M. Sc. CHEMISTRY

SYLLABUS - 2018

SCHOOL OF EXCELLENCE
with
CHOICE BASED CREDIT SYSTEM (CBCS)

SCHOOL OF PHYSICAL SCIENCES
St. JOSEPH'S COLLEGE (Autonomous)
Special Heritage Status Awarded by UGC
Accredited at 'A' Grade (3rd cycle) by NAAC
College with Potential for Excellence Conferred by UGC
DBT-STAR & DST-FIST Sponsored College
TIRUCHIRAPPALLI - 620 002, INDIA

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS)

POSTGRADUATE COURSES

St. Joseph's College (Autonomous), a pioneer in higher education in India, strives to work towards the academic excellence. In this regard, it has initiated the implementation of five "Schools of Excellence" from the academic year 2014-15, to standup to the challenges of the 21st century.

Each School integrates related disciplines under one roof. The school system allows the enhanced academic mobility and enriched employability of the students. At the same time this system preserves the identity, autonomy and uniqueness of every department and reinforces their efforts to be student centric in curriculum designing and skill imparting. These five schools will work concertedly to achieve and accomplish the following objectives.

- Optimal utilization of resources both human and material for the academic flexibility leading to excellence.
- Students experience or enjoy their choice of courses and credits for their horizontal mobility.
- The existing curricular structure as specified by TANSCHE and other higher educational institutions facilitate the Credit-Transfer Across the Disciplines (CTAD) - a uniqueness of the choice-based credit system.
- Human excellence in specialized areas
- Thrust in internship and / or projects as a lead towards research and
- The multi-discipline nature of the newly evolved structure (School System) caters to the needs of stake-holders, especially the employers.

What is Credit system?

Weightage to a course is given in relation to the hours assigned for the course. Generally, one hour per week has one credit. For viability and conformity to the guidelines credits are awarded irrespective of the teaching hours. The following Table shows the correlation between credits and hours. However, there could be some flexibility because of practical, field visits, tutorials and nature of project work.

For PG courses, a student must earn a minimum of 110 credits as mentioned in the table below. The total number of minimum courses offered by a department are given in the course pattern.

POSTGRADUATE COURSE PATTERN (June 2018 onwards)

Part	Semester	Specification	No. of Courses	Hours	Credits	Total Credits
1	I-IV	**Core Courses** Theory Practical	 12-14 3-6	84	68	81
	II	**Self-Paced Learning**	1	-	2	
	III	**Interdisciplinary Core**	1	6	5	
	IV	**Comprehensive Examination** **Project Work**	1 1	- 6	2 4	
2	I-III	**Core Electives**	3	12	12	12
3	II	**IDC (Soft Skills)**	1	4	4	**12**
	III	**IDC (WS)** **IDC (BS)**	1 1	4 4	4 4	
4	I	**Extra Credit Courses-1 (MOOC)**	1	-	(2)	(4)
	III	**Extra Credit Courses-2 (MOOC)**	1	-	(2)	
5	IV	Outreach Programme (SHEPHERD)	1	-	5	**5**
		TOTAL		**120**		**110 (+4 extra credits)**

Note: IDC: Inter-Departmental Courses, BS: Between School, WS: Within School

However, there could be some flexibility because of practical, field visits, tutorials and nature of project work. For PG courses, a student must earn a minimum of 110 credits. The total number of courses offered by a department is given above.

Course Pattern

The Post-Graduate degree course consists of five vital components. They are core course, core electives, IDCs, Extra credit courses, and the Outreach Programme.

Core Courses

A core course is the course offered by the parent department related to the major subjects, components like theories, practicals, Inter disciplinary core, self paced learning, comprehensive examination, Project work, field visits, library record and etc.

Inter-disciplinary Core

Inter-disciplinary Core should be shared by the various Departments of every School. This course should be opted by all the students belonging to the particular school. Each department of the respective school should allocate themselves the schedule and the units of the course.

Core Elective

The core elective course is also offered by the parent department. The objective is to provide choice and flexibility within the department. There are three core electives. They are offered in different semesters according to the choice of the school.

Extra Credit Courses

In order to facilitate the students gaining extra credits, the extra credit courses are given. According to the guidelines of UGC, the students are encouraged to avail this option of enriching by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL etc.

Inter-Departmental Courses (IDC)

IDC is an interdepartmental course offered by a department / School for the students belonging to other departments / school. The objective is to provide mobility and flexibility outside the parent department / School. This is introduced to make every course multi-disciplinary in nature. It is to be chosen from a list of courses offered by various departments.

There are three IDCs. Among three, one is the Soft-Skill course offered by the JASS in the II Semester for the students of all the Departments. The other one is offered "With-in the school" (WS) and the third one is offered "Between the school" (BS). The IDCs are of application oriented and inter disciplinary in nature.

Subject Code Fixation

The following code system (9 characters) is adopted for Post Graduate courses:

Year of Revision	PG Code of the Dept	Semester	Specification of Part	Running number in the part
↓	↓	↓	↓	↓
18	P##	*x*	*x*	*xx*
18	**PCH**	**1**	**1**	**01**

For Example :

I MSc - Chemistry, first semester '**Inorganic Chemistry-I**'
The code of the paper is **18PCH1101**.
Thus, the subject code is fixed for other subjects.

Specification of the Part

I - Core Courses: (Theory, Practical, Self paced Learning, Inter-disciplinary Core, Core, Comprehensive Examination, Project work)
II - Core Electives
III - Inter Departmental Courses (WS, Soft Skill & BS)
IV - Extra credit courses
V - Outreach Programme (Shepherd)

EXAMINATION

Continuous Internal Assessment (CIA):

PG - Distribution of CIA Marks	
Passing Minimum: 50 Marks	
Library Referencing	5
3 Components	35
Mid-Semester Test	30
End-Semester Test	30
CIA	**100**

Mid-Semster & End-Semester Tests

Centralised – Conducted by the office of Controller of Examinations

1. Mid-Semester Test & End-Semester Test: (2 Hours each); will have Objective + Descriptive elements; with the existing question pattern PART-A; PART-B; and PART-C
2. CIA Component III for UG & PG will be of 15 marks and compulsorily objective multiple choice question type.
3. The CIA Component III must be conducted by the department / faculty concerned at a suitable computer centres.
4. The 10 marks of PART-A of Mid-Semester and End-Semester Tests will comprise only: OBJECTIVE MULTIPLE CHOICE QUESTIONS; TRUE / FALSE; and FILL-IN BLANKS.
5. The number of hours for the 5 marks allotted for Library Referencing/ work would be 30 hours per semester. The marks scored out of 5 will be given to all the courses (Courses) of the Semester.
6. English Composition once a fortnight will form one of the components for UG General English

SEMESTER EXAMINATION

Testing with Objective and Descriptive questions

Part-A: Objective MCQs only (30 Marks)

Answers are to be marked on OMR score-sheet. The OMR score-sheets will be supplied along with the Main Answer Book. 40 minutes after the start of the examination the OMR score-sheets will be collected

Part-B & C: Descriptive (70 Marks)

Part-B: 5 x 5 = 25 marks; inbuilt choice;

Part-C: 3 x 15 = 45 marks; 3 out of 5 questions, open choice.

The Accounts Paper of Commerce will have

Part-A: Objective = 25 marks

Part-B: 25 x 3 = 75 marks

Duration of Examination must be rational; proportional to teaching hours 90 minute-examination / 50 Marks for courses of 2/3 hours/week (all Part IV UG Courses) 3-hours examination for courses of 4-6 hours/week.

GRADING SYSTEM

1. Grading

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added. The marks thus obtained, will then be graded as per the scheme provided in the following Table-1.

From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by Semester **Grade Point Average (GPA)** and **Cumulative Grade Point Average (CGPA)** respectively. These two are calculated by the following formulae:

GPA = $\frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$ **WAM** (Weighted Averag Marks) = $\frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$

where,

'C_i' is the Credit earned for the Course-*i,*
'G_i' is the Grade Point obtained by the student for the Course '*i*',
'M' is the marks obtained for the course '*i*', and
'*n*' is the number of Courses **Passed** in that semester.

CGPA: Average GPA of all the Courses starting from the first semester to the current semester.

2. Classification of Final Results

i) The classification of final results shall be based on the CGPA, as indicated in the following Table-2.

ii) For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as 'Outstanding'. Similarly, the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99, and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as 'Excellent', 'Very Good', 'Good', and 'Above Average' respectively.

iii) Absence from an examination shall not be taken as an attempt.

Table-1: Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above but below 90	9	A+
70 and above but below 80	8	A
60 and above but below 70	7	B+
50 and above but below 60	6	B
Below 50	NA	RA

Table-2: Final Result

CGPA	Classification of Final Results	Corresponding Grade
9.00 and above	O	Outstanding
8.00 to 8.99	A+	Excellent
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
Below 5.00	RA	Re-appearance

Credit based weighted Mark System is to be adopted for individual semesters and cumulative semesters in the column 'Marks Secured' (for 100).

A Pass in Outreach Programme (SHEPHERD) will continue to be mandatory although the marks will not count for the calculation of the CGPA.

Declaration of Result:

Mr./Ms. _____ has successfully completed the Post Graduate in _____ programme. The candidate's Cumulative Grade Point Average (CGPA) is _____ and the class secured _____ by completing the minimum of 110 credits.

The candidate has also acquired _____ (if any) extra credits offered by the parent department courses.

M. Sc. Chemistry

Course Pattern - 2018 Set

Sem	Code	Courses	Hours	Credits
I	18PCH1101	Inorganic Chemistry-I	6	5
	18PCH1102	Organic Chemistry-I	6	5
	18PCH1103	Physical Chemistry-I	6	5
	18PCH1104	Lab Course: Organic Chemistry-I	4	3
	18PCH1105	Lab Course: Physical Chemistry Practical-I	4	3
	18PCH 1301	IDC-I (WS): Industrial Products	4	4
	18PCH1401	Extra credit course-I (MOOC)	-	(2)
		Total for Semester-I	**30**	**25+(2)**
II	18PCH2106	Inorganic Chemistry-II	6	5
	18PCH2107	Organic Chemistry-II	6	5
	18PCH2108	Physical Chemistry-II	6	5
	18PCH2109	Lab Course: Organic Chemistry Practical-II	4	3
	18PCH2110	Lab Course: Physical Chemistry Practical-II	4	3
	18PCH2111	Self- Paced Learning: Selected Topics in Physical Chemistry	-	2
	18PSS2301	IDC-II: Soft-Skills	4	4
		Total for Semester-II	**30**	**27**
III	18PCH3112	Inorganic Chemistry-III	6	5
	18PCH3113	Organic Chemistry-III	6	5
	18SPS3101A	Interdisciplinary Core: Spectroscopy and Statistical Thermodynamics	6	5
	18SPS3101B	Interdisciplinary Core: Spectroscopy **		
	18SPS3101C	Interdisciplinary Core: Sensors and Transducers		
	18PCH3201A	Core Elective-IA: Analytical Chemistry	4	4
	18PCH3201B	Core Elective-IB: Chemical Instrumentation	(4)	(4)
	18PCH3202A	Core Elective IIA: Lab Course: Inorganic Chemistry-I	4	4
	18PCH3202B	Core Elective-IIB: Characterization of Coordination Complexes	(4)	(4)
	18PCH3302	IDC-III (BS): Health Chemistry	4	4
	18PCH3402	Extra credit course-II (MOOC)	-	(2)
		Total for Semester -III	**30**	**27+(2)**
IV	18PCH4114	Inorganic Chemistry-IV	4	4
	18PCH4115	Organic Chemistry-IV	4	4
	18PCH4116	Physical Chemistry-III	4	4
	18PCH4117	Lab Course: Inorganic Chemistry-II	4	3
	18PCH4203A	Core Elective-IIIA: Natural Products	4	4
	18PCH4203B	Core Elective-IIIB: Pharmaceutical Chemistry	(4)	(4)
	18PCH4118	Comprehensive Examination	-	2
	18PCH4119	Project Work	10	5
		Total for Semester -IV	**30**	**26**
	18PCW4501	Outreach Programme (SHEPHERD)	-	**5**
		Total Hours & Credits (I-IV)	**120**	**110+(4)**

Programme Outcomes (POs):

1. Graduates are prepared to be creators of new knowledge leading to innovation and **entrepreneurship employable** in various sectors such as private, government, and research organizations.
2. Graduates are trained to evolve new technologies in their own discipline.
3. Graduates are groomed to engage in lifelong learning process by exploring their knowledge independently.
4. Graduates are framed to design and conduct experiments /demos/create models to analyze and interpret data.
5. Graduates ought to have the ability of effectively communicating the findings of Physical sciences; incorporating with existing knowledge.

Programme Specific Outcomes (PSOs):

1. Human and Social Values and Responsibilities in the context of learning Chemistry
2. Communicative Skills and the Creative scientific mind towards learning chemistry
3. Positive approach towards Environment and Ecology from the Chemistry perspective
4. Critical thinking and the Analytical mind, students develop for the in depth knowledge in advanced-level Chemistry
5. The relevance of extension of Chemistry in the social context for solving social issues
6. Employability Skills shall enable the students to find jobs in core-chemistry and other related fields
7. Entrepreneurial Skills shall empower the students to start their own industries / business in core-chemistry fields
8. Analytical or Experimental Skills make the students capable of doing higher-level research works in the emerging fields of chemistry.

_____

Semester I **Hours/Week: 6**
18PCH1101 **Credits : 5**

INORGANIC CHEMISTRY - I

Course Outcomes:

1. The chemistry of transition and inner transition elements are learnt
2. Important compounds of transition metals and their applications are learnt
3. The fundamentals and instrumentation of nuclear chemistry are learnt
4. The applications of nuclear chemistry in theoretical and analytical fields are learnt
5. Concept of nuclear energy is understood
6. Importance and need of nuclear energy to the expanding human society is understood
7. Disposal techniques of nuclear wastes and safety in working with nuclear energy are understood
8. Various atomic power projects in India are learnt

Unit I: Transition Elements (18 hr)

Transition elements – General characteristics – atomic, ionic radii – variation along the period and group – variable valency, colour, magnetic properties, non-stoichiometry, catalytic property, formation of alloys, complexing tendency – Stabilization of unusual oxidation states.

Unit II: Inner Transition Elements (18 hr)

Inner transition elements – position in the periodic table – electronic configuration, oxidation states, solubility, colour and spectra, magnetic properties – Separation of lanthanides – lanthanide contraction: Causes and consequences – Gadolinium break, shift reagents – Extraction of thorium and uranium. Comparison of actinides and lanthanides

Unit III: (18 hr)

Selected Compounds of *d*-block Selected Compounds of *d*-block elements (Structure only): Chromium (II) acetate, Manganese (III) acetate, Manganese (III) oxalate, $[Re_2Cl_8]^{2>}$, $[Nb_6Cl_{12}]^{2+}$, $[Mo_6Br_8]^{4+}$, Prussian Blue, Turnbull's Blue, $[Ni(DMG)_2]$, [Zn(EDTA)]

Fundamentals of Nuclear Chemistry The nucleus – subatomic particles and their properties - nuclear binding energy – nuclear structure – Liquid drop model and nuclear shell model – *n/p* ratio - nuclear forces - Modes of radioactive decay – alpha, beta and gamma decay – orbital electron capture – nuclear isomerism – internal conversion

Unit IV: Instrumental Techniques in Nuclear Chemistry [ONLINE] (18 hr)

Q value of nuclear reaction, Coloumbic barrier, nuclear cross section, threshold energy and excitation function – Different types of nuclear reactions fragmentation, nuclear fission, nuclear fusion – proportional counter, Geiger-Muller counter, scintillation counter and Cherankov counter. Linear accelerators – cyclotron, synchrotron

Unit V: Applications of Fission, Fusion and Trace Elements (18 hr)

Characteristics of fission reactions – product distribution, theories of fission – fissile and fertile isotopes – nuclear fusion and stellar energy– Nuclear wastes – nuclear reprocessing – radiation hazards and prevention. Applications of isotopes – neutron activation analysis – isotopic dilution analysis – Uses of tracers in structural and mechanistic studies, agriculture, medicine and industry – Radio carbon dating - hot atom chemistry – Atomic Power Projects in India.

Textbooks

1. Huheey J E, Keiter E A and Keiter R L, *Inorganic Chemistry Principles of Structure and Reactivity*, 4th Ed., Harper Collins College Publishers, New York, 1993.
2. Glasstone S, *Source Book on Atomic Energy*, Affiliated East West Press Pvt. Ltd. New Delhi, 1967.

References

1. Cotton F A and Wilkinson G, *Inorganic Chemistry A Comprehensive Text*, 3rd Ed., Interscience Publishers, New York, 1972.
2. Purcell K F and Kotz J C, *Inorganic Chemistry*, W B Saunders Company, Philadelphia, 1977.
3. Shriver D, Weller M, Overton T, Rourke J and Armstrong F, *Inorganic Chemistry*, 6th Ed., W H Freeman and Company, New York, 2014.
4. Miessler G L, Fischer P J and Tarr D A, *Inorganic Chemistry*, 5th Ed., Pearson Education, Inc., New York, 2014.
5. Housecroft C E and Sharpe A G, *Inorganic Chemistry,* 4th Ed., Pearson Education Limited, Essex, 2012.
6. Lee J D, *Concise Inorganic Chemistry*, 6th Ed., ELBS, London, 1998.
7. Friedlander G, Macias E S, Kennedy J W and Miller J M, *Nuclear and Radiochemistry*, 3rd Ed., John Wiley and Sons Inc., London, 1981.
8. Arniker H J, *Essentials of Nuclear Chemistry*, New Age International Publishers, New Delhi, 2005.
9. Choppin G, Liljenzin J, Rydberg J and Ekberg C, *Radiochemistry and Nuclear Chemistry*, 4th Ed., Elsevier, Amsterdam, 2013.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PCH1101					Title of the Paper INORGANIC CHEMISTRY-I								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	4	3	3	4	5	3	4	2	3	2	4	5	4	3.54	
CO2	3	4	5	2	4	3	3	5	4	2	4	4	5	3.69	
CO3	5	3	4	4	3	5	5	4	3	4	3	3	5	3.92	
CO4	4	3	3	4	5	3	3	3	3	4	4	5	4	3.60	
CO5	5	3	4	4	5	4	5	5	5	3	4	5	4	4.31	
CO6	4	4	4	4	4	4	4	3	5	5	5	4	3	4.08	
CO7	5	4	4	3	3	5	5	4	3	5	3	3	5	4.00	
CO8	5	5	4	4	3	3	4	5	5	4	3	5	3	4.08	
										Overall Mean Score for COs				3.90	

Result: The Score for this Course is 3.9 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester I **Hours/Week: 6**
18PCH1102 **Credits : 5**

ORGANIC CHEMISTRY - I

Course Outcomes:

1. Students learn bonding in organic molecules and the structural implications on properties
2. Students get learnt the concept of aromatic character in some molecules
3. Students understand the importance of stereochemical aspects of structure and properties
4. Students get to know the chemical reactions and the mechanisms via different intermediates
5. Students learn the techniques of studying the mechanisms of reactions
6. Students understand the nucleophilic substitution reactions shown by organic molecuels
7. Students get to know the mechanistic pathways of those nucleophilic substitution reactions
8. Students understand the structural and stereochemical implications on nucloephilic substitution reactions

Unit I: Covalent Bonding and Aromaticity (18 Hours)

Hybridization with reference to carbon compounds - shapes of simple organic molecules - bond angle and bond length in organic molecules - electronegativity of atoms and groups - dipole moments of molecules - applications of dipole moment to study the properties of organic molecules - polarity of solvents - hydrogen bonding - inter and intramolecular hydrogen bonding. *Electronic Effects* - inductive, resonance and hyperconjucative effects and their influence - rules of resonance – tautomerism - steric effects.

Aromatic character: Huckel's theory of aromaticity: three-, four-, five-, six-, seven-, and eight-membered rings – other systems with aromatic sextet - concept of homo-aromaticity and anti-aromaticity - Craig's rule and its applications. Consequences of aromaticity – non-alteration in bond length - Resonance energy from heat of hydrogenation, heat of combustion and Huckel's MO calculation. *Electron occupancy in MO's and aromaticity* – NMR concept of aromaticity and antiaromaticity - diatropic and paratropic compounds

Unit II: Stereochemistry and Conformational Analysis (18 Hours)

Stereoisomerism – principles of symmetry - enantiomers and diastereomers – *R, S and E, Z and* erythro, threo nomenclature – optical activity and

chirality – types of molecules exhibiting optical activity – absolute configuration – chirality in molecules with non carbonstereocenters (N, S and P) – molecules with more than one chiral centre. Stereochemistry of molecules with axial chirality – biphenyls, allenes, spiranes and analogues - concept of atropisomerism - Helicity and chirality - Topocity and prostereoisomerism - topocity of ligands and faces - enantiotopic ligands and faces - diastereotopic ligands and faces - Resolution – methods of Resolution. Conformations of mono and disubstituted three-, four-, five- and six- membered ring systems and their optical activity - conformations of decalin. Quantitative correlation between conformation and reactivity - Winstein-Eliel equation and Curtin-Hammett principle.

Unit III: Reaction Intermediates & Methods of Determining Mechanisms (18 Hours)

Structure, stability, generation and reactions of carbocations (classical and non-classical), carbanions, carbenes, nitrenes and free-radicals.

Non-kinetic methods - product analysis and its importance - intermediates and transition states-trapping, testing and detection of intermediates - cross-over experiments - isotopic labeling - stereochemical studies.

Kinetic methods: isotope effects - primary, secondary and solvent isotope effect -correlation analysis-linear free energy relationships -Hammett equation-significances of ó and ñ - Applications of Hammett equation - Taft equation and its applications.

Unit IV: Nucleophilic Substitutions in Aliphatic and Aromatic Substrates (18 hours)

Aliphatic nucleophilic substitution: $S_N1$and $S_N2$mechanisms - effect of substrate structure, leaving group, attacking nucleophile and solvent polarity - neighboring group participation - substitution at vinylic and allylic carbons and reactivity - ambient nucleophiles and substrates - hydrolysis of esters – mechanisms - phase transfer catalysis - crown ethers.

Aromatic nucleophilic substitution: S_NAr mechanism- S_N1 (Aromatic) mechanism with evidences - Benzyne mechanism - effect of substrate structure, leaving group, attacking nucleophile and solvent.

Unit V: Selected Topics in Organic Chemistry I (Online) (18 Hours)

Bonding weaker than Hydrogen Bonding - Addition Compounds- Acids and Bases – HSAB Theory. Aromaticity in azulenes, tropones, annulenes, sydnones and fullerenes - alternant and non-alternant hydrocarbons.

Selected reactions of Aliphatic Nucleophilic Substitutions with mechanism: Von-Braun, Dieckmann, and Williamson ether synthesis.

Selected reactions of Aromatic Nucleophilic Substitutions with mechanism: Von Richter, Sommelet-Hauser and Smiles rearrangements.

Textbooks

1. Clayden J, Greeves N, Warren S and Wothers P, *Organic Chemistry*, Oxford University Press, New York, 2006.
2. Stanley H, Pine S H, *Organic Chemistry*, 5th Ed., Tata -Mcgraw Hill, New Delhi, 2006.
3. Smith M B, and March J, March's *Advanced Organic Chemistry,* 6th Ed., John-Wiley and Sons, New York, 2007.

References

1. Cahn R S, and Derner O C, *Introduction to Chemical Nomenclature,* Butterworth, London, 1968.
2. Sykes P, *Guide Book to Mechanism in Organic Chemistry,* 6th Ed., ELBS with Longmann, 1997.
3. Eliel E L, *Stereochemistry of Carbon Compounds,* Tata-McGraw Hill Publishing Company, New Delhi, 1998.
4. Finar I L, *Organic Chemistry Volume* 2, 6th Ed., ELBS with Longmann, Singapore 1997.
5. Nasipuri D, *Stereochemistry of Carbon Compounds*, 2nd Ed., New-Age International Publishers, New Delhi, 1996.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PCH1102				Title of the Paper ORGANIC CHEMISTRY-I									Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	2	4	1	4	5	2	2	4	4	4	3	4	5	3.23	
CO2	2	4	1	4	5	2	2	3	3	4	3	4	5	3.31	
CO3	2	4	1	4	5	2	2	4	3	3	4	4	5	3.31	
CO4	2	4	1	4	5	2	1	3	3	4	3	4	5	3.15	
CO5	2	4	1	4	5	2	2	4	4	4	4	3	5	3.38	
CO6	2	4	1	4	5	2	1	4	4	4	3	3	5	3.23	
CO7	2	4	1	4	5	2	2	3	4	4	3	4	5	3.31	
CO8	2	4	1	4	5	2	2	3	4	4	3	3	5	3.23	
Overall Mean Score for COs														3.26	

Result: The Score for this Course is 3.26 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester I **Hours/Week: 6**
18PCH1103 **Credits : 5**

PHYSICAL CHEMISTRY - I

Course Outcomes:

1. Students learn and understand the theories of reaction rates
2. Students learn the concept of potential energy contour plots
3. The concepts and applications of reaction kinetic chemistry are understood
4. Acid-base and enzyme catalysis concepts are learnt
5. Students learn and understand the concepts of surface catalysis
6. The theory of strong electrolytes and its applications is learnt
7. Students learn and understand the concepts of electrical double layer
8. The concepts of polarization and derivation of Butler -Volmer equation is learnt

Unit I: Theories of reaction rate (18 Hours)

Theories of reaction rates and reaction mechanism - Arrhenius equation - Potential energy surfaces and reaction coordinates - Collision theory – ARRT (thermodynamic treatment only) - Application of ARRT to unimolecular, bimolecular and termolecular reactions - Kinetic isotope effect, isokinetic relation and temperature - Theories of unimolecular reactions - Lindemann and RRK - Principle of microscopic reversibility and detailed balancing.

Unit II: Application of ARRT to solution kinetics (ONLINE) (18 Hours)

Application of ARRT to solution kinetics - Factors affecting reaction rate in solution-. Internal pressure - Solvent dielectric constant - Ionic strength - Hydrostatic pressure - Ion-dipole and dipole-dipole reactions – van't Hoff equation and volume of activation - Catalysis Characterics of a catalyst – Factors affecting Catalytic reactions - Types of Catalysis – homogeneous catalysis - Acid - base catalysis – van't Hoff and Arrhenius intermediates - Mechanism - protolytic and prototropic catalysis laws - Acidity functions - Hammett - Zucker hypothesis - Catalysis in biological systems. Michaelis - menten equation - Lineweaver - Burk and Eadie - Hofstee plots - Influence of substrate concentration, pH, and temperature on rate - Influence of substituent's on reaction rates – Hammett and Taft equations - Linear free energy relations.

Unit III: Surface Chemistry and Heterogeneous Catalysis (18 Hours)

Surface phenomenon - Physical and chemical adsorption - Adsorption and free energy relations at interface - Langmuir adsorption isotherm – Gibbs adsorption isotherm - BET isotherm - Measurement of surface area - Heterogeneous catalysis - Mechanism – Langmuir Hinshelwood Mechanism - Langmuir Rideal bimolecular mechanism - Role of surface in catalysis

Unit IV: Debye - Huckel Theory and its Applications (18 Hours)

Debye Huckel theory - Radius of ionic atmosphere - Calculations of thickness of ionic atmosphere - Evidences of ionic atmosphere - Asymmetry effect - Electrophoretic effect - Debye Falkenhagen effect - Wien effect - Debye - Huckel Onsager equation - Modification and verification of the equation - Debye - Huckel limiting law - Modification and verification - Finite ion size model - Huckel - Bronsted equation - Calculation of activity coefficient - Determination of ion size parameter - solubility - Solubility product of sparingly soluble salt - Common ion effect - Neutral salt effect and solubility - Determination of solubility and solubility product.

Unit V: Electrode Kinetics (18 Hours)

Theories of electrical double layer - Electric double layer at the electrode - Electrolyte interface - Helmholtz model of double layer - Law of electrical neutrality – Gouy - Chapman diffused charged model - Adsorption theory of double layer - Stern's model, Triple-layer theory- Electro capillary phenomenon - Electro capillary curves for solutions containing anions, cations and molecular substances - Electro capillary maximum – Lipmann equations and Lipmann potential - Experimental measurement and calculation of Lipmann potential - Capillary electrometer and contact angle method - Electro kinetic phenomena - Classification Electro osmosis and electrophoresis - Streaming potential and Sedimentation potential – Kinetics of electrode process - Equilibrium and non-equilibrium process - Concentration and Activation polarization - Theory of electrochemical over potential - Derivation and verification of the equations - Butler Volmer equation - Tafel equation.

Textbooks

1. Laidler K J, *Chemical Kinetics*, 3rd Ed., New Delhi TATA Mc Graw Hill Co. 1984.
2. Kuriacose and Rajaram, *Kinetics and Mechanism of Chemical Transformation*, Macmillan & Co, Delhi, 1993.
3. Glasstone S, *An Introduction to Electrochemistry*, New Delhi, East West Press Pvt. Ltd, 1956.

References

1. Huges G, *Radation Chemistry*, Oxford series, 1973.
2. Antorpov L, *Theoretical Electrochemistry*, 2nd Ed., Mir publishers, Moscow, 1977.
3. Bockris J O'M and Reddy A K N, *Modern Electrochemistry* Vol 1 & 2, 2nd Ed., Plenum Press, New York, 1998.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PCH1103					Title of the Paper PHYSICAL CHEMISTRY-I								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	4	4	4	3	3	4	3	3	4	3	4	3		3.53
CO2	4	3	3	3	3	4	3	2	3	4	3	4	4		3.30
CO3	3	4	3	3	4	3	2	3	4	3	4	3	3		3.23
CO4	3	4	3	3	3	3	3	3	3	3	3	4	3		3.23
CO5	4	3	3	4	3	2	4	2	3	4	3	3	4		3.15
CO6	3	4	4	3	4	3	3	3	4	3	3	4	3		3.46
CO7	3	4	2	3	4	3	4	3	3	4	3	4	3		3.30
CO8	3	4	5	4	3	4	3	4	5	3	4	3	3		3.76
													Overall Mean Score for COs		3.74

Result: The Score for this Course is 3.74 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$$

$$\text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester I **Hours/Week: 4**
18PCH1104 **Credits : 3**

Lab Course:
ORGANIC CHEMISTRY - I

Course Outcomes:

1. Students learn the separation of binary organic mixtures
2. Students understand the green chemistry concepts
3. Students learn the skills of doing microlevel analysis
4. Students get to know the methods of qualitative analysis of organic compounds
5. Students understand the single stage preparation of organic compounds
6. Students learn about the derivative of the organic functional groups

1. Micro Qualitative Analysis of an organic binary mixture

i. Pilot separation
ii. Bulk separation
iii. Analysis of organic compounds
iv. Preparation of derivatives of the functional groups

2. Semi-micro Preparation of Organic compounds (single-stage and double stage)

i. Preparation of benzoic acid from toluene
ii. Preparation of acetanilide from aniline
iii. Preparation of *p*-nitro aniline from acetanilide
iv. Preparation of *p*-bromo aniline from acetanilide
v. Preparation of methyl nitrobenzoate from methyl benzoate

References

1. Furniss B S, Hannaford A J, Smith P W G, and Tatchell A R, Vogel's *Textbook of Practical Organic Chemistry*, 5th Ed., Pearson publication.
2. Vengataswaran V *et al*., *Basic Principle of Practical Chemis*try – Sultan Chand and sons, New Delhi, 1997.
3. Ganapragasm and Ramamurthy, *Organic Chemistry Lab Manual*, 2nd Ed., S. Vishwanathan Printers and Publishers (P) Ltd., Chennai, 2007.
4. *Organic Chemistry Lab Manual for Micro Qualitative Analysis*, Department of Chemistry, St. Joseph's College, Tiruchirappalli-620002 (Private circulation).

Semester I **Hours/Week: 4**
18PCH1105 **Credits : 3**

Lab Course:
PHYSICAL CHEMISTRY - I

Course Outcomes:

1. Students learn and understand the effect of ionic strength on the rate constant
2. Students learn the concept of Polarimeter
3. Students get to know concepts of kinetics of chemical reaction
4. Phase rule and its applications are learnt and experimented
5. Surface catalysis and adsorption concepts are learnt and experimented· The concept of adsorption isotherm is understood

Regular Experiments

1. Neutral salt effect - Kinetics of reaction between iodide and Persulphate - Effect of ionic strength on rate constant.
2. Kinetics of iodination of acetone.
3. Kinetics of hydrolysis of ester - Comparison of acid strengths.
4. Determination of Arrhenius parameters - Hydrolysis of methyl acetate by acid.
5. Phase diagram of naphthalene - m-dinitrobenzene system. (Simple eutectic system).
6. Freundlich's Adsorption Isotherm - Adsorption of acetic acid by charcoal.
7. Phase diagram of two-component system forming a compound.

Demonstration experiments

1. Kinetic study under low temperature with ultracrystal circulator.
2. Partition coefficient - Study of $KI + I_2 \rightarrow KI_3$.
3. Polarimetry - Inversion of Cane sugar.
4. Phase diagram of three-component system.
5. Heat of solution of oxalic acid by solubility.
6. Heat of fusion of naphthalene.
7. Partial molar volume of electrolytes.

References

1. Venkateswaran V, Veeraswamy R, Kulandaivelu A.R., *Basic Principles of Practical Chemistry*, 2nd Ed., New Delhi, Sultan Chand & sons, 1997.
2. Daniels *et al*., *Experimental Physical Chemistry*, 7th Ed., New York, Mc Graw Hill, 1970.
3. Findlay A, *Practical Physical Chemistry*, 7th Ed., London, Longman, 1959.

Semester I **Hours/Week: 4**
18PCH1301 **Credits : 4**

IDC-I (WS): INDUSTRIAL PRODUCTS

Course Outcomes:

1. Students learn Industrial products like cement and glass and their manufacturing processes and their uses in day today life
2. Students get learnt the concept of dyes, pigments and paints and their preparation and uses
3. Students understand the importance of plastic and fibres and their utility
4. Students get to know the preparation and uses of fertilizers in the agricultural sector
5. Students learn the techniques of studying cosmetic and their uses
6. Students understand the recycling of plastic to avoid pollution

Unit-I: Cement and Glass (12 hours)

Cement - Composition, types - Portland cement - Composition, types, manufacture (Wet and Dry process), uses - Setting of cement, Glass- - Composition, Types, methods of manufacturing - Melting, Blowing, Pressing, Annealing and finishing- chemical and physical properties of glass

Unit-II: Pigments, Dyes and Paints (12 hours)

Pigments - Classification, Manufacture and uses; Dyes - Classification, preparation, Dyeing processes; Paints - Composition, Types, Manufacture and testing of Paints.

Unit-III: Fibres, Plastics and Rubber (12 hours)

Fibres – definition-difference between Natural and synthetic fibres-properties of synthetic fibres-Artificial silk, rayon, nylon and Terylene

Plastics - composition, Classification, manufacture, properties and uses recycling of plastics Rubber: types of rubber-synthetic rubber- natural rubber - Vulcanizations of Rubber- properties and uses

Unit-IV: Fertilizers and Fuels (12 hours)

Fertilizers - Organic and Inorganic fertilizers, Preparation and uses, Fuels - Energy resources - Industrial gases, Water gas, Producer gas, Oil gas, natural gas, coal gas, Gobar gas, Indane gas, Petroleum products and coal products.

Unit-V: Cosmetics (12 hours)

Shampoo- composition and its preparation, lipstick -preparation, Face cream and face powder -composition and their preparation. Hair dyes – chemical and herbal dyes. Perfumes and Deodorants.

Textbooks

1. Charkarabarthy B N, *Industrial Chemistry*, Oxford and IBH Publishing. Co. 1st Edition. New Delhi.
2. Sharma B K, *Industrial Chemistry*, Goel Publishing House, 1st Edition, Meerut.

References

1. Kirk Othmer, *Encyclopedia of Chemical Technology*, John Wiley and Sons, 1999.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PCH1301				Title of the Paper IDC-1 (WS): INDUSTRIAL PRODUCTS								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	2	4	3	4	5	2	2	4	4	4	3	4	5	3.54
CO2	2	4	3	4	5	4	2	3	3	4	3	4	5	3.54
CO3	2	4	3	4	5	4	2	4	3	3	4	4	5	3.61
CO4	2	4	3	4	5	2	4	3	3	4	3	4	5	3.54
CO5	2	4	3	4	5	4	2	4	4	4	4	3	5	3.38
CO6	2	4	3	4	5	2	4	4	4	4	3	3	5	3.46
										Overall Mean Score for COs				3.51

Result: The Score for this Course is 3.51 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	**1**	**2**	**3**	**4**	**5**
Relation	**0.0-1.0**	**1.1-2.0**	**2.1-3.0**	**3.1-4.0**	**4.1-5.0**
Quality	**Very poor**	**Poor**	**Moderate**	**High**	**Very High**

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs =** $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester II **Hours/Week: 6**

18PCH2106 **Credits : 5**

INORGANIC CHEMISTRY-II

Course Outcomes:

1. Concept of ionic bonding is understood
2. Various types of chemical forces and their effects on the physical properties of substances are learnt
3. Theories of covalent bonding are learnt
4. Methods of prediction of structures of polyatomic molecules are understood
5. Applications of electromotive force in inorganic chemistry are learnt
6. Various concepts of acids and bases and the basis of Hard-Soft-Acid-Base theory are learnt
7. Chemistry of non-aqueous solvents is understood
8. Structures and properties of inorganic chains, rings, cages and clusters are understood

Unit-I: Ionic Bonding (18 hr)

Effective nuclear charge – shielding - Slater's rule – Born-Lande equation – Born Haber cycle and its applications – Radius ratio – polarization- Fajan's rule – results of polarization. Electronegativity – determination – methods of estimating charges, electronegativity equalization – Types of chemical forces – van der Waals forces – hydrogen bonding - effects of chemical forces - melting and boiling points, solubility and hardness

Unit-II: Covalent Bonding (18 hr)

Octet rule – Valence bond theory – resonance – conditions of resonance – formal charge – hybridization – Molecular orbital theory – symmetry and overlap – molecular orbitals in homonuclear diatomic molecules: O_2, B_2, N_2 and C_2 – MO treatment of hetero nuclear diatomic molecules: CO and HCl – VSEPR theory: methane, ammonia, water, PCl_3F_2 (Bent's rule), SF_4, BrF_3, TeF_5^- , ICl_2^- >, ICl_4^- >, XeF_2, XeF_4, XeF_6, XeO_3, XeO_4, XeO_2F_2, $XeOF_4$, phosphorus trihalides, ammonia and NX_3 dipole moments, OF_2 and COF_2. Bond angle - *s*, *p* character relationship – energetics of hybridization.

Unit-III: Acids and Bases [ONLINE] (18 hr)

Electrode potentials and electromotive forces – applications – Acid-base concepts: Bronsted-Lowry, Lux-Flood, Usanovich, Lewis, solvent system and generalised acid base concepts – Measures of acid-base strength – steric effect and solvation effects *F*-strain and *B*-strain – Hard and soft acids and bases – acid base strength - hardness and softness – symbiosis

–Theoretical basis of hardness and softness, electronegativity and hardness and softness Types of solvents, types of reactions – autoionisation, neutralisation, precipitation, solvation, solvolysis and complex formation. *Liq*. NH_3, *liq*. SO_2, HF and H_2SO_4 as solvents - alkali metals in *liq.* NH_3

Unit-IV: Periodicity and the chemistry of halogens and noble gases (18 hr)

Periodicity: The use of *p*-orbitals in *pi*-bonding – $p\pi$-$p\pi$ bonding in heavier non-metals – the use of *d* orbitals by non-metals – experimental evidence of $p\pi$-$d\pi$ bonding – comparison of $p\pi$ bonding in phosphine complexes and oxides – experimental evidences for *d*-orbital contraction and participation

Chemistry of halogens and noble gases: Interhalogen compounds – polyhalide ions – oxyacids of heavier halogens –structure and reactivity of noble gas fluorides

Unit V: Inorganic chains, rings, cages and clusters (18 hr)

Silicate minerals – *ortho*-, *pyro*-, and *meta*-silicates – pyroxene, amphiboles – two-dimensional silicates – talc, mica and three dimensional aluminosilicates, feldspar, zeolites, ultramarine – Silicones-preparation, properties and uses – Iso- and hetero-polyacids – Structures of $[TeMo_6O_{24}]^{6-}$ and $[Mo_7O_{24}]^{6-}$ ions and $[PMo_{12}O_{40}]^{3-}$ ion – Polymeric sulphur nitride, phosphonitrilic compounds-trimers and tetramers - homocyclic inorganic ring systems – Concept of multi-centered bond – structure of B_2H_6, B_4H_{10}, $[B_{12}H_{12}]^{2-}$, B_6H_{10}, B_8H_{12}, $B_{10}H_{14}$ – Wade's rules, *closo*, *nido*, *arachno* boranes and carboranes – The "*styx*" code.

Textbooks

1. Cotton F A and Wilkinson G, *Inorganic Chemistry A Comprehensive Text*, 3rd Ed., Interscience Publishers, New York, 1972.
2. Huheey J E, Keiter E A and Keiter R L, *Inorganic Chemistry Principles of Structure and Reactivity*, 4th Ed., Harper Collins College Publishers, New York, 1993.

References

1. Purcell K F and Kotz J C, *Inorganic Chemistry*, W B Saunders Company, Philadelphia, 1977.
2. Shriver D, Weller M, Overton T, Rourke J and Armstrong F, *Inorganic Chemistry* 6th Ed., W H Freeman and Company, New York, 2014.
3. Miessler G L, Fischer P J and Tarr D A, *Inorganic Chemistry*, 5th Ed., Pearson Education, Inc., New York, 2014.
4. Housecroft C E and Sharpe A G, Inorganic Chemistry 4th Ed., Pearson Education Limited, Essex, 2012.
5. Lee J D, Concise Inorganic Chemistry, 6th Ed., ELBS, London, 1998.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PCH2106					Title of the Paper INORGANIC CHEMISTRY-II								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	5	3	3	3	3	3	5	5	5	3	3	5	3		3.77
CO2	4	3	4	4	5	5	4	3	4	4	4	5	4		4.08
CO3	3	3	4	5	5	3	3	5	5	5	3	3	3		3.85
CO4	3	3	3	3	3	5	3	3	5	5	3	3	3		3.46
CO5	5	4	3	5	3	4	3	4	5	4	5	4	4		4.08
CO6	3	3	3	3	3	3	3	3	3	5	5	5	3		3.46
CO7	4	5	5	4	3	4	5	5	4	3	4	3	4		4.08
CO8	3	5	5	3	3	4	4	4	3	3	3	5	5		3.85
													Overall Mean Score for COs		3.82

Result: The Score for this Course is 3.82 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 6**
18PCH2107 **Credits : 5**

ORGANIC CHEMISTRY-II

Course Outcomes:

1. Students learn the characteristic features of electrophilic substitutions
2. Students understand the different kinds of electrophilic mechanisms in both aromatic and aliphatic compounds
3. Students learn the addition reactions in carbon-carbon unsaturated bonds
4. Students get to know the addition reactions to carbon-hetero atom multiple bonds
5. Students have sufficient knowledge on the mechanisms of elimination reactions and their name reactions
6. Students have better knowledge on the synthetic uses of the different oxidants and reductants used in organic synthesis
7. Students get to know the classifications, mechanisms and applications of various molecular rearrangements
8. Students prepare and learn some selected topics by themselves through online study

Unit-I: Aliphatic & Aromatic Electrophilic Substitution Reactions (18 hr)

Aliphatic electrophilic substitution: S_E1 and S_E2 and S_Ei mechanisms - effect of substrate structure, leaving group, attacking nucleophile and solvent polarity - selected reactions - migration of double bonds - halogenation of aldehydes and ketones - Stork-Enamine reaction - decarboxylation of aliphatic acids - Haloform reaction.

Aromatic electrophilic substitution: Arenium ion mechanism - theory of orientation and reactivity - selected reactions: Vilsmeir-Haack reaction - Jacobsen reaction – Bischler-Napieralski reaction - Pechmann reaction - Houben-Hoesch reaction.

Unit II: Addition and Elimination Reactions (18 Hours)

Addition reactions to carbon-carbon multiple bonds: addition mechanisms - electrophilic, nucleophilic and free-radical additions - cyclo addition - orientation and reactivity - selected reactions - Birch reduction of alkyne, enone and aromatic substrates - Diels-Alder reaction – Hydroboration - Michael reaction.

Addition reactions to carbon-hetero atom multiple bonds: Addition mechanisms - orientation and reactivity - selected name reactions - Acyloin ester condensation, Aldol condensation, Benzoin condensation, Darzen's

condensation, Mannich, Stobbe and Cannizaro reaction - Claisen reaction - Knovenegal reaction – Aldol condesation - Benzoin condensation.

Elimination reactions: E1, E2 and $E1_cB$ mechanisms-spectrum of E1, E2 and E1cB mechanisms, orientation and reactivity - Bredt's rule - selected reactions - dehydration of alcohols – dehydrohalogenation - Chugav reaction - Hofmann exhaustive methylation - Cope elimination - Shapiro reaction - Extrusion reactions.

Unit III: Oxidation and Reduction Reactions (18 Hours) ***Oxidations:***

Weingberg scheme of redox reactions - synthetic uses of the following oxidants – DDQ, PCC, PDC, Jones reagent, chromyl chloride, MnO_2, SeO_2, $KMnO_4$, CrO_3, $Pb(OAc)_4$, peracids, ozone, periodate, $KBrO_3$, Thallium nitrate, OsO_4, RuO_4, Lemieux-Johnson reagents - Prevost-Woodward reactions.

Reductions: Dehydrogenating reagents - catalytic hydrogenation - synthetic uses of the following reductants - $NaNH_2$, Wilkinson's catalyst, $NaBH_4$, $(^tBuO)_3AlH$, $NaBH_3CN$, R_3SnH, Me_3SiCl, alkali metals (Na, Li) Mg-Hg, hydrazine, MPV reduction, Clemmensen reduction, Wolf-Kishner reduction.

Unit-IV: Molecular Rearrangements and Name Reactions (18 Hours)

Classifications - mechanisms and applications of the following rearrangements: Baeyer-Villiger, Beckmann, Curtius, Dienone-Phenol, Favorskii, Fries, Lossen, Neber, Schmidt, Stevens, Tiffenev-Deminov ring expansion, Bamford-Stevens reaction.

Unit-V: Selected Reactions in Organic Chemistry (ONLINE) (18 Hours)

Selected reactions of aromatic electrophilic subsutitution: Nitration-Nitrosation – Sulphonation – Halogenation - Friedel Craft's reactions - Gattermann reaction - Gattermann Koch reaction - Reimer -Tiemann reaction.

Selected reactions of free-radical: Hunsdiecker, Kolbe, Meerwein arylation, Hoffmann-Loffler-Fretag reaction.

Textbooks

1. Clayden J, Greeves N, Warren S and Wothers P, *Organic chemistry*, Oxford University Press, New York, 2006.
2. Stanley H and Pine S H, *Organic chemistry*, 5th Ed., Tata–McGraw Hill, New Delhi, 2006.
3. Smith M B, and March J, March's *Advanced Organic Chemistry,* 6th Ed., John-Wiley and Sons, New York, 2007.

References

1. Sykes P, *Guide Book to Mechanism in Organic Chemistry,* 6th Ed., ELBS with Longmann, 1997.
2. Eliel E L, *Stereochemistry of Carbon Compounds,* Tata-McGraw Hill Publishing Company, New Delhi, 1998.
3. Nasipuri D, *Stereochemistry of Carbon Compounds,* 2th Ed., New-Age International Publishers, New Delhi, 1996.
4. Kalsi P S, *Stereochemistry: Conformation and Mechanism,* 4th Ed., New--Age International Publishers, New Delhi, 1997.
5. Finar I L, *Organic Chemistry* Volume I and II, 4th Ed., ELBS with Longmann, Singapore, 1997.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PCH2107					Title of the Paper ORGANIC CHEMISTRY-II								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	2	4	1	4	5	2	2	4	4	4	3	4	5	3.38	
CO2	2	4	1	4	5	2	2	3	3	4	3	4	5	3.23	
CO3	2	4	1	4	5	2	2	4	3	3	4	4	5	3.31	
CO4	2	4	1	4	5	2	1	3	3	4	3	4	5	3.15	
CO5	2	4	1	4	5	2	2	4	4	4	4	3	5	3.38	
CO6	2	4	1	4	5	2	1	4	4	4	3	3	5	3.23	
CO7	2	4	1	4	5	2	2	3	4	4	3	4	5	3.31	
CO8	2	4	1	4	5	2	2	3	4	4	3	3	5	3.23	
Overall Mean Score for COs														3.27	

Result: The Score for this Course is 3.27 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 6**
18PCH2108 **Credits : 5**

PHYSICAL CHEMISTRY-II

Course Outcomes:

1. Students learn and understand the concept of classical mechanics
2. Hydrogen atomic spectrum is learnt and understood
3. The concepts of mathematics of quantum chemistry is learnt
4. Students learn and understand the concepts of Schrodinger equation
5. The concept of probability distribution is learnt
6. Students learn and understand the concept of group theory
7. Students understand the concept of building a character table
8. The concept of hybridization and crystal symmetry is learnt.

Unit-I: Classical Mechanics (ONLINE) (18 Hours)

Conservation Principles- Conservation of linear momentum, angular momentum and energy. Equations of motion - Newtonian, Lagrangian and Hamiltonian. Failure of Classical mechanics - Black body radiation, Photoelectric effect - Heat capacity of substances, Hydrogen atomic spectrum. Wave particle dualism, de-Broglie equation, Compton effect - Uncertainty principle and its applications - Conversion of classical wave equation into Schrodinger wave equation.

Unit-II: Mathematics for Quantum Chemistry (18 Hours)

Functions - Definition, Classification, Linearly dependent and independent functions, odd and even functions. Inner product, Normalization, Orthogonality, ortho normal functions, Kronecker delta, Proper function - Eigen functions - need for normalization. Review of vectors and vector spaces. Operators - Linear and non-linear operators. Commutation relationship, Construction of operators-Linear momentum, Angular momentum and energy operators, Commutation relation among angular momentum operators, Hermitian operators and their properties, Anti Hermitian - Postulates of quantum mechanics.

Unit-III: Basic Quantum Chemistry (18 Hours)

Solution of the Schrodinger equation for exactly solvable problems - Particle in a 1D and 3D boxes - Harmonic oscillator and Rigid rotor, Tunneling , One dimensional potential barrier and wells - Solution of the Schrodinger equation for the hydrogen atom - Radial and angular probability distributions - Atomic orbital and electron spin - Pauli's exclusion principle.

Unit-IV: Rudiments of Group Theory (18 Hours)

Principles of Group theory - Symmetry elements - Symmetry operations - Properties of group - Abelian, non - Abelian and cyclic groups - Multiplication Tables - Classes – Subgroups - Molecular point groups – Schoenflies symbols – Optical activity and dipole moment on the basic of point groups- Matrices for symmetry operations - Reducible and irreducible representations - Statement of Great Orthogonality theorem – Construction of Character Table - Explanation of a Character Table.

Unit-V: Applications of Group Theory (18 Hours)

Applications of Group theory - Standard reduction formula relating reducible and irreducible representations - Hybridization schemes for atoms in molecules of different geometry - AB_4 tetrahedral, AB_3 triangular planar. Symmetries of vibrational modes in non-linear molecules (H_2O, NH_3 and BF_3) - Integration method - Selection rules in spectroscopy - IR & Raman active - Vibration modes -Mutual exclusion rule - Symmetry in crystals - Hermann - Mauguin symbols - Space groups of crystals -Translational elements of symmetry - Comparison of crystal symmetry with molecular symmetry.

Text Books

1. Prasad R K, *Quantum Chemistry,* 5th Ed., New Delhi, Wiley Eastern Ltd, 1992.
2. Anderson J M, *Mathematics of Quantum Chemistry*, 1st Ed., Massachusetts, W.A. Benjamine Inc., 2005.
3. Kuriakose J C and Rajaram J C *Thermodynamics,* Jalandar, Shoban Lal Co., 1996.

References

1. Donald A McQuarrie, *Quantum Chemistry*, Indian *Ed.,* Viva Books Private Ltd., 2007.
2. Levine I N, *Quantum Chemistry,* 6th Ed., Prentice Hall of India, Pvt. Ltd., 2009.
3. Atkins P W, *Molecular Quantum Mechanics,* Clarendon, 1973.
4. Raman K.V, *Group Theory and its Applications to Chemistry*, Tata Mc Graw-Hill Publishing Company, 1990.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PCH2108					Title of the Paper PHYSICAL CHEMISTRY-II								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	4	4	4	3	3	4	3	3	4	3	4	3	3.54	
CO2	3	4	3	3	4	3	2	3	4	3	4	3	3	3.23	
CO3	3	4	3	3	3	3	3	3	3	3	3	4	3	3.23	
CO4	3	4	4	3	4	3	3	3	4	3	3	4	3	3.46	
CO5	3	4	2	3	4	3	4	3	3	4	3	4	3	3.30	
CO6	4	3	3	3	3	4	3	2	3	4	3	4	4	3.31	
CO7	4	3	3	4	3	2	4	2	3	4	3	3	4	3.15	
CO8	3	4	5	4	3	4	3	4	5	3	4	3	3	3.77	
													Overall Mean Score for COs	3.37	

Result: The Score for this Course is 3.37 (High Relationship)

Note:

Mapping	**1-20%**	**21-40%**	**41-60%**	**61-80%**	**81-100%**
Scale	**1**	**2**	**3**	**4**	**5**
Relation	**0.0-1.0**	**1.1-2.0**	**2.1-3.0**	**3.1-4.0**	**4.1-5.0**
Quality	**Very poor**	**Poor**	**Moderate**	**High**	**Very High**

Values Scaling:

Mean Score of COs $= \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** $= \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester II **Hours/Week: 4**
18PCH2109 **Credits : 3**

Lab Course: ORGANIC CHEMISTRY-II

Course Outcomes:

1. Students understand the quantitative analysis in organic chemistry
2. Students know the estimation of organic compounds
3. Students understand the double stage organic preparations
4. Students get to know the chromatographic techniques
5. Students learn the chemical characterization of oils, proteins and dyes

I. Quantitative Analysis Organic Compounds

1. Determination of saponification value of oil.
2. Estimation of iodine value of oil.
3. Estimation of phenol
4. Estimation of aniline.
5. Estimation of ketone.
6. Estimation of glucose.
7. Estimation of nitrogen by Kjeldhal method
8. Estimation of ascorbic acid.

1I. Micro Preparation of an Organic Compounds (Two-stage)

1. Preparation of orange-II dye
2. Preparation of *p*-nitroaniline
3. Preparation of methyl orange dye
4. Preparation of *p*-bromoaniline
5. Preparation of 1,3,5-tribromobenzene
6. Preparation of acetyl salicyclic acid
7. Preparation of methyl red
8. Preparation of gango dye

References

1. Ganapragasam and Ramamurthy G, *Organic Chemistry Lab Manual*, 2nd Ed., S. Vishwanathan Printers and Publishers (P) Ltd., Chennai, 2007.
2. Furniss B S, Hannaford A J, Smith P W G and Tatchell A R, *Vogel's Textbook of Practical Organic Chemistry,* 5th Ed., Pearson Publication.
3. Vengataswaran V *et al*., *Basic Principle of Practical Chemistry*, Sultan Chand and sons, New Delhi, 1997.
4. *Organic Chemistry Lab Manual for Micro Qualitative Analysis*, Department of Chemistry, St. Joseph's College, Tiruchirappalli (Private circulation).

Semester II **Hours/Week: 4**
18PCH2110 **Credits : 3**

Lab Course: PHYSICAL CHEMISTRY-II

Course Outcomes:

1. Students learn and understand the concept Electrode potential
2. The concept of Salting out constant is learnt
3. Students learn and understand the concepts of Conductometric titrations
4. Students learn and understand the concepts of Potentiometric titrations
5. The concepts and measurement of equivalent conductance is learnt
6. Redox properties of ionic species is well understood

Experiments

1. Salting out constant - Effect of NaCl on solubility of Benzoicacid.
2. Dissociation constant of weak acid by conductivity method.
3. Determination of second-order rate constant for saponificationof ethyl acetate by conductivity.
4. Conductometric acid-base titration - mixture of acids - dibasicacid.
5. Conductometric precipitation titration - iodide and chloridemixture.
6. Potentiometric precipitation titration - mixture of iodide, bromide and chloride versus silver nitrate.
7. Potentiometric Redox titration.
8. Determination of standard electrode potential of Zinc and Copper.
9. Solubility of sparingly soluble salt by (i) Conductivty and (ii) Potentiometry.
10. Determination of equivalent conductance of a strong electrolyte at infinite dilution.

Demonstration Experiments

1. Measurement of dipole moment with dipole meter.
2. Measurement of ultrasonic velocity by ultrasonic interferrometer.
3. Determination of Copper and Nickel by electro gravimetry.
4. Polarographic determination of Zinc ion and Cadmium ion.

References

1. Venkateswaran V, Veeraswamy R., Kulandaivelu A.R., *Basic Principles of Practical Chemistry*, 2nd *Ed.*, New Delhi, Sultan Chand & sons, 1997.
2. Daniels *et al., Experimental Physical Chemistry*, 7th *Ed.,* New York, McGraw Hill, 1970.
3. Findlay A, *Practical Physical Chemistry*, 7th *Ed.,* London, Longman, 1959.

Semester II **Hours/Week: -**
18PCH2111 **Credits : 2**

Self-paced Learning:
SELECTED TOPICS IN PHYSICAL CHEMISTRY

Course Outcomes:

1. Students learn and understand the concept of Partial molar properties and Fugacity
2. The concept of laws of thermodynamics and activity is learnt
3. The Concepts of basics of thermodynamics is learnt
4. Radiation chemistry and its concept are understood
5. Corrosion and its applications is learnt and understood
6. Students learn and understand the concept of Renewable sources of energy

Unit-I: Chemical Thermodynamics-I

Partial molar properties – Molarity and mole fraction – Partial molar quantities - Methods of determination of partial molar volume - Chemical potential - Gibbs-Duhem equation - Chemical potential of mixture of gases - Chemical potential in terms of U, H - Variation of chemical potential with temperature and pressure - Determination of partial molar properties from apparent molar properties - Free energy of mixing - Entropy of mixing and volume of mixing. Fugacity – Definition - Methods of determination - Variation of fugacity with temperature, pressure and composition - Duhem-Margules equation - Fugacity of solids, liquids and mixture of gases - Determination of fugacity in gas mixtures (Lewis-Randall Rule).

Unit-II: Chemical Thermodynamics-II

Activity and activity coefficients - Definition - Standard state, reference state, choice of standard state for gases, liquids and solids, liquid solvent and solute – Dependence of activity on temperature and pressure - Determination of activity coefficient of non electrolyte – Mean ionic activity - Determination of activity coefficient of electrolytes by freezing point method.

Laws of thermodynamics - I law and II law of thermodynamics based on Reversible isothermal process of ideal and real gases – Irreversible isothermal process of ideal and real gases-Reversible adiabatic process of ideal and real gases - Irreversible adiabatic process of ideal and real gases- problems in I and II laws of thermodynamics.

Unit-III: Chemical Thermodynamics III

Joule Thomson effect - Thermo chemistry - Kirchoff's equation - III law of thermodynamics -Determination of ÄH by Bomb Calorimeter – Determination

of density and viscosity of liquids and liquid mixtures - Determination of volume of mixing by relative density method - Ultrasonic interferometer and its application.

Unit-IV: Radiation Chemistry and Corrosion

Radiation chemistry - Sources of high energy radiations - Interaction of high energy radiations with matter - Detection of radiations - Dosimeters - Primary and secondary processes. Radiolysis of water - Hydrated electron - G value. Corrosion – definition – costs of corrosion – economic losses – human life and safety – types of corrosion- dry corrosion – wet corrosion – mechanisms - galvanic corrosion – concentration cell corrosion – atmospheric corrosion – soil corrosion – pitting corrosion - inter-granular corrosion-water line corrosion – stress corrosion – microbial corrosion.

Unit-IV: Renewable sources of Energy and Overpotential

Significance of renewable sources of energy – types of renewable sources of energy – Solar energy - Wind energy – Hydroelectric energy – Geothermal – biomass – Advantages and disadvantages – Overvoltage – Hydrogen over voltage – mechanism of hydrogen evolution reaction – pH and metal depositions – Applications of Hydrogen overpotential.

Textbook

1. Kuriakose J. C and Rajaram J.C, *Thermodynamics,* Jalandar Shoban Lal Co., 1999.

References

1. Gupta M.C, *Statistical Thermodynamics, 2nd Ed.*, New Age International Publishers, Chennai, 1998.
2. Francis W. Sears and Gerhard L. Salinger, *Thermodynamics, Kinetic theory and statistical Thermodynamics*, 3rd Ed., Narosa Publishing House, Chennai,1998.
3. Glasstone S, *Thermodynamics for Chemists,* New Delhi, East West Affiliated Pvt. Ltd, 1969.
4. Donald McQuarrie, *Statistical Thermodynamics,* Indian Edition, Viva Books Private Ltd., NewDelhi, 2003.
5. Ferrell L Hill, *Introduction to Statistical Thermodynamics*, Addison-Wesley Publishing Company, INC, London., 1962.
6. Web resources and e-content.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PCH2111	Title of the Paper SELECTED TOPICS IN PHYSICAL CHEMISTRY											Hours -	Credits 2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	3	3	4	5	3	4	2	3	2	4	5	4	3.54
CO2	3	4	5	2	4	3	3	5	4	2	4	4	5	3.69
CO3	5	5	4	4	5	4	5	5	5	4	4	5	4	4.53
CO4	4	3	3	4	5	3	3	3	3	4	4	5	4	3.60
CO5	5	3	4	4	3	5	5	4	3	4	3	3	5	3.92
CO6	4	4	4	4	4	4	4	3	5	5	5	4	3	4.08
Overall Mean Score for COs														3.89

Result: The Score for this Course is 3.8 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 4**
18PSS2301 **Credits : 4**

IDC: SOFT SKILLS

Course Outcomes:

1. Students are taught the various nuances of grooming such as, good manners and etiquettes and they are trained to practice them in the class rooms.
2. Students are empowered with public speaking skills via extempore speeches and prepared speeches, presented before the class and assessed by the trainer as well as the companions which eventually helps build self confidence of the students.
3. Students learn the different types of resumes and different types of interview skills and write and print their own resumes and present before the interview panel for their mock interview.
4. Students actively learn the ten parameters of group discussion, perform on the stage with their colleagues, which is videotaped, reviewed and evaluated.
5. As students go through their teenage, self discovery becomes a tool to develop their personality facilitated with scientific psychological personality tests.
6. Students are guided to knowing their SWOT (Strengths, Weaknesses, Opportunities and Threats)and setting their short term and long term goals for their lives.

Module 1: Basics of Communication: Definition of communication, Process of Communication, Barriers of Communication, Non-verbal Communication, **Effective Communication**: The Art of Listening, Exercises in Kinesthetics, Production of Speech, Organization of Speech, Modes of delivery, Conversation Techniques, Dialogue, Good manners and Etiquettes, Politeness markers & Listening links.

Module II: Resume Writing: What is Resume? Types of Resume? Chronological, Functional and Mixed Resume, Steps in preparation of Resume, structure and framework for writing resume, Intensive training / personalized training on resume writing. **Interview Skills**: Common interview questions, Attitude, Body Language, The mock interviews, Phone interviews, Behavioral interviews.

Module III: Group Discussion: Group Discussion Basics, GD Topics for Practice, Points for GD Topics, Case-Based and Article based Group Discussions, Points for Case Studies, and Notes on Current Issues for GDS & Practicum with video coverage. **Team Building:** Team Vs Group – Synergy,

Stages of Team Formation, Broken Square-Exercise, Win as much as you win- Exercise, Leadership – Styles, Work ethics.

Module IV: Personal Effectiveness: Self Discovery, Self Esteem, Goal setting, Problem-solving, Conflict and Stress Management

Module V: Numerical Ability: Average, Percentage, Profit and Loss, Problems on ages, Simple Interest, Compound Interest, Area, Volume and Surface Area,Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams, Calendar, Clocks, Permutations and Combinations, Probability.

Module VI: Test of Reasoning: Series Completion, Analogy, Data Sufficiency, Blood Relations, Assertion and Reasoning, Logical Deduction, Direction. **Non-Verbal Reasoning**: Series, Classification

Text Book

1. Melchias, G., Balaiah John., John Love Joy (Eds) 2015. *Winners in the making*. St.Joseph's College, Trichy-2

References

1. Aggarwal, R. S. *Quantitative Aptitude, S.Chand & Sons*
2. Aggarwal, R.S. (2010). *A Modern Approach to Verbal and Non Verbal Reasoning*. S. Chand & Co, Revised Edition.
3. Covey, Stephen. (2004). *7 Habits of Highly effective people,* Free Press.
4. Egan Gerard (1994). *The Skilled Helper* (5th Ed). Pacific Grove, Brooks/ Cole.
5. Khera, Shiv (2003). *You Can Win.* Macmillan Books, Revised Edition.
6. Murphy, Raymond. (1998). *Essential English Grammar*. 2nd ed., Cambridge University Press.
7. Prasad, L. M. (2000). *Organizational Behaviour, S.Chand & Sons.*
8. Schuller, Robert. (2010). *Positive Attitudes*. Jaico Books.
9. Trishna's (2006). *How to do well in GDs & Interviews*, Trishna Knowledge Systems.
10. Yate, Martin. (2005). H*iring the Best: A Manager's Guide to Effective Interviewing and Recruiting*.

Modules	Topics	Examination Pattern	
		CIA	Online
I	Basics of Communication	15	5
II	Resume Writing & Interview Skills	15	5
III	Group Discussion & Team Building	10	5
IV	Personal Effectiveness	10	5
V	Numerical Ability (Common Session)	5	10
VI	Test of Reasoning (Common Session)	5	10
Total		**60**	**40**

Semester III **Hours/Week: 6**
18PCH3112 **Credits : 5**

INORGANIC CHEMISTRY-III

Course Outcomes:

1. Theories of bonding in coordination compounds are learnt
2. Basics of organometallics and structure and bonding in organometallic compounds are understood
3. Mechanisms of reactions of complexes are learnt
4. Industrial applications of organometallic catalysts are learnt
5. Different types of magnetic behaviors and their measurement are learnt
6. Origin of electronic spectra of complexes and their interpretations are understood
7. Applications of infrared spectroscopy to the study of coordination chemistry is understood
8. Applications of NMR, ESR and Mossbauer spectrometric methods to the field of coordination chemistry are learnt

Unit-I: Theories of Coordination Chemistry (18 hr)

Crystal field theory – Splitting pattern of octahedral, tetrahedral, square planar, trigonal bipyramidal and square pyramidal complexes – Magnetic properties, CFSE, high spin-low spin cross over – limitations – Structural and thermodynamic effects of inner orbital splitting, Jahn-Teller effect (static, dynamic, elongation and flattening) – Ligand Field theory – Evidences for M-L overlap, spin-orbit coupling constant and Racha parameters – MO theory of Octahedral complexes (sigma and pi bonding) – MO of tetrahedral and square planar complexes.

Unit-II: Basics of Organometallics (18 hr)

Hapticty – 16 and 18 electron rules-applications and limitations – Carbonyls – bonding – terminal, doubly, triply bridged carbonyls – structure of carbonyls – CO stretching frequencies of carbonyls and mixed carbonyls – Carbonyl hydrides – Nitrosyls-terminal, bridging and bent – *Pi* complexes with olefins – ferrocene and benzenoid metal complexes – Nonbenzenoid aromatics as ligands and carbene complexes – fluxional molecules

Unit-III: Reaction Kinetics in Coordination Chemistry [Online] (18 hr)

Inert and labile complexes – Stepwise, overall stability constants – Chelate effect – mechanisms of substitutions in octahedral complexes – Dissociative (*D*), Associative (*A*), and Interchange (*I*) mechanisms – Aquation (acid

hydrolysis) and anation – Conjugate base mechanism of base hydrolysis – Substitution reactions in square planar complexes – Trans effect-theories and Applications - Electron transfer reactions – inner and outer sphere mechanisms – Catalysis by organometallic compounds – oxidative addition – insertion – hydrogenation (Wilkinson's catalyst) – hydroformylation – Wacker process – Fischer-Tropsch reaction – Zeigler-Natta Catalyst

Unit-IV: Physical Methods in Coordination Chemistry–I (18 hr)

Types of magnetic behaviour – magnetic susceptibility measurements – Gouy method – Orbital contribution – Spin-orbit coupling and its effects on magnetic properties – Temperature independent paramagnetism (TIP) – Electronic spectra of complexes – bandwidth and intensity –Sugano-Tanabe and Orgel Diagrams – charge transfer spectra – Infrared spectra of Coordination complexes – characteristic frequencies – mode of coordination and interpretation of IR spectra of complexes containing $ClO_4>$, $SO_4^{2}>$, $CO_3^{2}>$, ester, amine, amide, DMSO ligands

Unit-V: Physical Methods in Coordination Chemistry–II (18 hr)

NMR – Applications of NMR to inorganic compounds – NMR of metal hydrides (^{1}H NMR), metal carbonyls(^{13}C NMR), ^{19}F and ^{31}P NMR – Applications of NQR spectroscopy to the study of complexes– ESR – zero-field splitting – Krammer's degeneracy – pattern for number of lines of complexes having d^1-d^9 systems –bis(salicylaldimine) Cu(II), Mn(II) complexes – Mossbauer spectroscopy – quadrupole interactions – magnetic interactions – $FeSO_4$, $FeCl_3$, ferro- and ferricyanides, nitroprusside, $Fe_3(CO)_{12}$, $I_2Br_2Cl_4$

Textbooks

1. Huheey J E, Keiter E A and Keiter R L, *Inorganic Chemistry Principles of Structure and Reactivity*, 4th Ed., Harper Collins College Publishers, New York, 1993.
2. Sutton D, *Electronic Spectra of Transition Metal Complexes*, McGraw Hill, Australia, 1968.
3. Drago R S, *Physical Methods in Chemistry*, 3rd Ed., W. B. Saunders Company, London, 1992.

References

1. Cotton F A and Wilkinson G, *Inorganic Chemistry A Comprehensive Text*, 3rd Ed., Interscience Publishers, New York, 1972.
2. Purcell K F and Kotz J C, *Inorganic Chemistry*, W B Saunders Company, Philadelphia, 1977.

3. Shriver D, Weller M, Overton T, Rourke J and Armstrong F, *Inorganic Chemistry,* 6th Ed., W H Freeman and Company, New York, 2014.
4. Miessler G L, Fischer P J and Tarr D A, *Inorganic Chemistry*, 5th Ed., Pearson Education, Inc., New York, 2014.
5. Housecroft C E and Sharpe A G, *Inorganic Chemistry* 4th Ed., Pearson Education Limited, Essex, 2012.
6. Lee J D, *Concise Inorganic Chemistry*, 6th Ed., ELBS, London, 1998.
7. Lewis J and Wilkins R G, *Modern Coordination Chemistry*, Interscience Publishers, Inc., New York, 1960.
8. Basalo F and Pearson R G, *Mechanisms of Inorganic Reactions*, John-Wiley and Sons Inc., New York, 1960.
9. Crabtree R H, *The Organometallic Chemistry of the Transition Metals*, 6th Ed., John-Wiley and Sons Inc., New York, 2014.
10. Kazuo Nakamota, *Infrared and Raman Spectra of Inorganic and Coordination Compounds,* Part A and B, 6th Ed., John-Wiley and Sons, Inc. New York, 2009.
11. Straughn B P and Walker S, *Spectroscopy* Volumes 1,2 and 3, Chapmann and Hall, London, 1976.
12. Ebsworth EAV, *Structural Methods in Inorganic Chemistry*, 3rd Ed., Great Britain, ELBS, 1987.
13. Parish R V, *NMR, NQR, EPR, and Mossbauer Spectroscopy in Inorganic Chemistry*, Ellis Harwood Limited, London, 1990.
14. Gibbs T C, *Principles of Massbauer Specroscopy*, Chapman and Hall, London, 1976.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PCH3112					Title of the Paper INORGANIC CHEMISTRY-III							Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	5	5	3	3	4	4	4	3	3	3	5	5	3.85
CO2	3	3	4	3	5	5	3	4	3	3	3	4	4	3.61
CO3	3	3	4	5	5	3	3	5	5	5	3	3	3	3.85
CO4	3	3	3	3	3	3	3	3	3	5	5	5	3	3.46
CO5	5	3	3	3	3	3	5	5	5	3	3	5	3	3.77
CO6	5	5	4	4	4	3	5	5	4	3	4	4	5	4.23
CO7	3	5	5	3	3	3	4	4	4	3	3	3	4	3.62
CO8	3	3	3	3	3	5	3	3	5	5	3	3	3	3.46
												Overall Mean Score for COs		3.73

Result: The Score for this Course is 3.73 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 6**
18PCH3113 **Credits : 5**

ORGANIC CHEMISTRY-III

Course Outcomes:

1. Students learn concepts and applications of UV-Vis spectroscopy
2. Students get learnt the concept IR spectroscopy and are able to find out the IR stretching frequency of organic functional groups
3. Students learn the principles, techniques and applications the of NMR and ESR spectroscopy for the structural elucidations
4. Students get to know the instrumentation, ionization techniques and fragmentation patterns, of chemical compounds using mass spectrometry
5. Students analyse and design the strategies of the retrosynthtic approach to synthesize organic molecules.
6. Students understand stereo chemical implications of pericyclic reaction in organic synthesis.
7. Students get to know the mechanistic pathways of DA, sigmatropic and electrocyclic reaction
8. Students understand the structural and stereochemical implications on photochemical reactions

Unit-I: Organic Spectroscopy – I (Online) (18 Hours)

UV-visible spectroscopy: electromagnetic spectrum – energy-wavelength relationship - basic principles of electronic transitions - chromophore, auxochrome – differentiating geometrical and positional isomers - Woodward-Fischer rules applied to conjugated dienes, *á*- and *â*-unsaturated carbonyl compounds & aromatic systems. Factors influencing the chromophoric absorption - applications.

ORD and CD-the concept of circularly polarized light - causes of optical activity - atomic and conformational asymmetry - ORD and CD - octant rule, *alpha*-haloketone rule and their applications - Cotton effect and ORD curves - applications to determine the absolute configurations of monocyclic ketones and steroids.

IR spectroscopy: Hooke's Law - types of vibrations - characteristic group frequencies and factors influencing them – inter-, and intra-molecular hydrogen bonding - conformational aspects in cyclic 1, 2- and l, 3- diols - Finger print region - applications of IR towards identifying the organic compounds

Unit-II: Organic Spectroscopy – II (18 Hours)

PMR spectroscopy – principle - magnetically active nuclei - number of signals – position of signals (chemical shift) - peak area and proton counting - magnetic non-equivalence of protons - types of coupling and coupling constants (J) - correlation of chemical shift with structure - spin decoupling of exchangeable protons - ^{13}C NMR spectroscopy - Basic principles - broad band and off-resonance decoupling – NOE, DEPT.

ESR spectroscopy - basic principle - predicting number of ESR lines for simple organic free radicals such as methyl, ethyl, phenyl and naphthyl radicals.

Mass spectrometry- basic principles – instrumentation - parent ion peak, base and meta stable peaks - calculation of molecular formula - Nitrogen rule – McLafferty rearrangement - fragmentation patterns of various classes of organic compounds

Unit-III: Retrosynthetic analysis (18 Hours)

Synthons and synthetic equivalents - types of synthons: donor and acceptor synthons - umpolung reactions - typical examples. Functional Group Interconversion (FGI), Functional Group Addition (FGA) - monofunctional disconnection: alcohol disconnection - alkene disconnection-ketone disconnection - acid and their derivatives disconnection - alkane disconnection - amine disconnection: Bifunctional disconnection: 1,2; 1,3; 1,4; 1,5 and 1,6-bifunctional disconnection.

Unit-IV: Pericyclic reactions (18 Hours)

Pericyclic reactions: characteristics – types of pericyclic reactions –Diels-Alder reaction-[4+2] cycloaddition – General description of Diels-Alder reaction- stereochemistry of Diel-Alder reaction- FMO and MO correlation diagram methods to cycloaddition reactions – regioselectivity in inter and intra molecular Diels-Alder reactions, Woodward-Hoffmann rules for Diels-Alder reactions and their applications to simple systems – the Alder-ene reaction: cycloadditions involving hydrogen transfer- photochemical [2+2] cycloaddition reaction-Regioselectivity of photochemical [2+2] cycloaddition reaction-thermal [2+2] cycloaddition reaction -1,3-dipolar addition

Sigmatropic reactions: [3,3]-sigmatropic rearrangement - Cope, oxy-cope, anionic Cope rearrangements - Claisen rearrangements - *ortho* ester Claisen, Ireland-Claisen, Ester enolate Claisen and Claisen rearrangement of *O*-allyl-*N,N*-dialkyl ketene aminals. [2,3]-sigmatropic rearrangement – thermal [1,n]

H sigmatropic and photochemical [1,n] H sigmatropic shifts Electrocyclic reaction: rules for electrocyclic reactions - Nazarov cyclization

Unit-V: Photochemical reactions (18 Hours)

Photochemistry - Fundamental concepts - Jablonskii diagram – photosensitization – laws of photochemistry - types of photochemical reactions – photochemistry of carbonyl compounds: - Norrish type-I and type-II reactions - photocycloaddition: Paterno-Buchi reaction - photochemistry of alkenes - photochemical rearrangements: Di-*pi* methane rearrangement – photo-Fries rearrangement- *á,b*-epoxy ketone - valence isomerization - photolysis of diazo compounds - photo substitution reaction: Barton reaction – Hofmann-Loefftier - Freytag reaction- photochemistry of dienes and aromatic compounds

Textbooks

1. Pavia D L, Lampman, G M, Kriz G S, and Vyvyan J R, *Spectroscopy*, Indian Edition, Cengage Learning, New Delhi, 2007.
2. Silverstein R M and Bassler G C, *Spectrometric Identification of Organic Compounds*, 4th Ed., John- Wiley and Sons, New York, 1993.
3. Clayden J, Greeves N, Warren S, and Wothers P, *Organic Chemistry*, Oxford University Press, New York, 2006.

References

1. Kemp W, *Organic Spectroscopy,* 3rd Ed., ELBS, London, 1987.
2. Smith M B, and March J, March's *Advanced Organic Chemistry,* 6th Ed., John-Wiley and Sons, New York, 2007.
3. Fleming I, *Spectroscopic Methods in Organic Chemistry*, 4th Ed., Tata-McGraw Hill Publishing Company, New Delhi, 1988.
4. Pine S H, *Organic chemistry*, 5th Ed., Tata -McGraw Hill, New Delhi, 2006.
5. Warren S, *Designing Organic synthesis: The Disconnection Approach*, Wiley, New Delhi, 1984.
6. Morrison R T, Boyd R N, and Bhattacharjee, *Organic Chemistry*, 7th Ed., Pearson India, 2011.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PCH3113					Title of the Paper ORGANIC CHEMISTRY-III								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	2	4	1	4	5	2	2	4	4	4	3	4	5		3.38
CO2	2	4	1	4	5	2	2	3	3	4	3	4	5		3.23
CO3	2	4	1	4	5	2	2	4	3	3	4	4	5		3.31
CO4	2	4	1	4	5	2	1	3	3	4	3	4	5		3.15
CO5	2	4	1	4	5	2	2	4	4	4	4	3	5		3.38
CO6	2	4	1	4	5	2	1	4	4	4	3	3	5		3.23
CO7	2	4	1	4	5	2	2	3	4	4	3	4	5		3.31
CO8	2	4	1	4	5	2	2	3	4	4	3	3	5		3.23
														Overall Mean Score for COs	3.27

Result: The Score for this Course is 3.27 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 6**
18SPS3101A **Credits : 5**

Interdisciplinary Core:

SPECTROSCOPY AND STATISTICAL THERMODYNAMICS

Course Outcomes:

1. Students learn and understand the concept of Molecular spectroscopy
2. The concept of FT-IR is well understood
3. The concepts of Raman Spectroscopy is well understood
4. Students learn and understand the concepts of NMR spectroscopy
5. The concepts of probability distribution is understood
6. The concept of statistical thermodynamics is understood
7. Students learn and understand the concept of partial molar properties
8. The application of statistical thermodynamics is understood

Unit-I: Rotational and Vibrational Spectroscopy (18 hr)

Basic aspects of Spectroscopy - Characterisation of electromagnetic radiation - Quantization of energy. Microwave Spectroscopy - Rotation of molecules and selection rules, Diatomic molecules - Rigid and non-rigid rotator, Rotational constant and centrifugal distortion - Techniques and instrumentation. Vibrational spectroscopy - diatomic molecules, Harmonic and anharmonic oscillators - zero point energy - force constant - fundamental absorption and overtones (hot bands, fermi resonance) - Polyatomic molecules - Techniques and instrumentation of FT-IR.

Unit-II: Raman and NMR and Mossbauer Spectroscopy (18 hr)

Raman spectroscopy - Raman and Rayleigh scattering - Quantum and Classical theories of Raman effect - Stokes and anti-stokes lines - Pure rotational Raman spectra - Vibrational Raman spectra - Mutual exclusion rule - Polarized and depolarized Raman lines - Techniques and instrumentation. NMR - Hydrogen nuclei - Chemical shift and spin-spin splitting - Coupling constant (*J*). Splitting with and without chemical exchange - Interaction between spin and magnetic field - Gyromagnetic ratio – Instrumentationof NMR - FT NMR- Applications of 2D NMR techniques like COSY, NOESY. Applications of C^{13} NMR spectroscopy - Mossbauer spectroscopy - principles of Mossbauer spectroscopy, Doppler shift, Recoil energy, Isomer shift, Quadrupole splitting - Applications to various compounds.

Unit-III: ESR spectroscopy & Electronic Spectroscopy (18 hr)

ESR – Principle - Position of ESR absorptions - *g* value - Hyperfine splitting - Zero field splitting - ESR spectrum of free radicals and copper salicyaldehyde complexes.

Electronic spectra - Electronic spectra of diatomic molecules – Born Oppenheimer approximation - Vibrational coarse structure - Franck - Condon Principle - Dissociation energy and dissociation products - rotational fine structure of electronic vibration - vibration transition - Fortrate Diagram. Electronic angular momentum in diatomic molecules - Spectrum of molecular hydrogen - Molecular photoelectron spectroscopy - UV photo electron spectroscopy and X-ray photo electron spectroscopy.

Unit-IV: Fundamentals of Statistical Thermodynamics (Online) (18 hr)

Statistical method - Microstates, macro states - Permutations and combinations - Combinatory rule - Probability theorems – Ensembles - Phase space - Thermodynamic probability - Statistical equilibrium - Maxwell-Boltzmann statistics - Derivation of M.B. statistics - Relationship between entropy and probability - Heat capacity of solids - Einstein and Debye models - Statistical meaning of third law of thermodynamics.

Unit-V: Applications of Statistical Thermodynamics (18 hr)

Partition functions - Molar, translational, rotational and vibrational partition functions of diatomic and polyatomic molecules - Separation of partition function according to forms of energy-Partition function and vibrational energy - Total partition function - Electronic partition function-Derivation of thermodynamic quantities E, S, A, H, G, K and *Cp*, *Cv* using partition function-Sackur-Tetrode equation – Bose Einstein statistics - Fermi Dirac statistics - Electronic heat capacity of gases - Equipartition of energy - Classical and quantum statistical theory of heat capacities - Heat capacities for diatomic molecule - Rotational heat capacity of hydrogen molecule - Nuclear spin statistics - Nuclear spin entropy- Quantum statistics.

Textbooks

1. Banwell C N, *Molecular spectroscopy,* 2nd Ed., New Delhi, TATA McGraw Hill Co., 2010.
2. Kuriakose J. C and Rajaram J.C, *Thermodynamics,* Jalandar Shoban Lal Co., 1999.

References

1. Drago R S, *Physical Methods in Inorganic Chemistry,* New Delhi, East West Press Ltd, 1971.
2. Chang R, *Basic Principles of Spectroscopy,* New Jersey, Englewood Cliffs, 1978.
3. Straughan B P and Walker S, *Spectroscopy Volume 1,2,3,* New York, London Chapman and Hall, A Halstet Press Book, John Wiley & Sons Ins. 1975.

4. Barrow G M, *Introduction to Molecular Spectroscopy,* Tata McGraw - Hill Ed., 1993.
5. Gurdeep R Chatwal and Sham K Anand, *Spectroscopy*, Himalaya Publishing House, 2009.
6. Gupta, M. C., *Statistical Thermodynamics, 2nd* Edition, New Age International Publishers, Chennai, 1998.
7. Donald McQuarrie, *Statistical Thermodynamics,* Indian Edition, Viva Books Private Ltd., New Delhi, 2003.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18SPS3101A					Title of the Paper SPECTROSCOPY AND STATISTICAL THERMODYNAMICS								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	4	4	4	3	3	4	3	3	4	3	4	3	3.5	
CO2	4	3	3	3	3	4	3	2	3	4	3	4	4	3.3	
CO3	3	4	3	3	4	3	2	3	4	3	4	3	3	3.5	
CO4	3	4	3	3	3	3	3	3	3	3	3	4	3	3.6	
CO5	4	3	3	4	3	2	4	2	3	4	3	3	4	3.1	
CO6	3	4	4	3	4	3	3	3	4	3	3	4	3	3.4	
CO7	3	4	2	3	4	3	4	3	3	4	3	4	3	3.4	
CO8	3	4	5	4	3	4	3	4	5	3	4	3	3	3.7	
										Overall Mean Score for COs				3.43	

Result: The Score for this Course is 3.43 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester III **Hours/Week: 6**
18SPS3101B **Credits : 5**

IDC: SPECTROSCOPY

Course Outcomes:

1. Understand the aspects of rotational spectroscopy and its techniques.
2. Understand the theory and principles of vibrational spectroscopy and its techniques.
3. Comprehend the basics of Raman and their instrumentation techniques.
4. Understand the physics behind NMR and ESR spectroscopy and its instrumentation.
5. Perceive the theory and principles of electronic and X-ray spectroscopy.
6. Understand Mossbauer spectroscopic techniques and hyperfine spectral lines.
7. Understand phosphorescence and fluorescence.
8. Analyze the structure of compounds by various spectroscopic techniques.

Unit-I: ROTATIONAL SPECTROSCOPY

Basic aspects of spectroscopy-characterization of EM radiation, quantization of energy Microwave spectroscopy-rotation of molecules and selection rules, diatomic molecules; Rigid diatomic molecule - intensities of spectral lines-effect of isotppe substitution - Non-rigid rotator (rotational constant-centrifugal distortion constant) - polyatomic molecules -techniques and instrumentation - Chemical analysis.

Unit-II: INFRA-RED SPECTROSCOPY

Vibration Spectroscopy - diatomic molecules; Harmonic and anharmonic oscillators, Zero point energy - force constant - The diatomic vibrating rotator - fundamental vibrations and overtones (hot bands, Fermi resonance) - Influence of rotation on polyatomic molecules - Analysis by IR techniques - Techniques and instrumentation.

Unit-III: RAMAN SPECTROSCOPY

Raman spectroscopy: Raman Rayleigh scattering- Quantum and Classical theory of Raman effect- Pure rotational Raman spectra - Stokes and anti-Stokes lines – Raman activity of vibrations - mutual exclusion principle-overtones and combinations vibrations- vibrational Raman spectra-rotational fine structure-Polarized and depolarized Raman lines- Structure determination-Techniques and instrumentation.

Unit-IV: SPIN RESONANCE SPECTROSCOPY

Nature of spinning particles - Interaction between spin and magnetic field - Gyromagnetic ratio-The Larmor Presession - NMR: Hydrogen nuclei - chemical shift - spin-spin splitting - coupling constant - Chemical analysis by NMR - CNMR Spectroscopy – Instrumentation - FT-NMR - ESR- Principle - position of ESR absorptions - g value - hyperfine splitting - zero field splitting - ESR spectrum of free radicals and complex

Unit-V: ELECTRONIC AND MOSSBAUER SPECTROSCOPY

Born-Oppenheimer approximation - vibrational coarse structure - Frank-Condon Principle - dissociation energy and dissociation product- vibration transitions - Fortratdiagram-electronic structure of diatomic molecules - electronic angular momentum in diatomic molecules -spectrum of Molecular hydrogen - Photo electron spectroscopy - UV photo electron spectroscopy - X-ray photo electron spectroscopy. Mossbauer Spectroscopy - Principle - Doppler shift - recoil energy - isomer shift - quadrupole splitting - hyperfine splitting - Applications.

Books for Study:

1. Colin N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, TMH Edition, 4th Edition (1994).

Unit	Book	Sections
I	1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3.1, 2.3.2, 2.3.3, 2.3.4, 2.3.5, 2.4.1, 2.4.2, 2.5, 2.6
II	1	3.1.1, 3.1.2, 3.1.3, 3.2, 3.3, 3.5.1, 3.5.2, 3.6.1, 3.6.3, 3.7.1, 3.7.2, 3.8.1, 3.8.3
III	1	4.1, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 4.3.5, 4.4.1, 4.4.2, 4.4.3, 4.5, 4.6,
IV	1	7.1.1, 7.1.2, 7.1.3, 7.1.4, 7.1.5, 7.1.6, 7.2.1, 7.2.2, 7.2.3, 7.2.4, 7.2.5, 7.3.1, 7.3.2, 7.4, 7.4.1, 7.4.2, 7.5.1, 7.5.2, 7.5.3, 7.5.4, 7.5.5,
V	1	6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.1.6, 6.1.7, 6.2.1, 6.2.2 6.2.3, 6.2.4, 6.4, 5.5, 6.5, 6.5.1, 6.5.2, 9.1, 9.2.1, 9.2.2, 9.2.3

Books for Reference:

1. Straughan, B.P and Walker.S, Spectroscopy Vol. 1,2,3, Chapman and hall, London (1996).
2. Gurdeep R. Chatwal and Sham K. Anand, Spectroscopy, Himalaya Publishing House (2009).

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18SPS3101B					Title of the Paper SPECTROSCOPY								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	4	4	4	4	4	4	2	4	3	4	3	1	4	3.59	
CO2	4	4	4	4	3	5	2	4	5	4	4	1	4	3.63	
CO3	4	4	4	4	4	3	2	4	3	4	4	3	4	3.61	
CO4	4	3	4	4	5	4	2	3	4	3	4	1	4	3.46	
CO5	5	4	4	4	4	4	3	3	3	3	3	4	4	3.55	
CO6	4	4	4	3	3	3	3	3	3	4	4	1	4	3.30	
CO7	4	3	4	4	4	3	3	4	5	3	4	4	4	3.76	
CO8	3	4	3	4	3	3	3	3	3	3	3	4	3	3.23	
										Overall Mean Score for COs				**3.51**	

Result: The Score for this Course is 3.5 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	**1**	**2**	**3**	**4**	**5**
Relation	**0.0-1.0**	**1.1-2.0**	**2.1-3.0**	**3.1-4.0**	**4.1-5.0**
Quality	**Very poor**	**Poor**	**Moderate**	**High**	**Very High**

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester IV — **Hours/Week: 6**
18SPS3101C — **Credits : 5**

SENSORS AND TRANSDUCERS

Course Outcomes

1. Understand the working principles of various transducers.
2. Characterize and measure the non - electrical quantities
3. Acquire knowledge of measurement techniques of thermal conductivity
4. Enhance the knowledge on integrated sensors.
5. Able to understand the usage of electrolytic sensors
6. Learn about biosensors and MEMS based sensors
7. Design the signal conditioning circuits used in bio- instrumentation
8. To analyze the operations of various sensors used in industries and commercial applications.

Unit-I: TRANSDUCERS (15 hr)

Introduction to measurement - Direct and indirect measuring methods - Accuracy - Errors - Transducers - Resistive transducers - Potentiometers - Non-linear potentiometers function generators - Strain gauges - Types of strain gauges - Resistance thermometers – Variable inductance transducers - Linear variable differential transformer - Capacitive transducers - Piezo electric transducers - Hall Effect transducers - Magneto resistors

Unit-II: MEASUREMENT OF NON-ELECTRICAL QUANTITY (14 hr)

Measurement of vibrations - Seismic transducers - Measurement of flow rate - Measurement of thickness - Measurement of humidity - Measurement of sound using microphones - Measurement of pH value - Measurement of thermal conductivity - Measurement of pressure.

Unit-III: INTEGRATED SENSORS (14 hr)

LM 35 temperature sensor - DS18s20 1-wire digital thermometer - TSOP 17 photo modules for PCM remote control system - MOC3041 zero cross optoisolators - TL173L linear hall effect sensor - KMZ51 magnetic field sensor - MPXV5004G pressure sensor - A1425 analog speed sensor - LM1830 water level sensor - HC610 humidity sensor - ICM105A VGA CMOS sensor

Unit-IV: BIOSENSORS AND MEMS BASED SENSORS (15 hr)

Introduction - FET & MOSFET chemical sensor - Bio sensors - Ion exchange membrane electrodes - Oxygen electrodes - CO2 electrodes enzyme electrode - Construction - ISFET for glucose, urea - Electrolytic sensors - Optical

sensor - Fiber optic sensors - ADXL 335 accelerometer - MPU 6050 IMU Sensor.

Unit-V: SIGNAL CONDITIONING CIRCUITS (14 hr)

Signal conditioning basics – type of signal conditioning: analog and digital – analog signal conditioning amplification - attenuation – level shifting - Clippers – clampers - data sampling and optimization - Filters: RC filter - active filter - Wheatstone bridge - AC bridges- noise reduction techniques. Comparators – Schmitt trigger for noise removal – Current amplification – isolation.

Books for study

1. A.K. Sawhney, "A course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Co. publishers,2011.
2. N.Mathivanan, "PC Based Instrumentation: Concepts and Practice", PHI, 2007.

Books for Reference

1. H. S. Kalsi, "Electronic Instrumentation", Tata McGraw-Hill publishers
2. Albert D. Helfrick and William D.Cooper, "Modern Electronic Instrumentation and Measurement techniques", New Delhi: Prentice Hall of India, 1995.

Unit	Book	Sections
I	1	25.2 – 25.9
II	1	25.11 – 25.13,25.16,25.17,25.19,25.22-25.24,25.28-25.31
III		Lecture notes
IV		Lecture notes
V	2	2.1 – 2.5, 2.7, lecture notes

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18SPS3101C					Title of the Paper SENSORS AND TRANSDUCERS								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	4	4	3	4	4	4	4	2	3	4	4	4	4		3.7
CO2	4	4	3	4	4	3	4	2	3	2	4	3	5		3.5
CO3	4	4	3	4	4	4	4	2	4	4	4	3	5		3.8
CO4	5	4	3	4	4	3	4	2	4	4	4	3	4		3.7
CO5	5	4	3	4	4	4	4	2	4	3	4	3	4		3.7
CO6	5	4	3	4	4	4	4	2	3	3	4	3	4		3.6
CO7	5	4	3	4	4	4	4	2	3	3	4	3	4		3.6
CO8	5	4	3	4	4	4	4	2	3	3	4	3	4		3.6
										Overall Mean Score for COs					3.6

Result: The Score for this Course is 3.6 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PCH3201A **Credits : 4**

Core Elective-IA:

ANALYTICAL CHEMISTRY

Course Outcomes:

1. The nature of errors in analyses and their types are learnt
2. Methods of minimization of errors in analytical measurements are understood
3. Statistical methods in error analysis are learnt
4. Validation methods of experimental data are understood
5. Fundamentals and applications of thermo-analytical techniques are learnt
6. Various chromatographic techniques – their theory, instrumentation, types and applications are learnt

Unit-I: Error Analysis – I (ONLINE) (12 hr)

Significant figures – rounding off the values – accuracy and precision– errors – classification of errors – constant errors and proportional errors – determinate errors (systematic errors) and indeterminate (random and accidental) – minimization of errors: calibration of apparatus, analysis of standard samples, running a blank determination, and independent analysis.

Unit-II: Error Analysis – II (12 hr)

Average, range, median, average deviation, relative average deviation and standard deviation, variance, coefficient of variation – the normal error curve – testing of significance: *F*-test, *t*- test and *Q*-test – confidence limit – method of least squares

Unit-III: Thermoanalytical Methods and Colorimetry (12 hr)

General Characteristics of thermo-analytical methods – Thermogravimetic analysis – Principle, instrumentation and applications – Factors affecting thermogram – Differential Thermal Analysis- DTA instrumentation and applications – Differential scanning calorimetry – Principle, instrumentation and applications. Colorimetry – fundamental laws – deviations from Beer's law – instrumentation and applications of spectrophotometry

Unit-IV: Instrumental Methods of Analysis (12 hr)

Principle, instrumentation and applications of fluorimetry, phsophorimetry

Flame photometry and atomic absorption spectrophotometry – Theory, instrumentation, interferences and applications.

Unit-V: Chromatography (12 hr)

Principles of chromatography – retardation factor – plate theory – column efficiency – Classification of chromatographic techniques – Principle, instrumentation and applications of gas chromatography (GC), thin-layer chromatography (TLC) and high-performance liquid chromatography (HPLC)

Textbooks

1. Jeffery G H, Bassett J, Mendham J and Denney R C, *Vogel's Textbook of Quantitative Chemical Analysis*, 5th Ed., Longman Scientific & Technical, Essex, 1989.
2. Gary D Christian, *Analytical Chemistry*, 6th Ed., John Wiley & Sons Inc., 2004.

References

1. Gopalan R, Subramanian P S, Rengarajan K, *Elements of Analytical Chemistry*, 3rd Ed., Sultan Chand & Sons, New Delhi, 2003.
2. Skoog D A, Holler F J and Crouch S R, *Principles of Instrumental Analysis*, 6th Ed., Thompson Brooks/Cole, Belmont CA, 2007.
3. Skoog D A, West D M, Holler F J and Crouch S R, *Fundamentals of Analytical Chemistry*, 9th Ed., Brooks/Cole, Belmont CA, 201Chromatography4.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PCH3201A				Title of the Paper Core Elective-IA: ANALYTICAL CHEMISTRT									Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	4	5	5	4	3	3	5	5	3	5	5	4.07	
CO2	3	3	4	3	5	5	3	4	3	3	3	4	4	3.61	
CO3	3	3	4	5	5	3	3	5	5	5	3	3	3	3.85	
CO4	3	3	3	3	3	5	3	3	5	5	3	3	3	3.46	
CO5	5	3	3	3	3	3	5	5	5	3	3	5	3	3.77	
CO6	3	3	3	3	3	3	3	3	3	5	5	5	3	3.46	
Overall Mean Score for COs														3.70	

Result: The Score for this Course is 3.7 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester III **Hours/Week: 4**
18PCH3201B **Credits : 4**

Core Elective-IB:
CHEMICAL INSTRUMENTATION

Course Outcomes:

1. The nature and choice of methods of measurement are learnt
2. Variables that control measurements are understood
3. Limits of detection and amplification are learnt
4. Concept of operational amplifiers is understood
5. Control of current and voltage are understood
6. Signal-to-noise ratio is learnt

Unit-I: Measurement and Instrumentation (12 hr)

Introduction – the nature of a measurement – choice of a method of measurement – control of variables – basic design patterns – general properties of modules – propagation of uncertainity – single channel design – limit of detection and amplification – automatic operation and computer control

Unit-II: Operational Amplifiers (12 hr)

The operational amplifier – limitations on amplifier performance – mathematical operations – differentiation – integration – measurement of current and voltage – precise control of current and voltage

Unit-III: Signal-to-Noise Optimization [ONLINE] (12 hr)

Sensitivity and detection limits – noise – minimizing noise in a system – signal averaging – modulation: chopping – demodulation: phase sensitive detection – other methods of optimizing signal-to-noise ratio

Unit-IV: Digital Electronics (12 hr)

Binary logic concepts – logic gates – multivibrators – counters – wave shaping – analog to digital converters – instruments and digital computers

Unit-V: Instrumentation for Optical Absorption Spectrometry (12 hr)

Visual photometers (colorimeter) – filter photometer – the spectrophotometer – double beam spectrophotometer – recording spectrophotometers – optimal values of adjustable parameters – multiple internal reflection assembly – rapid scanning spectrometer – non-dispersive photometers – photometric titration equipment – Fourier transform spectrometers

Textbook

1. Strobel H A, *Chemical Instrumentation A systematic approach to Instrumental Analysis,* 2nd Ed., Addison-Wesley Publishing Company Inc, Philippines, 1973.

References

1. Jeffery G H, Bassett J, Mendham J and Denney R C, *Vogel's Textbook of Quantitative Chemical Analysis*, 5th Ed., Longman Scientific & Technical, Essex, 1989.
2. Skoog D A, Holler F J and Crouch S R, *Principles of Instrumental Analysis*, 6th Ed., Thompson Brooks/Cole, Belmont CA, 2007.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PCH3201B	Title of the Paper Core Elective-IB: CHEMICAL INSTRUMENTATION											Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	3	4	5	5	4	3	3	5	5	3	5	5	4.07
CO2	3	3	4	3	5	5	3	4	3	3	3	4	4	3.61
CO3	3	4	5	5	4	3	4	5	4	5	4	3	4	4.08
CO4	3	4	3	4	4	4	3	4	5	5	3	3	3	3.69
CO5	5	3	4	3	4	5	5	5	5	3	4	4	3	4.08
CO6	3	4	5	3	3	3	4	3	4	3	4	5	3	3.62
Overall Mean Score for COs														**3.85**

Result: The Score for this Course is 3.85 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PCH3202A **Credits : 3**

Core Elective-IIA:

Lab Course: INORGANIC CHEMISTRY-I

Course Outcomes:

1. Qualitative analysis of common metals are learnt
2. Qualitative analysis of rare metals are learnt
3. Beer-Lamberts' law is understood
4. Colorimetric analysis of some common metals are learnt
5. Experimental conditions and setup for the general methods of preparation of complexes are learnt
6. Preparation methods of some inorganic complexes are understood

Experiments

1. Systematic qualitative analysis of mixtures containing 4 cations of which 2 are rare.
2. Colorimetric estimation of iron, copper, nickel and manganese.

References

1. Svehla G, *Vogel's Textbook of Macro and Semimicro Qualitiative Inorganic Analysis*, 5th Ed., Longman, London, 1979.
2. Ramanujam V, *Inorganic Semi-micro Qualitative Analysis*, 3rd Ed., National Publishing Company, Chennai, 1990.

Semester III **Hours/Week: 4**
18PCH3202B **Credits : 4**

Core Elective-IIB:

Lab Course:
CHARACTERIZATION OF COORDINATION COMPLEXES

Course Outcomes:

1. Determination of metal-ligand ratio is learnt
2. Estimation of charges on complexes is understood
3. Para and diamagnetic nature of complexes is understood
4. Determination of magnetic susceptibility of complexes is learnt
5. Uses of electronic spectra in the characterization of complexes are learnt
6. Use of IR data in determining the metal-ligand linkage is understood

Experiments

1. Job's method of determination of metal-ligand ratio
2. Conducivity studies
3. Magnetic studies – Gouy method
4. Electronic spectra
5. IR spectral studies

Textbook

1. Svehla G, *Vogel's Textbook of Macro and Semimicro Qualitiative Inorganic Analysis*, 5th Ed., Longman, London, 1979.

Semester III **Hours/Week: 4**
18PCH3302 **Credits : 4**

IDC-III (BS):

HEALTH CHEMISTRY

Course Outcomes:

1. Students learn the importance of basic nutrients and maintenance of good health
2. Students understand the classification of carbohydrates, proteins and vitamins
3. Students gain knowledge on drugs and their mode of action
4. Students learn the functions of body fluids
5. Students learn the factors affecting the blood pressure
6. Students learn the various digestion processes occurring in mouth, stomach, intestine and pancreas

Unit-I: Health and its maintenance (12 hr)

Health – Mental health and Physical health - Food Pyramid – Types of malnutrition – causes and remedies – Macro and micronutrients - Carbohydrates – Classification and their Biological functions, Proteins- Classification and their Biological functions, Vitamins – Classification and their Biological functions – Minerals (Fe, Ca, P, Na and K) and their biological functions

Unit-II: Drugs and their functions (12 hr)

Drugs – Classification of drugs – Drugs acting on CNS – General Anaesthetics, Hypnotics & sedatives, Narcotics, Antipyretics, Antirheumatics, Analgesics, Anticonvulsants and Antitussives – Chemotherapeutic drugs - antibiotics, antiseptics and disinfectants - Cardiovascular agents - Anti cancer drugs

Unit-III: Body fluids (12 hr)

Blood volume, Blood groups, Functions of blood, blood pressure, anemia, blood sugar, hemoglobin- chemistry of respiration-urine-electrolyte balance

Unit IV: Enzymes, Hormones, Digestion (12 hr)

Enzymes – Types and their action - Hormones and their biological functions- digestion in mouth, stomach, intestine and pancreas

Unit-V*:* Common and Vitamin Deficiency Diseases (Online) (12 hr)

Jaundice, Typhoid, Dengue, Ulcer, Goiter, Diabetes, Rickets, Scurvy, Beriberi, Pellagra, Night blindness,– symptoms, causes and treatments.

Textbooks

1. Alex V Ramani, *Food Chemistry*, MJP Publishers, Chennai, 2009.
2. Deb A C, *Fundamentals of Biochemistry*, New Central Book Agency, Calcutta, 1994.
3. Satake M and Mido Y, *Chemistry for Health Science*, Discovery Publishing, House, New Delhi, 2003.
4. Jayashree Ghosh, A *Text book of Pharmaceutical Chemistry*, S. Chand and Co. Ltd, 1999.

Reference

1. Ashutosh Kar, Medicinal Chemistry, Wiley Easterns Limited, New Delhi, 1993.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PCH3302					Title of the Paper IDC-III (BS): HEALTH CHEMISTRY								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	4	5	5	4	3	3	5	5	3	5	5	4.07	
CO2	3	3	4	3	5	5	3	4	3	3	3	4	4	3.61	
CO3	3	3	4	5	5	3	3	5	5	5	3	3	3	3.85	
CO4	3	3	3	3	3	5	3	3	5	5	3	3	3	3.46	
CO5	5	3	3	3	3	3	5	5	5	3	3	5	3	3.77	
CO6	3	3	3	3	3	3	3	3	3	5	5	5	3	3.46	
											Overall Mean Score for COs			3.70	

Result: The Score for this Course is 3.70 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester IV **Hours/Week: 4**
18PCH4115 **Credits : 4**

INORGANIC CHEMISTRY-IV

Course Outcomes:

1. Various structures of solid inorganic molecules are understood
2. Principles and applications of X-ray diffraction methods are learnt
3. Structural preferences of spinels and anti-spinels are understood
4. Structures of covalent crystals are understood
5. Various crystal defects are understood
6. Theories of solids and the concept of super conductivity are learnt

Unit-I: Solid State –I (12 Hours)

Elements of crystallography – space lattices-unit cell – crystal systems – Xray diffraction Bragg's method – Rotating crystal method and powder methods – indexing of crystal planes – Structure of typical lattices such as sodium chloride, cesium chloride, zinc blende, wurzite, rutile, fluorite, antifluorite, pervoskite and ReO_3

Unit-II: Solid State –II (12 Hours)

Spinels and anti-spinels – Applications of CFT – covalent crystals diamond and graphite –Crystal Structure and properties – Types of solids – stoichiometric defects – point, line and plane defects – colour centers – non-stoichiometric defects – *n, p* semiconductors – structure of solids – free electron and band theory of solids – Electrical conductivity and superconductivity – high temperature superconductors

Unit-III: Photochemistry [ONLINE] (12 Hours)

Laws of photochemistry – Photo physical processes –Jablonski diagram – Fluorescence – Phosphorescence – Kasha's rule – Stoke's shift – Types of electronic transitions in transition metal complexes – Photo chemistry of Cr(III) complexes – Photo substitution – Photo aquation – Adamson's rules – Photo rearrangement – Photo redox reations – *Photochemistry of organometallic compounds*.

Unit IV: Bio-inorganic Chemistry–I (12 Hours)

Structure and function of chlorophyll – Photo system I and Photo system II – light reactions and dark reactions – Mn Catalyzed oxidation of H_2O to O_2 in chlorophyll – Role of Mg^{2+} ion- Structure and function of Haemoglobin - Cooperative effect in Haemoglobin - Role of Globin - Structure and function of Myoglobin - Structure and function of Cytochrome C.

Unit-V: Bio-inorganic Chemistry–II (12 Hours)

Structure and function of Blue copper proteins – Structure and function of Vitamin B_{12} – In-*vivo* nitrogen fixaction – Fe-S proteins – Ionophores – Ion transport mechanism in cell membrane –Na-K pump – Role of metal ions in DNA replication, transcription, translation – *Cis*-platin and its mode of action in the treatment of cancer

Textbooks

1. Keer H V, *Principles of Solid State,* Wiley Eastern Ltd, New Delhi, 1993.
2. Bertini I, Gray H B, Lippard S J and Valentine J S, *Bioinorganic Chemistry*, University Science Books, California, 1994.
3. Rohatgi-Mukherjee K K, *Fundamentals of Photochemistry*, New Age International Publishers, New Delhi, 2006.

References

1. Azaroff, *Introduction to Solids,* Tata McGraw Hill Publishing Co., New Delhi, 1994.
2. Evans R C, *Crystal Chemistry,* Cambridge University Press, London, 1964.
3. Addison W E, *Structural Principles of Inorganic Compounds,* Longman, London, 1961.
4. West A R, *Solid State Chemistry and its Applications*, 2nd Ed., John-Wiley and Sons Ltd., New York, 2014.
5. Wheatly P J, *The Determination of Molecular Structure*, Oxford University Press, London, 1959.
6. Huheey J E, Keiter E A and Keiter R L, *Inorganic Chemistry Principles of Structure and Reactivity*, 4th Ed., Harper Collins College Publishers, New York, 1993.
7. Purcell K F and Kotz J C, *Inorganic Chemistry*, W B Saunders Company, Philadelphia, 1977.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PCH4115					Title of the Paper INORGANIC CHEMISTRY-IV								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	4	5	5	4	3	3	5	5	3	5	5		4.07
CO2	3	5	4	5	3	5	5	5	5	4	3	3	5		4.23
CO3	3	4	4	5	5	4	4	5	5	5	3	3	4		4.15
CO4	4	3	4	4	3	5	3	4	5	5	4	4	4		4.00
CO5	5	3	3	3	3	3	5	5	5	3	3	5	3		3.77
CO6	4	5	5	4	3	4	5	4	3	5	5	3	3		4.08
														Overall Mean Score for COs	**4.03**

Result: The Score for this Course is 4.03 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 4**
18PCH4116 **Credits : 4**

ORGANIC CHEMISTRY-IV

Course Outcomes:

1. Students learn and understand the stereochemical aspects of the chemical reactions
2. Students can learn and understand the asymmetric synthesis of organic molecules
3. Students understand the importance of stereochemical aspects of small ring system
4. Students learn the overview of the organic reaction mechanisms.
5. Students are motivated to know the concept of green chemistry.
6. Students understand the different types of green chemistry solvents

Unit-I: Regioselective and Diastereoselective Reactions (12 hr)

Regioselectivity: Regioselectivity in electrophilic and nucleophilic aromatic substitution, and in elimination reactions, electrophilic attack on alkenes, regioselectivity in radical reactions, nucleophilic attack on allylic compounds, electrophilic attack on conjugated dienes and conjugate addition.

Diastereoselectivity: prochirality, Cram's rule and chelation effect, diastereoselectivity in aldol reaction, diastereoselective epoxidation.

Unit-II: Stereoselective Reactions in Cyclic systems (12 hr)

Reactions on small rings - stereochemical control in six membered rings - conformational control in the formation of six membered rings - stereochemistry of bicyclic compounds -fused bicyclic compounds - spirocyclic compounds-reactions with cyclic intermediates or cyclic transition states - stereoselective reactions of acyclic alkene compounds.

Unit III: *Asymmetric Synthesis* (12 hr)

Asymmteric synthesis-chiral auxiliaries- alkylation of chiral enolates-enantiomeric excess-optical purity-chiral reagents and chiral catalysis-asymmteric hydrogenation-asymmetric epoxidation-asymmteric dihydroxylation

Unit-IV: Organometallics in Organic Synthesis (12 hr)

Introduction-Formation of organometallics : Oxidative insertion of Mg and Li into alkyl halides, deprotonation of alkyne, ortholithiation of functionalized benzene rings, halogen metal exchange, transmetallation – Applications

Chan-Lam Coupling, Hiyama coupling - Corey-Fuchs Reaction, Me_2CuLi (Gillman's reagent), Heck reaction, Suzuki coupling, Stille coupling, Sonogashira reaction, Fukuyama Coupling - Negishi Coupling, Kumada Coupling

Organo main group chemistry containing Boron, Silicon and Tin: Hydroboration-oxidation-formation of C-O, C-N and C-C bonds-Nucleophilic substitution at silicon, allyl and vinyl silanes, Brook rearrangement, tin-lithium exchange reaction and its application.

Unit-V: Green Chemistry (Online) (12 hr)

The twelve principles, atom economy for addition, elimination, substitution reactions ant its calculation, green starting materials, green reagents, green catalysts, green solvents and green reactions

Textbook

1. Clayden J, Greeves N, Warren S, and Wothers P, *Organic Chemistry*, Oxford University Press, New York, 2006.
2. Pine S H, *Organic Chemistry*, *5th* Ed., Tata-McGraw Hill, New Delhi, 2006.
3. Morrison R T, Boyd R N, and Bhattacharjee, *Organic Chemistry*, 7*th* Ed., Pearson India, 2011.
4. Anastas P T, *Text Book on Green Chemistry*, Oxford University Press, 2006.

References

1. Smith M B and March J, March's *Advanced Organic Chemistry, 6th* Ed., John-Wiley and Sons, New York, 2007.
2. Bruice P Y, *Organic Chemistry,* 6th Ed., Prentice Hall, 2013.
3. Finar I L, *Organic Chemistry* Vol. I and II, 6th Ed., ELBS with Longmann, Singapore, 1997.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PCH4116				Title of the Paper ORGANIC CHEMISTRY-IV								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	2	4	1	4	5	2	2	4	4	4	3	4	5	3.38
CO2	2	4	1	4	5	2	2	3	3	4	3	4	5	3.23
CO3	2	4	1	4	5	2	2	4	3	3	4	4	5	3.31
CO4	2	4	1	4	5	2	1	3	3	4	3	4	5	3.15
CO5	2	4	1	4	5	2	2	4	4	4	4	3	5	3.38
CO6	2	4	1	4	5	2	2	4	4	4	4	3	5	3.38
													Overall Mean Score for COs	3.30

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester IV — **Hours/Week: 4**
18PCH4117 — **Credits : 4**

PHYSICALCHEMISTRY-III

Course Outcomes:

1. Students learn and understand the concept of EMF and its Applications
2. Polarography and its application is well understood
3. Students learn and understand the concepts and Instrumentation of Amperometry
4. The underlying concepts of Cyclic voltammetry is well understood
5. Students learn and understand the concepts of Electrogravimetry and Coulometry
6. The concept of applications of quantum chemistry is learnt

Unit I: EMF Measurements and Applications (Online) (12 hr)

EMF and thermodynamics quantities - Nernst equation - Gibb's Helmoltz relation and EMF - Reversible electrodes – Types of electrodes - Hydrogen – Oxygen - chlorine electrodes – metal-metal ion electrode - metal – metal insoluble salt electrode - electrode potentials - Single electrode potential - electrochemical series - chemical cells - concentration cells with and without transference- Applications of EMF measurements - Activity coefficients and solubility determination- Storage and Fuel cells.

Unit II: Electroanalytical Techniques - I (12 hr)

Polarography - Experimental set up - Advantages of dropping mercury electrode - Supporting electrolyte – Polarographic peak Maxima – types of peak maximas - Polarographic peak Maxima suppressor - Residual current - Migration current - Diffusion current – Polarogram - Half wave potential - Ilkovic equation (derivation is not required) - Outline of applications (Polarogram of Zn^{2+} and Cd^{2+}) - Cyclic voltametry, Principle, Experimental set up - Cyclic voltammogram of Fe^{2+} in H_2SO_4 - Anodic peak current - Cathodic peak current - Electrochemically reversible couple - Cathodic peak potential – Anodic peak potential - Electrochemically irreversible couple - Outline of applications.

Unit-III: Electro analytical Techniques II (12 hr)

Amperometry - Principle of amperometric titration - Different types of current voltage curves - Amperometric titration between Pb^{2+} *vs* $K_2Cr_2O_7$, Pb^{2+} *vs* SO_4^{2-}, SO_4^{2-} *vs* Pb^{2+} Ni^{2+} *vs* DMG Electrogravimetry - Principle - Experimental set up - Physical characteristics of metal deposits - Separation of Cu & Ni – Coulometry - Principle, Experimental set up - Controlled potential Coulometric

analysis and application - Experimental set up for Constant current Coulometry – Coulometric - Titration of Fe(II) with Cerium(III).

Unit-IV: Applications of Quantum Chemistry-I (12 hr)

Approximation methods - Need for approximation - Perturbation Theory - Time independent Perturbation (First order only) - Application of Perturbation theory to particle in one dimensional box - Anharmonic oscillator and helium atom - Principle of variation and its proof - Trial function and secular determinant- Variation methods and its applications to Hydrogen and Helium atoms - Particle in one dimensional box.

Unit-V: Applications of Quantum Chemistry-II (12 hr)

The Born - Oppenheimer approximation, VB theory of hydrogen molecule and MO theory of hydrogen molecular ion (H^{2+}) - Coulomb integral, Exchange integral and Overlap integral, Detailed calculation of energy and overlaps. Construction of sp, sp^2 and sp^3 hybrid orbitals, Huckel molecular orbital theory - Principles and applications to ethylene, butadiene, benzene, cyclobutadiene, trimethylamine, bicyclobutadiene and allyl systems. Hartee - Fock method, Self consistent field method and Roothan equations.

Textbooks

1. Willard, Merit, Dean and Settle, *Instrumental Methods of Analysis,* CBS Publication New Delhi, 1986.
2. Anatharaman R, *Fundamentals of Quantum Chemistry,* McMillan, New Delhi, 2001.
3. Prasad R K, *Quantum Chemistry,* Revised 4rd Ed., New age international (P) Ltd., New Delhi, 2008.
4. Donald A McQuarrie, *Quantum Chemistry*, 2nd Indian Edition, Viva Books Private Ltd., 2008.

References

1. Vogel A I, *Text book of Quantitative Inorganic Analysis,* ELBS, 1978.
2. Levine I N, Quantum chemistry, 6th Ed., PHI Learning Private Limited, 2009.
3. Noel M and Vasu K I, *Cyclic voltammetry and the Frontiers of Electrochemistry*, Oxford and IBH, 1990.
4. Kissinger P T and Heinman, Laboratory Techniques in Electroanalytical Chemistry, Editors, Marcel, Dekker, *Inc*., New York, 1984.
5. Puri Sharma and Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., 47th Edition, 2017.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PCH4117					Title of the Paper PHYSICAL CHEMISTRY-III								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	4	4	4	3	3	4	3	3	4	3	4	3	3.53	
CO2	3	4	4	3	4	3	3	3	4	3	3	4	3	3.46	
CO3	3	4	3	3	3	3	3	3	3	3	3	4	3	3.23	
CO4	4	3	3	4	3	2	4	2	3	4	3	3	4	3.15	
CO5	3	4	5	4	3	4	3	4	5	3	4	3	3	3.76	
CO6	3	4	2	3	4	3	4	3	3	4	3	4	3	3.30	
													Overall Mean Score for COs		3.41

Result: The Score for this Course is 3.41 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 4**
18PCH4118 **Credits : 3**

Lab Course:

INORGANIC CHEMISTRY-II

Course Outcomes:

1. Principles behind volumetric and gravimetric techniques are learnt
2. Separation of metal ions in binary mixtures are learnt
3. Quantification methods of metal ions are learnt
4. Estimation of iron and copper are understood
5. Estimation of volumetric and gravimetric analysis of Zn are understood
6. Simple single stage preparations of some complex compounds are learnt

Experiments

1. Quantitative analysis of a mixture of iron (volumetry) and copper (gravimetry)
2. Quantitative analysis of a mixture of copper (volumetry) and nickel (gravimetry)
3. Quantitative analysis of a mixture of iron (volumetry) and zinc (gravimetry)
4. Quantitative analysis of a mixture of copper (volumetric) and zinc (gravimetry)
5. Preparation of any three complexes

References

1. Jeffery G H, Bassett J, Mendham J and Denney R C, *Vogel's Textbook of Quantitative Chemical Analysis*, 5th Ed., Longman Scientific & Technical, Essex, 1989.
2. Department Material, St. Joseph' College (Autonomous), Tiruchirappalli-620002.

Semester IV **Hours/Week: 4**
18PCH4203A **Credits : 4**

Core Elective-IIIA

NATURAL PRODUCTS

Course Outcomes:

1. Students know the structure of carbohydrates
2. Students learn the mechanism of photosynthesis and citrate cycle
3. Students learn the biosynthesis as well as chemical synthesis of proteins
4. Students learn the protecting and deprotecting groups of some functional groups
5. Students learn how to elucidate the structures of some natural products
6. Students study the chemistry of important heterocycles

Unit-I: Carbohydrates (12 hr)

Carbohydrates – Ring structures of glucose and fructose – Fischer's proof for the configuration of D-(+) glucose – Citric acid cycle – Structure of fructose, sucrose, maltose, lactose and cellobiose – Structural difference between starch and cellulose – Uses of cellulose derivatives

Unit-II: Proteins and Nucleic Acids (12 hr)

Amino acids – Synthesis of á-amino acids (Strecker synthesis and Gabriel synthesis) – Peptides – Synthesis of dipeptides and polypeptides (Merrifield resin synthesis) – End group analysis – structure of proteins – primary, secondary, tertiary and quaternary.

Nucleic acids - Purine and Pyrimidine bases - nucleosides and nucleotides– structure of DNA – Biosynthesis of proteins

Unit-III: Alkaloids, Terpenoids and Antibiotics (12 hr)

Alkaloids: Introduction – occurrence and extraction – classification – structural elucidation of papaverine only.

Terpenoids: Introduction – extraction – isoprene rule - classification – structural elucidation of Zingiberene only.

Antibiotics: Structure-activity relationship of chloramphenicol – structure and medicinal uses of penicillin, streptomycin and terramycin.

Unit-IV: Heterocycles (12 hr)

Preparation, physical properties and reactions of five-membered and six-membered heterocyclics containing one hetero atom (pyrrole, furan, thiophene & indole, pyridine, quinoline and isoquinoline) – Five-membered

heterocycle containing two nitrogen atoms (imidazole) Only the structures and numbering and naming of diazins (pyrazine, pyrimidine and pyrazine), azines (oxazine and azepine).

Unit-V: Hormones (Online) (12 hr)

Hormones – Introduction – chemical nature – Prostaglandins-structure (structural elucidation not required). Structural elucidation of cholesterol (synthesis not required). Sex hormones – Stucture and properties of oestrone, equilinin, androsterone, testosterone (elucidation not required).

Textbooks

1. Finar I L, *Organic Chemistry* Volume I and II, 6th Ed., ELBS with Longmann, Singapore, 1997.

References

1. Bruice P Y, Organic Chemistry, 3rd Ed., Pearson Education, New Delhi, 2012.
2. Gosh J. *Textbook of Pharmaceutical Chemistry*, S. Chand & Chand publications New Delhi, 1997.
3. Anand Solomon K, Chemistry of Natural Products, MJP Publishers, Chennai, 2012.
4. Hoffmann R W, Classical Methods in Structural Elucidation of Natural Products, Wiley VCHA, Switzerland, 2014.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PCH4203A					Title of the Paper Core Elective-IIIA: NATURAL PRODUCTS								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	4	5	5	4	4	3	5	5	3	5	5		4.15
CO2	3	3	4	3	5	5	3	4	4	3	3	4	4		3.85
CO3	3	3	4	5	5	4	3	5	5	5	3	3	3		3.92
CO4	3	3	3	3	3	5	4	3	5	5	3	3	3		3.54
CO5	5	3	4	3	3	3	5	5	5	3	3	5	3		3.85
CO6	3	3	3	4	3	3	3	3	3	5	5	5	3		3.46
													Overall Mean Score for COs		3.79

Result: The Score for this Course is 3.79 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 4**
18PCH4203B **Credits : 4**

Core Elective-IIIB
PHARMACEUTICAL CHEMISTRY

Course Outcomes:

1. Students understand the design, structure and activity relationship of drugs.
2. Students learn various modes of spread of common diseases and their treatment.
3. Students learn the advanced drugs for new diseases.
4. Students learn the mechanism of action of drugs on the biological systems
5. Students learn the structure of important drugs
6. Students get to know the importance of anti-biotics and anti-septics

Unit-I: Introduction to Chemistry of Drugs (12 hr)

Drugs - definition- sources- study of drugs -classification (Biological chemical, commercial and utility)-Nomenclature of drugs- Biotransformation- Drug design - factors affecting the stability of drugs- Encapsulation – drug delivery systems and sustained release of drugs.

Unit-II: Pharmaceutical Aids (Online) (12 hr)

Preservatives- Antioxidants- Sequestering agents- Emulsifiers- Colorantsm Flavoring agents - Sweeteners – Stabilizers - suspending agents- Ointment bases- Solvents.

Unit-III: Common Diseases and Treatment (12 hr)

Insect borne diseases - Treatment using drugs - Air borne diseases- Treatment using drugs - water borne diseases- Treatment using drugs- Digestive disorders - treatment- diseases of respiratory system- treatment diseases of nervous system - treatment - other common diseases- treatment.

Unit-IV: Pathogenicidal Drugs (12 hr)

Antibiotics - Classification- Chloramphanicol- penicillin-streptomycin- Tetracycline -Macrolides-Erythromycin - Rifamycin- Antiseptics and disinfectants - Phenols Halogen compounds - Analgesics - Antipyretics - Anti -inflammatory agents - Sulpha drugs.

Unit-V: Bio Regulatory Drugs (12 hr)

Cardiovascular drugs - Cardiac glycosides - anti arrhythmic drugs - antihypertensive agents -antianginal agents. Diabetes and Hypoglycaemic

drugs - two types of diabetes – Diabetes insipidus and diabetes mellitus - Control of diabetes - Insulin -Hypoglycaemic agents. Anticonvulsants - Cancer and antineoplastic drugs - Common causes - antimetabolites

Text Books:

1. Gosh J, Text Book of Pharmaceutical Chemistry, S. Chand & Chand Publications, New Delhi, 1997.
2. Srivastava, S K, A Complete Text Book of Medical Pharmacology, Volumes I and II, 2nd Edition, Avichal Publishing Company, Kolkatta, 2012.

Reference

1. Deb A C, Fundamentals of Biochemistry, New Central Book Agency, Calcutta, 1994.
2. Satake M and Mido Y, Chemistry for Health Science, Discovery Publishing House, New Delhi, 2003.
3. Ashutosh Kar, Medicinal Chemistry, Wiley Easterns Limited, New Delhi, 1993.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PCH4203B			Title of the Paper Core Elective-IIIB: PHARMACEUTICAL CHEMISTRY									Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	3	4	5	5	4	4	3	5	5	3	5	5	4.15
CO2	3	3	4	3	5	5	3	4	4	3	3	4	4	3.85
CO3	3	3	4	5	5	4	3	5	5	5	3	3	3	3.92
CO4	3	3	3	3	3	5	4	3	5	5	3	3	3	3.54
CO5	5	3	4	3	3	3	5	5	5	3	3	5	3	3.85
CO6	3	3	3	4	3	3	3	3	3	5	5	5	3	3.46
													Overall Mean Score for COs	3.79

Result: The Score for this Course is 3.79 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

***Values Scaling*:**

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$ | **Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Notes

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