLEOPHILIC SUBSTITUTION REACTIONS **15**

Aliphatic nucleophilic substitution – mechanisms – SN1, SN2, SNi – ion-pair inSN1 mechanisms – neighbouring group participation, non-classicalcarbocations – substitutions at allylic and vinylic carbons. Reactivity – effect of structure, nucleophile, leaving group and stereochemical factors – correlation of structure with reactivity – solvent effects – rearrangements involving carbocations – Wagner-Meerwein and dienone-phenol rearrangements.

Aromatic nucleophilic substitutions – SN1, SNAr, Benzyne mechanism – reactivity orientation – Ullmann, Sandmeyer and Chichibabin reaction – rearrangements involving nucleophilic substitution – Stevens – Sommelet- Hauser and von-Richter rearrangements.

UNIT II - ELECTROPHILIC SUBSTITUTION REACTIONS **15**

Aromatic electrophilic substitution reaction – orientation, reactivity and mechanisms based on transition state theory with suitable reactions – substitutions in thiophene and pyridine – N-oxide quantitative treatment of the structural effects on reactivity. Substituent effects – origins of Hammett equation – principles of Hammett correlation – effect of structure on reaction mechanisms Hammett parameters – σ and ρ, modified forms of Hammett equation, Taft Equation.

Aliphatic electrophilic substitution – SE2, SEi and SE1 mechanisms – diazonium coupling reactions – metals as electrophile in substitution reactions and decomposition of diazonium salts.

UNIT III - ADDITION AND ELIMINATION REACTIONS **15**

Addition to carbon-carbon multiple bonds – electrophilic, nucleophilic and free radical additions – orientation of the addition – stereochemical factors influencing the addition of bromine and hydrogen bromide, hydroxylation, 1,2- dihydroxylation – hydroboration leading to formation of alcohols – oxidation and ozonolysis. Addition to carbonyl and conjugated carbonyl systems – mechanism – Grignard reagents – 1,2- and 1,4-additions (lithium dimethylcuprate) – addition to carbon-oxygen double bond – Benzoin, Knoevenagel, Stobbe, Darzens glycidic ester condensation and Reformatsky reactions.

Elimination reactions – mechanisms; E1, E2, E1cB – stereochemistry of elimination, Hofmann's and Zaitsev's rules – competition between elimination and substitution – pyrolytic *cis*-elimination, Chugaev reaction – examples such as Hofmann degradation,

Cope elimination – Bredt's rule with examples.

UNIT IV - HETEROCYCLES	15

Nomenclature: Trivial, systematic and replacement nomenclature – nonaromatic heterocycles – synthesis of tetrahydrofurans – pyrrolidines – tetrahydropyrans – piperidines. Synthesis and reactivity of heterocycles: aziridines – oxiranes – thiiranes – azetidines – oxetanes – oxazoles – imidazoles – thiazoles – isooxazoles. Synthesis and reactivity of aromatic heterocycles: pyrazoles – isothiazoles – triazoles – pyrimidines – purines – triazines – pyridazines – pyrazines.

UNIT V - NATURAL PRODUCTS	15

Terpenoids: introduction – biosynthesis of menthol, camphor – total synthesis: Takasago synthesis of menthol, Corey's synthesis of longifolene, Curran's synthesis of hirsutene.

Steroids: introduction – partial synthesis of androsterone and testosterone (from Cholesterol) – total synthesis: Johnson's synthesis of progesterone and Vollhardt's synthesis of estrone. Alkaloids: introduction – biosynthesis of nicotine, camptothecin – total synthesis: Corey's synthesis of epibatidine, Comin's asymmetric synthesis of Camptothecin and Woodward's synthesis of reserpine.

LECTURE	TUTORIALS	SELF STUDY	PRACTICAL	TOTAL
60	15	-	-	75

TEXT BOOKS

1. S. H. Pine and J. B. Hendrickson, D. J. Cram and G. S. Hammond, Organic Chemistry; 5th Ed., McGraw Hill, Noida, (1987).
2. T. H. E. Lowry and K. S. Richardson, Mechanism and Theory in Organic Chemistry; 3rd Ed., Benjamin-Cummings Publishing, USA, (1997).
3. J. March and M. B. Smith, Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 6th Ed., Wiley, New York, (2007).
4. J. Clayden, N. Greeves, S. Warren, and P. Wothers, Organic Chemistry, 2nd Ed., Oxford University Press, UK, (2012).
5. I. L. Finar, Organic Chemistry; Vol.II, 7th Ed., Pearson Education Ltd., New Jersey, (2009).

REFERENCES

1. R. K. Bansal, Reaction Mechanism in Organic Chemistry; Tata McGraw Hill, Noida, (1990)
2. F. A. Carey, and R. J. Sundberg, Advanced Organic Chemistry, Parts A and B, 5th Ed., Springer, Germany, (2007).
3. E. J. Corey, and X-M. Cheng, The Logic of Chemical Synthesis; 1st Ed., Wiley-Interscience, New York, (1995).
4. T. L. Gilchrist, Heterocyclic Chemistry; 3rd Ed., Prentice Hall, New Jersey, 1997.
5. R. K. Bansal, Heterocyclic Chemistry; 3rd Ed., Wiley Eastern Ltd, New Delhi, 1999.
6. K. C. Nicolaou and E. J. Sorensen, Classics in Total Synthesis, Targets, Strategies, Methods; Wiley VCH, Germany, 1996.
7. Longifolene: F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry; Vol.2. 5th Ed., Springer, Berlin, 2008.
8. Androsterone and Testosterone: J. Chem. Soc. Perkin Trans. I; 1986, 117.
9. Epibatidine: J. Org. Chem; 1993, 58, 5600.
10. Estrone, Estradiol and 2-Methoxyestradiol: J. Org. Chem; 2009, 74, 6362.

COURSE CODE	COURSE NAME	L	T	P	C
YCY305	ANALYTICAL CHEMISTRY	4	1	0	5
PREREQUISITES	NIL	L	T	P	H
C:P:A	4.4:0:0.6	4	1	0	5

COURSE OUTCOMES		Domain	Level
CO1	***Describe*** the basic principle of instrumental methods	Cognitive	Remember, Understand
CO2	***Classify*** the various types of analytical error and show their significance.	Cognitive	Remember, Understand
CO3	***Inspect*** the application ofvarious techniques in chromatography.	Cognitive Affective	Analyze Receive
CO4	***Illustrate*** the principles and instrumentation of thermoanalytical and fluorescence techniques.	Cognitive	Understand, Analyze
CO5	***Examine*** the concept of electroanalytical techniques.	Cognitive Affective	Analyze, Respond

UNIT I: INSTRUMENTAL METHODS OF ANALYSIS **15**

Principles and applications of extended X-ray absorption fine structure (EXAFS) – surface extended X-ray absorption (SEXAFS) – atomic absorption spectroscopy (AAS) – flame emission spectroscopy (FES) – turbidimetry – theory and applications.

UNIT II: DATA AND ERROR ANALYSIS **15**

Various types of error – accuracy, precision, significant figures – frequency distributions, the binomial distribution, the Poisson distribution and normal distribution – describing data, population and sample, mean, variance, standard deviation, way of quoting uncertainty, robust estimators, repeatability and reproducibility of measurements.

Hypothesis testing, levels of confidence and significance, test for an outlier, testing variances, means t-Test, paired t-Test – analysis of variance (ANOVA) – correlation and regression.

Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals – general polynomial equation fitting, linearizing transformations, exponential function fit – r and its abuse – multiple linear regression analysis, elementary aspects.

UNIT III: CHROMATOGRAPHY **15**

Solvent extraction – principles of ion exchange, paper, thin-layer and column chromatography techniques – columns, adsorbents, methods, Rf values, McReynold's constants and their uses – HPTLC, HPLC techniques – adsorbents, columns, detection methods, estimations, preparative column – GC-MS techniques – methods, principles and uses.

UNIT IV: THERMOANALYTICAL METHODS AND FLUORESCENCE SPECTROSCOPY **15**

Principles – instrumentations and applications of thermogravimetry analysis (TGA), Differential Thermal Analysis (DTA) and Differential Scanning - Calorimetry (DSC) –thermometric titrations – types – advantages.

Basic aspects of synchronous fluorescence spectroscopy – spectral hole burning – flow cytometry – fluorometers (quantization) – instrumentation – applications.

UNIT V: ELECTROANALYTICAL TECHNIQUES **15**

Electrochemical sensors, ion-sensitive electrodes, glass – membrane electrodes, solid-liquid membrane electrodes – ion-selective field effect transistors (ISFETs) – sensors for the analysis of gases in solution.

Po larography – principles and instrumentation – dropping mercury electrode – advantages – Ilkovic equation – applications of polarography – polarographic maxima – oscillographic polarography, AC polarography – cyclic voltammetry – advantages over polarographic techniques – chronopotentiometry – advantages – controlled potential coulometry – amperometric titrations: principles – techniques – applications – estimation of lead.

LECTURE	TUTORIAL	SELF STUDY	PRACTICAL	TOTAL
60	15	-	-	75

TEXT BOOKS

1. D. B. Hibbert and J. J. Gooding, Data Analysis for Chemistry; Oxford UniversityPress, UK, 2006.
2. J. Topping, Errors of Observation and Their Treatment; 4th Ed., Chapman Hall, London, (1984).
3. A. Braithwaite and J. F. Smith, Chromatographic Methods; 5th Ed., Springer, Germany; (1995).
4. V. K. Srivastava and K. K. Srivastava, Introduction to Chromatography; 2nd Ed.,Holden Day, New York, (1985).
5. H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis; 6th Ed., CBS Publishers and Distributors, Chennai, (1986).
6. D. A. Skoog, D. M. West and D. J. Holler, Fundamentals of Analytical Chemistry, 7th Ed., Harcourt College Publishers, Singapore, (2004).
7. A. Sharma, S. G. Schulman, Introduction to Fluorescence Spectroscopy; Wiley- Interscience, New York, (1999).

REFERENCES

1. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy; 4th Ed., Tata McGraw-Hill, New Delhi, (1994).
2. A. I. Vogel, Text Book of Quantitative Inorganic Analysis; 6th Ed., Longman, New Delhi, (2000).
3. D. C. Harris, Quantitative Chemical Analysis; 4th Ed., W. H. Freeman Publications, New York, (1995).
4. S. C. Gupta, Fundamentals of Statistics; 6th Ed., Himalaya Publications, Delhi, (2006).

COURSE CODE	COURSE NAME	L	T	P	C
YEC304A	PHARMACEUTICAL CHEMISTRY	4	1	0	5
PREREQUISITES	Nil	L	T	P	H
C:P:A	4:0:1	4	1	0	5

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Recall*** the various terminology of pharmaceutical chemistry.	Cognitive	Remember Understand
CO2	***Outline*** the structural aspects of antibiotics and ***relate*** their functions..	Cognitive	Understand
CO3	***Illustrate*** the biologicalactivities of analgesic and antipyretics.	Cognitive Affective	Remember Understand Receive
CO4	***Summarize*** the activities of anaesthetics and local anaesthetics.	Cognitive Affective	Understand Respond
CO5	***Inference*** the various concepts of clinical chemistry.	Cognitive Affective	Analyze Respond

UNIT I	BASICS OF PHARMACEUTICALCHEMISTRY	15

Definitions – the terms – drugs, pharmacology, pharmacy, chemotherapy, therapeutics – pharmacologically active principles in plants – first aid – important rules of first aids, cuts, fractures, bleeding for blood, maintaining breathing burns and first aid box – tuberculosis (t.b.), jaundice, piles, typhoid, malaria, cholera – causes – symptoms, diagnosis – prevention and treatment – medicinally important compounds of iron – ferrous gluconate, ferrous sulphate and ferric ammonium citrate.

UNIT II	ANTIBIOTICS	15

Definition – introduction – classification and biological actions – penicillin, chloramphenicol, streptomycin and tetracycline – structure, properties and therapeutic uses – chemical structure and pharmacological activity – effect of unsaturation, chain length, isomerism, halogens, amino groups, hydroxyl groups and acid groups.

UNIT III	ANALGESIC AND ANTIPYRETICS	15

Narcotic analgesic – analgesic action of morphine – derivatives of morphine – heroin and apomorphine – synthetic analgesics – pethidine, methadone – nonnarcotic analgesic – aspirin, paracetamol and phenacetin – analgin – preparation, properties and uses – ibuprofen and ketoprofen – structure and uses.

UNIT IV	ANAESTHETICS AND LOCAL ANAESTHETICS	15

Characteristics of anaesthetics – classification of anaesthetics – general anaesthetics – volatile anaesthetics – ether, chloroform and halothane – advantages and disadvantages – non-volatile anaesthetics (intravenous anaesthetics) – methohexitone and propanidid – structure and uses – cocaine and amethocaine – structure and uses – benzocaine and procaine – structure, synthesis and uses.

UNIT V	CLINICAL CHEMISTRY	15

Determination of sugar (glucose) in serum – *o*-toluidine method – diagnostic test for sugar in urine – Benedict's test – detection of diabetes – detection of cholesterol in urine – detection of anaemia – estimation of haemoglobin (Hb concentration) – red cell count.

LECTURE	TUTORIAL	SELF STUDY	PRACTICAL	TOTAL
60	15	-	-	75

TEXT BOOKS

1. Jayashree Ghosh, A Text Book of Pharmaceutical Chemistry; 5th Ed., S.Chand and Company Ltd., New Delhi, (2014).

REFERENCES

1. S. Lakshmi; Pharmaceutical Chemistry; 1st Ed., S. Chand and Company Ltd., New Delhi,

(1995).
2. Bhagavathi Sundari; Applied Chemistry; 1st Ed., MJP Publishers, Chennai, (2006).

COURSE CODE	COURSE NAME	L	T	C
YEC403B	INDUSTRIAL CHEMISTRY	4	1	5
		L	T	H
C:P:A	3.75:0.75:0.5	4	1	5

COURSE OUTCOMES: *On the successful completion of the course, students will be able to*		DOMAIN	LEVEL
CO1	***Illustrate*** the basic ideas of an industry and industrial wastes.	Cognitive Psychomotor	Remember Understand Set
CO2	***Rephrase*** and ***Report***the preparation and properties of petroleum and petrochemicals.	Cognitive Affective	Understand Respond
CO3	***Identify*** the role and functions of portland cement.	Cognitive Affective	Understand Apply Respond
CO4	***List*** the various process involved in the paper industry	Cognitive Psychomotor	Analyze Perception
CO5	***Outline*** the preparation and mode of action of soaps, detergents and perfumes.	Cognitive Psychomotor	Analyze Perception

SYLLABUS:

UNIT I	**Basic Ideas and Industrial Wastes**	
Basics idea about unit operation – flow chart – chemical conversion – batch versus continuous processing – chemical process selection – design – chemical process control. Types of industrial wastes – treatment of wastes or effluent with organic impurities – treatment of wastes or effluent with inorganic impurities – treatment of some important chemical wastes.		**15**
UNIT II	**Petroleum and Petrochemicals**	
Introduction – saturated hydrocarbons from natural gas – uses of saturated hydrocarbons – unsaturated hydrocarbons – acetylene, ethylene, propylene, butylene – aromatic hydrocarbons – toluene and xylene. Preparation of rectified spirit from beat – methylated spirit – preparation of absolute alcohol from rectified spirit – petrochemicals in India.		**15**
UNIT III	**Manufacture of Cement**	
Introduction – types of cement – high alumina cement, water proof cement, slag cement, acid resisting cement, white cement, coloured cement, Pozzolana cement. Setting of cement – properties of cement – testing of cement – uses of cement –concrete – cement industries in India.		**15**
UNIT IV	**Pulp and Paper and Manufacture of Paper**	
Introduction – manufacture of pulp – types of pulp – sulphate or craft pulp, soda pulp, Rag pulp – beating, refining, filling, sizing and colouring. Calendaring – uses – paper industries in India.		**15**
UNIT V	**Soaps, Detergents and Perfumes**	

Introduction – types of soaps – hard and soft soaps – manufacture of soap (hot and continuous process only) – cleansing action of soap – detergents – surface active agents – biodegradability of surfactants, amphoteric detergents. Introduction – production of natural perfumes – flower perfumes – jasmine, rose and lily – production of synthetic perfumes – muscone and nitro-musks.	**15**

REFERENCE BOOKS:

1. B. K. Sharma, Industrial Chemistry; 8th Ed., Goel Publishing House, New Delhi, 1997.
2. R. N. Shreve, and J. A. Brink Jr. Chemical Process Industries; 4th Ed., McGraw Hill, Toronto, 1977.
3. A. C. S. Brain, Production and Properties of Industrial Chemicals; Reinhold, New York, 1989.

	LECTURE	TUTORIAL	SELF-STUDY	TOTAL HOURS
Hours	**60**	**15**	**-**	**75**

COURSE CODE	COURSE NAME	L	T	C
YEC404B	**CHEMISTRY OF NANOSCIENCE AND NANOTECHNOLOGY**	**4**	**1**	**5**
		L	**T**	**H**
C:P:A	**4.4:0:0.6**	**4**	**1**	**5**

COURSE OUTCOMES: ***On the successful completion of the course, students will be able to***		**DOMAIN**	**LEVEL**
CO1	***Outline*** the synthetic methods of nanomaterials.	Cognitive Psychomotor	Remember Understand Set
CO2	***Compare*** the properties and characterization of nanomaterials.	Cognitive Affective	Understand Respond
CO3	***Predict*** the reactions of nanoparticles	Cognitive Affective	Understand Apply Respond
CO4	***Classify*** theapplications ofcarbon clusters and nanostructures.	Cognitive Psychomotor	Analyze Perception
CO5	***List*** the role and significance of nanoparticles in nanodevice.	Cognitive Psychomotor	Analyze Perception

SYLLABUS:

UNIT I	**Synthetic Methods**	
Definition of nanodimensional materials – historical milestones – unique properties due to nanosize, quantum dots, classification of nanomaterials.General methods of synthesis of nanomaterials – hydrothermal synthesis, solvothermal synthesis – microwave irradiation– sol-gel and precipitation technologies – combustion flame – chemical vapour condensation process – gas-phase condensation synthesis – reverse micelle synthesis – polymer-mediated synthesis–protein microtubule-mediated synthesis – synthesis of nanomaterials using microorganisms and other biological agents – sonochemical synthesis –hydrodynamic cavitation. Inorganic nanomaterials – typical examples – nano TiO_2/ZnO/CdO/CdS, organic nanomaterials – examples – rotaxanes and catenanes		**15**
UNIT II	**Characterisation of Nanoscale Materials**	

Principles of Atomic Force Microscopy (AFM) – Transmission Electron Microscopy(TEM) Resolution and Scanning Transmission Electron Microscopy (STEM) – Scanning Tunneling Microscopy (STM) – Scanning Nearfield Optical Microscopy (SNOM).Scanning ion conductance microscope, scanning thermal microscope, scanning probe microscopes and surface plasmon spectroscopy.	**15**
UNIT III **Reactions in Nanoparticles**	
Reactions in nanospace – nanoconfinement – nanocapsulesCavitands, cucurbiturils, zeolites, M.O.Fs, porous silicon, nanocatalysis.	**15**
UNIT IV **Carbon Clusters and Nanostructures**	
Nature of carbon bond − new carbon structures − carbon clusters – discovery of C60−alkali doped C60−superconductivity in C60−larger and smaller fullerenes. Carbon nanotubes – synthesis − single walled carbon nanotubes − structure and characterization − mechanism of formation − chemically modified carbon nanotubes −doping − functionalizing nanotubes − applications of carbon nanotubes. Nanowires −synthetic strategies − gas phase and solution phase growth – growth control − properties.	**15**
UNIT V **Nanotechnology and Nanodevices**	
DNA as a nanomaterial – DNA – knots and junctions, DNA – nanomechanical device designed by Seeman. Force measurements in simple protein molecules and polymerase – DNA complexes–molecular recognition and DNA based sensor. Protein nanoarray, nanopipettes, molecular diodes, self-assembled nanotransistors, nanoparticle mediated transfection.	**15**

REFERENCE BOOKS:

1. C. N. R. Rao, A. Muller and A. K. Cheetham (Eds), The Chemistry of Nanomaterials: Vol. 1 and 2; Wiley-VCH;Germany, Weinheim, 2004.
2. C. P. Poole, Jr: and F. J. Owens, Introduction to Nanotechnology; Wiley Interscience, New Jersey, 2003.
3. K. J. Klabunde (Ed), Nanoscale Materials in Chemistry; 2nd Ed., Wiley-Interscience, New York, 2009.
4. T. Pradeep, Nano: The Essentials in Understanding Nanoscience and Nanotechnology; 1st Ed., Tata McGraw Hill, New York, 2007.
5. H. Fujita (Ed.), Micromachines as Tools in Nanotechnology; Springer-Verlag, Berlin, 2003.
6. Bengt Nolting, Methods in Modern Biophysics; 3rd Ed., Springer-Verlarg, Berlin, 2009.
7. H. Gleiter, Nanostructured Materials: Basic Concepts, Microstructure and Properties, Elsevier, Chennai, 2000.
8. W. Kain and B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life; 2nd Ed., John-Wiley R Sons, New York, 2013.

Hours	LECTURE	TUTORIAL	SELF-STUDY	TOTAL HOURS
	60	15	-	75

M.Phil Chemistry

COURSE CODE	ZQCY201	L	T	P	SS	C
COURSE NAME	NANOCHEMISTRY AND GREEN CHEMISTRY	4	4	0	0	8
C:P:A	3.6:0:0.4	L	T	P	SS	H
		4	4	0	0	8

UNIT I	INTRODUCTION TO NANOCHEMISTRY	12

Definition of Nanodimensional materials- Historical milestones in the saga of nano forms – properties -Size effects – Importance of Nanomaterials – Classification of Nanomaterials – unique properties of Nanosized materials – Elementary aspects of bio nanotechnology- Recent discoveries in nanoscience and technology.

UNIT II		12

TECHNIQUES IN NANOCHEMISTRY

Nano scale material-characterization techniques- Atomic Force Microscopy (AFM)- Transmission Electron Microscopy (TEM) - Resolution and Scanning Transmission Electron Microscopy (STEM)- Scanning Tunneling Microscopy (STM)- Scanning Nearfield Optical Microscopy (SNOM) and Surface Plasmon Spectroscopy.

PHOTOCHEMISTRY AND ELECTROCHEMISTRY OF NANO ASSEMBLIES

Semiconductor Nanoparticles – Photo-induced charge transfer processes – Electrochemistry of Semiconductors –Nanostructures – Nanostructural Oxide films modified with dyes and redox chromophores –Electrochemistry of metal Nanostructures – Particles – Nanoelectrodes Biosensors – Chemical sensors.

UNIT III	BIOMINERALISATION	12

Biomineralisation – Control and assembly of advanced materials in Biology – Nucleation and crystal growth – Biominerals – calcium phosphate –calcium carbonate - amorphous silica, Iron biominerals, Strontium and barium sulphates.

INORGANIC NANOPARTICLES AD NANOPOROUS MATERIALS

Oxide Nanoparticles –Oxomolybdates – Nanocatalysis – Porous silicon - Transition and Non-transition metal phosphates.

UNIT IV	CARBON CLUSTERS AND NANOSTRUCTURES	12

Nature of carbon bond – New Carbon structures –Carbon clusters: Discovery of C_{60} – Alkali doped C_{60} – Superconductivity in C_{60}- Larger and smaller fullerenes. Carbon Nanotubes: Synthesis – Single walled carbon nanotubes – Structure and characterization – Mechanism of formation – Chemically modified carbon nanotubes – Doping – Functionalized nanotubes – Application of carbon nanotubes. Nanowires – Synthetic strategies – Gas phase and solution phase growth – Growth control – Properties.

UNIT V	GREEN CHEMISTRY FOR CLEAN TECHNOLOGY	12

Introduction – Goals and significance of Green Chemistry –Basic components of Green Chemistry Research -12 Principles - Green Strategies -Green chemistry in practice - Alternative feed stocks on starting materials, Alternative reagents on transformations, Alternative reaction conditions, Alternative products on target molecules, atom economy, Functional group approaches to green chemistry, Elimination of toxic functional group-Optimization of frameworks for the design of greener Systematic Pathways- Industrial applications of green chemistry-Products from Natural materials- Green solvents- Green Energy – E-Green Propellants Zeolites.

	LECTURE	TUTORIAL	PRACTICAL	SELF STUDY	TOTAL
HOURS	60	0	0	0	60

TEXT BOOKS

1. C.N.R. Rao, A.Muller, A.K.Cheetam (Eds), The chemistry of Nanomaterials, Vol.1, Wiley-VCH, Weinheim,2004.
2. C.P.Poole, F.J.Owens, Introduction to Nanotechnology Wiley Interscience, New Jersey, 2003.
3. Kenneth J. Klabunde (Ed), Nanoscale materials in chemistry, Wiley Interscience, New York, 2001.
4. T.Pradeep, Nano: The Essentials in understanding nanoscience and nanotechnology, Tata McGraw Hill, New Delhi, 2007.
5. H.Fujita (Ed), Micromachines as tools in nanotechnology, Springer-Verlag, Berlin, 2003.
6. Sengt Nolting, Methods in modern biophysics, Springer-Verlag, Berlin, First Indian Reprint, 2004.
7. H.Gletier, Nanostructured Materials: Basic Concepts, Microstructure and properties. Acta materialia, – Elsevier, 2000.
8. W.Kain and B.Schwederski, Bioinorganic chemistry: Inorganic Elements in the Chemistry of Life, John- Wiley R Sons, New York.
9. T.Tang and P.Sheng(Eds), Nanoscience and Technology- Novel Structure and Phenomena, Taylor & Francis, New York, 2004.
10. A.Nabok, Organic and Inorganic Nanostructures, Artech House, Boston, 2005.
11. J.M.Lehn, Supramolecular Chemistry-Concepts and Perspectives, V.C.H, 1995.

COURSE CODE	ZQCY202	L	T	P	SS	C
COURSE NAME	ELECTRO CHEMISTRY AND CORROSION	4	0	0	0	4
C:P:A	3.6:0:0.4	L	T	P	SS	H
		4	0	0	0	4

CO1	Explain principles of electrochemistry and different terms of corrosion.
CO2	Classify and explain Characteristic features, causes and remedial measures of different forms of corrosion.
CO3	Describe the principal and different methods of corrosion protection.
CO4	Explain corrosion rate expressions and testing methods.
CO5	Explain prevention methods and electroanalytical methods

UNIT I	ELECTROCHEMISTRY	12

Basic concepts of conductance – Kohlraush's law and conductometric titrations –electrode potentials– Nernst equation: derivation and problems - reversible and irreversible cells – electrolytic and electrochemical cells– emf and its measurements - types of electrodes- reference electrodes - primary and secondary - glass electrode - determination of pH using quinhydrone and glass electrodes - electrochemical series and its applications - Galvanic cells and concentration cells - potentiometric titrations - redox titrations.

UNIT II	INTRODUCTION TO CORROSION	12

Cost of Corrosion – Definition of Corrosion – Environments – Corrosion Damage – Classification of Corrosion.- Chemical Corrosion: Electrochemical Corrosion Corrosion Principles : Introduction – Corrosion Rate Expressions. Electrochemical Aspects : Electrochemical Reactions – Polarisation – passivity, Environmental Effects: Thermodynamic and Kinetics of Electrode Processes- Polarization Curves, Over-Potential, Passivity and Transpassivity, Pourbaix diagram for Metal Water System Effect of oxygen and oxidizers – Effect of Velocity – Effect of temperature – Effects of Corrosive concentration – Effect of Galvanic Coupling – Metallurgical Aspects.

UNIT III	BIOMINERALISATION	12
Characteristic features, causes and remedial measures of different forms of corrosion: Dry & Wet corrosion, Uniform, Galvanic, Crevice, Pitting, Crevice, Erosion, Intergranular, Selective leaching, Stress corrosion cracking, Hydrogen Damage, Liquid metal attack, Liquid metal embrittlement, Chemical degradation of non-metallic materials like rubbers, plastics, ceramics etc. Surface Films – Velocity – Turbulence – Impingement - Galvanic Effect - Dezincification Characteristics, Mechanism, prevention – Graphitization – Other Alloy systems- Hydrogen Blistering – Hydrogen Embrittlement – Prevention.		
UNIT IV	**FORMS OF CORROSION**	**12**
Principles of corrosion prevention, Material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method. Control of environment including Inhibitors and Passivators, Coatings – metallic, inorganic, organic, Electroplating of copper, Nickel and Chromium, electroless plating, Anodising, Galvanizing, Thermal spraying, Alloy plating: Chemical and electrochemical polishing: Phosphating, Chromating, Chemical colouring. Corrosion testing methods.		
UNIT V	**ELECTROANALYTICAL METHODS**	**12**
Electroanalytical measurement: Potentiometric Technique, Potentiostatic Technique, voltammogram. Thermodynamics and Potentials. Ion-selective electrodes (ISE), glass electrodes, liquid membrane electrodes, solid-state electrodes, applications of ISEs. Potentiometry: Potential step experiments, potential sweep experiments. Reactions controlled by rate of electron transfer, electrical double layer.Cyclic voltammetry-Applications, spectroelectrochemistry, electrochemiluminescence (ecl), Scanning Electron Microscopy,Scanning Probe Microscopy. Electrode scanning tunneling microscopy (stm), atomic force microscopy (afm), scanning electrochemical microscopy (secm), electrochemical quartz crystal, microbalance (eqcm), impedance spectroscopy. Controlled potential techniques: Controlled potential, , polarography, the ilkovic equation, pulse voltammetry, ac voltammetry, stripping analysis, flow analysis.		

	LECTURE	TUTORIAL	PRACTICAL	SELF STUDY	TOTAL
HOURS	**60**	**0**	**0**	**0**	**60**

TEXT BOOKS

Textbooks:

1. Emerging Trend in Corrosion Control – Evaluation, Monitoring and Solution, Editors: A. S. Khanna, K. S. Sharma and A. K. Sinha, Academia Books International.
2. Surface Modification Technologies - An Engineer's Guide by T. S. Sudarshan, Marcel Dekker
3. Electroplating and Other Surface Treatments - A Practical Guide' by C. D. Varghese, TMH

Surface Treatments for Protection, The Institute of Metallurgists Wear of Metals by A. D. Sarkar

4. Corrosion and Corrosion Control, 3rd ed., H.H.Uhlig Wiley, 1986
5. An introduction to electrometallurgy- Satya Narayan & Rajendra Sharan, Standard Publishers & Distributors, New Delhi
6. An introduction to metallic corrosion & its prevention by Rajnarain.
7. Wang, Joseph, Analytical Electrochemistry, 3th edition, John Wiley & Sons, New Jersy, 2006.

REFERENCES

1. Donald R. Askeland – Pradeep P. Phulé, The Science and Engineering of Materials, 4th ed. (req. for corrosion part, Chapter 22)
2. A. J. Bard and L. R. Faulkner, Electrochemical Methods: Fundamentals and Applications,

2nd Ed., John Wiley & Sons, New York, 2001. ISBN: 0-471-04372-9.
3. Denny A Jones, Principles and Prevention of Corrosion (second edition), Prentice-Hall, N. J. (1996).
4. M. G. Fontana, Corrosion Engineering (Third Edition) McGraw-Hill Book Company(NY) (1987).

PhD Chemistry Syllabus

COURSE CODE	RCY010	L	T	P	SS	H	C
COURSE NAME	Organic Solar Cells Theory and Practice	3	0	0	0	3	3
C:P:A	3:0:0						

COURSE OUTCOMES:		Domain	Level
CO1	***Describe*** the difference between the three generations of solar cells and able to distinguish between different solar cell technologies	Cognitive	Understanding
CO2	***Identify*** the different steps in the theory behind the solar cells	Cognitive	Remembering
CO3	***Explain*** the most common polymerization methods and characterization techniques used with the materials	Cognitive	Applying
CO4	***Recall*** different kinds of degradation behaviours - Know about decay curves,	Cognitive	Creating

SYLLABUS		HOURS
UNIT I	**Solar Cells and Life Cycle Analysis**	**4**
Solar cells, and their place as a renewable energy - Different solar cell technologies -Difference between the three generations of solar cells - Four steps of life cycle analysis Embedded energy, energy return factor, and energy payback time.		
UNIT II	**Organic and Polymer Solar Cells**	**5**
The theory behind the solar cells - Efficiency of a solar cell - Different layers in the solar cell and their function - Applications of the solar cells.		
UNIT III	**Materials in Solar Cells**	**5**
Conjugated polymers and side chains - Low band gap polymers - Polymerization methods -Characterization techniques used with the materials - Acceptor materials used in the active layer of organic solar cells.		
UNIT IV	**Stability and Degradation**	**5**
Different kinds of degradation behaviours - Decay curves, burn-in and T80 - Distinguish between different ISOS standards.		
	Total Hours	**19**

COURSE CODE	RCY010	L	T	P	SS	H	C
COURSE NAME	Material Behaviour	3	0	0	0	3	3
C:P:A	3:0:0						

COURSE OUTCOMES:		Domain	Level
CO 1	***Describe*** the core principles of materials science and introduces the concept of the microstructure-processing-properties relationship	Cognitive	Understanding
CO 2	***Discuss*** the structure of the atom, how atoms interact with each other, and how those interactions affect material properties.	Cognitive	Remembering
CO 3	***Recall*** the lattice structure of a crystalline material in part determines the properties of that material.	Cognitive	Applying
CO 4	***Explain*** how defects - deviations from the expected microstructure - also have a large effect on properties.	Cognitive	Creating

SYLLABUS		HOURS
UNIT I	**Introduction**	**3**
Principles of materials science - Different general material types (metal, ceramic, polymer, etc.) - properties - material's properties-choosing a suitable material for a simple application- microstructure-processing-properties relationship.		
UNIT II	**Atomic Structure and Bonding**	**4**
Structure of the atom, atoms interacts with each other- interactions affect material properties. Types of atoms present in a material - kind of bonding occurs- three types of primary bonds - metallic, ionic, and covalent, and the implications of the type of bonding on the material microstructure. Arrangement of atoms among themselves as a natural result of their size and bonding. Relationship between a material's microstructure and its properties.		
UNIT III	**Crystalline Structure**	**5**
Crystalline materials -Bravais lattice- physical properties of a material - crystallographic principles.		
UNIT IV	**Point Defects and Diffusion**	**4**
Defects - deviations from the expected microstructure - Effect on properties- one-dimensional, or point, defects which can be missing atoms (vacancies) or excess atoms (interstitial solution) or the wrong type of atom at a lattice point (substitutional solution). Diffusion - the movement of atoms through the crystal structure.		
	Total Hours	**16**