SCOTT CHRISTIAN COLLEGE (AUTONOMOUS)

NAGERCOIL

(Estd. 1893)

CURRICULUM AND SYLLABUS

DEPARTMENT OF CHEMISTRY

(Approved by the Standing Committee of the Academic Councils held on 21.10.2023 & 13.01.2024)

POSTGRADUATE PROGRAMME

CBCS-SEMESTER SYSTEM

(For those who join from 2023 to 2026)

An evolution towards revolution …

Education is crucial for attaining full human potential, developing an unbiased and evenhanded society and promoting national and global development. The education sector in India is witnessing a sweeping wave of change. The very first policy for education, *National Policy on Education* (NPE-1968) was promulgated in 1968, with the National Policy on Education (NPE- 1986) following in 1986. The National Policy on Education (NPE- 1992) and the Programme of Action 1992 (POA-1992) refined and implemented the NPE-1986. The National Education Policy 2020 (NEP 2020) is a landmark document and an evolution towards revolution in the Indian educational sector. It presents the vision for greater access, equity, excellence, inclusion, multiple entry and exit and affordability to help India emerge as the global knowledge superpower.

Providing access to quality education is the key to the curriculum and syllabus of Scott Christian College (Autonomous), in terms of social justice and equality, scientific advancement, cultural preservation and national and global integration. Students should have the freedom and flexibility in choosing their courses, skills, and capacities to become moral, successful, innovative, adaptable, and productive human beings.

Higher education plays an important role in promoting human as well as societal wellbeing and in contributing towards sustainable livelihoods and economic development. The present Outcome-Based Education (OBE) curriculum and syllabus, provides valuable insights and recommendations on aspects of education that include moving towards multidisciplinary and holistic education, mastery and high-order learning and promotion of quality research.

The current curriculum has been designed based on NEP 2020, the National Credit Framework (NCrF), the National Higher Education Qualifications Framework (NHEQF) and Curriculum and Credit Framework for Undergraduate Programmes (CCFUP) which envisage that students must develop into good, thoughtful, well-rounded, creative individuals with a standard of achievement. The themed curriculum aims to support teachers and students in developing their understanding of the curriculum design and delivery process as per the requirement of the world of work.

Dr.Sidney Shirly
Dean of Arts
Scott Christian College
(Autonomous)
Nagercoil

Dr. V. Robin Perinba Smith
Dean of Science
Scott Christian College
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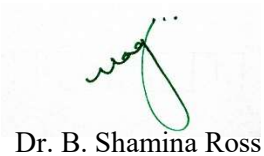

Dr. B. Shamina Ross
Dean of IT and Technical Education
Scott Christian College
(Autonomous)
Nagercoil

DEPARTMENT PROFILE

Scott Christian College (Autonomous) established in 1893 is one of the oldest co-educational institutions in South India by the missionaries of the London Missionary Society. The college has its motto, "Truth shall make you free" and serves as a model of academic excellence and social harmony. Scott Christian College offers (Autonomous) diversified undergraduate and post graduate courses. Among the available departments, Department of Chemistry is one of the well-recognized departments, much known for its excellence in teaching and research. It was established in 1952, upgraded as a PG department in 1982 and became a fully fledged research centre in 2005. It celebrated its Diamond Jubilee in 2012-13. It has highly qualified and dedicated team of faculty members. The Department has well equipped, separate laboratories for UG, PG and research scholars.

The Department is well known for its research in thrust areas like photochemistry, environmental chemistry, polymer nanocomposites, electrochemistry, synthetic organic chemistry and radiation chemistry. It is credited with scores of publications in reputed national and international journals and several ongoing minor and major projects from UGC, ISRO and DRDO. The research laboratory is well equipped with modern instruments and is funded by DST-FIST. Seventy five scholars completed their Ph.D and 32 are currently persuing their research activities. Our former students are working in prestigious institutions like Indian Institute of Technology, National Chemical Laboratory, Pune and Central Universities. Besides these our students have entered into Indian Administrative and Foreign Services also.

Vision

Envisions to be a centre of excellence in chemistry for teaching learning and research

Mission

- To impart current knowledge to the young learners through learner centric methods
- To transform the lives of learners by inculcating values and life skills
- To promote advanced research activities in collaboration with industries
- To encourage the faculty periodically updating themselves through professional development training.

DEPARTMENT OF CHEMISTRY

Eligibility : B.Sc

Duration of Course : 2 Years (4 Semesters)

Min. Duration : 2 Years

Medium of Instruction : English

FACULTY MEMBERS

MEMBERS OF THE BOARD OF STUDIES

Chairperson Dr.R.Ragel Mabel Saroja

Faculty Members

Dr. G. Allen Gnana Raj	:	Associate Professor
Dr. I. Starlet Thanjam	:	Associate Professor
Dr. J. Prema Kumari	:	Associate Professor
Dr. S. Begila David	:	Associate Professor
Dr. A. Malar Retna	:	Associate Professor
Dr. T. Sumitha Celin	:	Assistant Professor
Dr. A Yardily	:	Assistant Professor
Dr. A. Jeena Pearl	:	Assistant Professor
Dr.C.Anuba	:	Assistant Professor
Dr. R.D. Femitha	:	Assistant Professor
Dr. G.R.Bella	:	Assistant Professor
Dr.R.Jeba Jeevitha	:	Assistant Professor
Dr.G.S Prabha Littis Malar	:	Assistant Professor

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Subject Expert: Dr.T.F. Abbs Fen Reji (**Nominated by theVC**)
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Representative	Mr. M. Praveen Mathew Industrialist Director, Kurian Abraham Pvt Ltd Nagercoil. 9443360221.
Postgraduate Meritorious Alumnus	Mr. A. Bebin Senior Research Fellow CSIR-CECRI Mob: 8148018894

The Scott Christian College (Autonomous) defines the focus reinforcing its academic programmes and student life experience on campus through the Graduate Attributes (GA), that describe the knowledge, competencies, values and skills students imbibe for holistic development, multidisciplinary development and contribution to society. These attributes comprise characteristics that are transferable beyond the sphere of study into the national and international realm through curricular, co-curricular and extra-curricular engagements. They equip graduates for life long personal development and employment. Every Graduate of Scott Christian College (Autonomous) – (SCC) is desired to possess the following Graduate Attributes:

GA 1: Intellectual Competencies

Graduates of SCC

- have a comprehensive and incisive understanding of their domain of study as well as the ability for cross-disciplinary learning
- have the ability to apply the knowledge acquired through the curriculum as well as self-directed learning to a broad spectrum ranging from analytical thinking to synthesize new knowledge through research
- are able to have critical, independent and individual outlook regarding academic work and socially relevant issues

GA 2: Problem Solving

Graduates of SCC

- have the capacity to extrapolate from what has been learnt, translate concepts to real-life situations and apply acquired competencies in the required contexts to generate solutions to specific problems
- can view a problem or a situation from multiple perspectives and think 'out of the box' and generate solutions to complex problems in unfamiliar contexts

- are effective problems-solvers, able to apply critical, creative and evidence-based thinking to conceive innovative responses to challenges

GA 3: Communication Skills

Graduates of SCC

- listen carefully, analyse texts and research papers, and present complex information in a clear and concise manner
- express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media
- confidently express herself/himself and construct logical arguments using correct technical language related to a field of learning and area of professional practice

GA 4: Environmental Awareness

Graduates of SCC

- lessen the effects of environmental degradation,climate change and pollution
- learn the nuances for cleanliness, conservation and wise use of resources so that it can be used for generations
- know the nuances of waste management, conservation of biological diversity, management of biological resources and biodiversity and sustainable development and living

GA 5: Professional Ethics

Graduates of SCC

- develop principled and expert behavior, and this will be showcased in their chosen careers and constructive roles as citizens of the world at large
- imbibe intellectual integrity and ethics in scholarly engagement and develop a spirit of inclusiveness through interactions with diverse people at all levels in life
- acquire new knowledge and skills, including 'learning how to learn' skills, for pursuing learning activities throughout life and adapting to changing demands of the workplace throughknowledge,skilldevelopment and reskilling, ethically

GA 6: Leadership Qualities

Graduates of SCC

- inculcate leadership qualities and attitudes, and team behaviour along autonomous lines through curricular, co-curricular and extra-curricular activities
- develop managerial and entrepreneurial skills to create new opportunities for diverse careers and gear up to take up competitive examinations
- acttogetherasagrouporateamintheinterestsofacommoncauseandworkefficientlyas a memberofateam

GA 7: Holistic Skill Development

Graduates of SCC

- develop critical thinking, problem-solving capacity, effective communication, and social skills

- are self-aware, flexible, resilient and have the capacity to accept and give constructive feedback and cope up with stress
- develop soft skills, e-skills and life skills to live, learn and work in the technically sound society globally and use appropriate digital methods for analysis of data

GA 8: Cross-Cultural Competencies

Graduates of SCC

- gain cross-cultural competencies through engaging with diverse linguistic, ethnic and religious communities and know how to understand, accept and appreciate individuals at local, national and international levels
- develop a global perspective through contemporary curriculum, culture, language and international exchange programmes
- acquire knowledge of the value sand beliefs of multiple cultures and a global perspective to honour diversity, gender sensitivityandadoptgender-neutralapproach and showempathytotheless advantagedandthedifferently-abled

GA 9: Community Engagement

Graduates of SCC

- are sensitive to social concerns and have conviction toward social justice through active social engagement
- are endowed with a strong sense of environmental awareness through the curriculum and a friendly and serene campus eco-system.
- formulateaninspiringvisionandbuildateamthatcanhelpachievethevision, and motivate peopletotherightdestination

GA 10: Value-Based Ethical Competency

Graduates of SCC

- are rooted in the principles of ethical responsibility and integrity permeated with Christian values, leading to the building of character and constitutional values
- develop virtues such as truth, love, courage, unity, integrity, brotherhood, industry and uprightness
- practiseresponsible national and globalcitizenshiprequiredforrespondingtocontemporarychallenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, andsustainablesocieties

Learning Outcomes Descriptors fora Higher Education Qualification at Level 6 on the NHEQF

The Bachelor's degree (Honours/ Honours with Research) or the Post-Graduate Diploma is awarded to students who have demonstrated the achievement of the outcomes located at level 6 on the NHEQF.

Descriptors for qualifications at levels 6 on the NHEQF

Element of the Descriptor	NHEQF Level Descriptors
Knowledge and Understanding	The graduates should be able to demonstrate the acquisition of: • advanced knowledge about a specialized field of enquiry, with depth in one or more fields of learning within a broad interdisciplinary context. • a coherent understanding and awareness of the established methods and techniques of research and enquiry • procedural knowledge required for performing and accomplishing professional tasks
General, Technical and Professional Skills	The graduates should be able to demonstrate the acquisition of: • a range of cognitive and technical skills required for performing and accomplishing complex tasks required to undertake research to generate solutions to real-life problems • generating solutions to complex problems independently, requiring the exercise of full personal judgement, responsibility, and accountability for the output of the initiatives taken as a practitioner • apply advanced knowledge relating to research methods to carry out research and investigations to formulate evidence-based solutions to complex and unpredictable problems
Generic Learning Outcomes	The graduates should be able to demonstrate the ability to: • communicate technical information and explanations, and the findings/ results of the research studies relating to specialized fields of learning and pursue self-paced and self-directed learning • present in a concise manner one's views on the relevance and applications of the findings of research and evaluation studies in the context of emerging developments and issues. • define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships
Constitutional, Humanistic, Ethical, and Moral Values	The graduates should be able to demonstrate the willingness and ability to: • embrace and practice constitutional, humanistic, ethical, and moral values in professional practice and life. • present coherent arguments in support of relevant ethical and moral issues and participate in actions to address environmental and sustainable development issues. • follow ethical practices in all aspects of research and development,
Employability and Entrepreneurship Skills	The graduates should be able to demonstrate the acquisition of knowledge and skills required for: • adapting to the future of work and to the demands of the fast pace of technological developments and innovations that drive a shift in employers' demands for skills • managing complex technical or professional activities or projects • should be willing to take a calculated risk and be open to new ideas
Credit Requirements	A Post-Graduate Diploma programme builds on a 3-year/6-semester bachelor's degree and requires a minimum of 40 credits for individuals who have completed a Bachelor's programme.
Entry Requirements	• An individual seeking admission to the bachelor's degree (Honours/ Honours with Research) in a specified field of learning would normally have completed all requirements of the relevant 3-year Bachelor's degree.

Learning Outcomes Descriptors for a Higher Education Qualification at Level 6.5 on the NHEQF

The Master's degree (e.g. M.A., M.Com., M.Sc., etc.) is awarded to students who have demonstrated the achievement of the outcomes located at level 6.5 on the NHEQF.

Descriptors for qualifications at levels 6.5 on the NHEQF

Element of the Descriptor	NHEQF Level Descriptors
Knowledge and Understanding	The graduates should be able to demonstrate the acquisition of: • advanced knowledge about a specialized field of enquiry with a critical understanding of the emerging developments and issues relating to one or more fields of learning • advanced knowledge and understanding of the research principles, methods, and techniques applicable to the chosen field of learning or professional practice, • procedural knowledge required for performing and accomplishing complex, specialized and professional tasks relating to teaching, and research and development.
General, Technical and Professional Skills	The graduates should be able to demonstrate the acquisition of: • advanced cognitive and technical skills required for performing and accomplishing complex tasks related to the chosen fields of learning. • advanced cognitive and technical skills required for evaluating research findings and designing and conducting relevant research that contributes to the generation of new knowledge. • specialized cognitive and technical skills relating to a body of knowledge and practice to analyze and synthesize complex information and problems.
Application of Knowledge and Skills	The graduates should be able to demonstrate the ability to: • apply the acquired advanced theoretical and/or technical knowledge about a specialized field of enquiry or professional practice and a range of cognitive and practical skills to identify and analyze problems and issues associated with the chosen fields of learning. • apply advanced knowledge relating to research methods to carry out research and investigations and to formulate evidence-based solutions to complex and unpredictable problems. • develop appropriate tools for data collection for research
Generic Learning Outcomes	The graduates should be able to demonstrate the ability to: • communicate in a well-structured manner, technical information and explanations, and the findings/results of the research studies undertaken in the chosen field of study, • evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and address opposing viewpoints • pursue self-paced and self-directed learning to upgrade knowledge and skills, including research-related skills, required to pursue a higher level of education and research.

Constitutional, Humanistic, Ethical, and Moral Values	The graduates should be able to demonstrate the willingness and ability to: • embrace and practice constitutional, humanistic, ethical, and moral values in one's life and in the field of study and professional practice, • participate in actions to address environmental protection and sustainable development issues, • follow ethical principles and practices in all aspects of research and development, including inducements for enrolling participants and avoid unethical practices
Employability and Entrepreneurship Skills	The graduates should be able to demonstrate the acquisition of knowledge and skill sets required for: • adapting to the future of work and responding to the demands of the fast pace of technological developments and innovations that drive the shift in employers' demands for skills • transition towards more technology-assisted work involving the creation of new forms of work and rapidly changing work and production processes. • exercising full personal responsibility for the output of own work as well as for group outputs and for managing work that is complex and unpredictable requiring new strategic approaches.
Credit Requirements	• The 2-year/4-semester Master's programme builds on a 3-year/6-semester bachelor's degree and requires a total of a minimum of 80 credits from the first and second years of the programme, with a minimum of 40 credits in the first year and minimum of 40 credits in the second year of the programme at level 6.5 on the NHEQF.
Entry Requirements	• A 3-year Bachelor's degree for the 2-year/4-semester Master's degree programme (e.g. M.A., M.Com., M.Sc., etc.).

PLO & GA Mapping

Programme Learning Objective #	Programme Learning Objective (PLO)	Description of PLO	PLO Mapped with GA#
PLO 1	Learning Dispositions	Recognize and reflect on the production of knowledge in multiple spaces	GA 1 GA 8
		Develop the leadership capacity to negotiate intercultural learning spaces	GA 1 GA 6 GA 8
		Engage dialogically with distinct and/or intersecting intellectual communities to develop the scope of inquiry	GA 2 GA 3
PLO 2	Domain specific knowledge	Develop intensive and extensive knowledge and expertise in their respective domains	GA 1
		Formulate and extrapolate the knowledge gained to be applied in real– life situations, for self-directed learning and in competitive examinations	GA 1 GA 2 GA 3
		Evaluate and create domain specific knowledge in areas of learning, research and industry	GA 1 GA 2

PLO 3	Application oriented knowledge and diverse perspectives	Translate theoretical understanding to experimental knowledge for solving complex problems	GA 1 GA 3
		Ability to solve problems using pragmatic, alternative and creative approaches	GA 1 GA 2 GA 3 GA 5
		Capacity to apply advanced knowledge and approaches to solve concrete and abstract problems in domain-related and multi-disciplinary issues.	GA 1 GA 2
PLO 4	Innovation and research	Develop aptitude for innovation and entrepreneurship	GA 6
		Identify contemporary research problems, analyze data qualitatively and quantitatively and propose solutions	GA 1 GA 2 GA 9
		Create new ideas, analyze problems, diagnose them and identify their causes independently and/or in groups	GA 6 GA 7
PLO 5	Scientific communication skills	Document, prepare and present research work as reports and articles in academic forums	GA 6
		Critically assess, review and present theories and concepts	GA 1
		Take technically complex scientific topics and craft them into accessible, informative, and compelling content for specific audiences	GA 1 GA 2
PLO 6	Digital competency	Use domain-related advanced software resources, computational skills and digital tools for data analysis and interpretation	GA 2 GA 5
		Ethically apply digital skills to creatively communicate ideas and issues related to academic experiences	GA 5 GA 10
		Acquire the ability to leverage digital technologies to communicate, collaborate, and analyze data	GA 5
PLO 7	Ethical reasoning	Apply domain specific ethical principles and practices in academic, professional and social engagements	GA 1 GA 5
		Transform the behaviour of students to preserve public interest, the environment and be a source of help	GA 4 GA 5
		Being honest and taking responsibility for academic work and environmental sustainability	GA 4 GA 5
PLO 8	Comparative and	Develop an interdisciplinary approach to research	GA 1

	interdisciplinary knowledge practices		GA 7
		Compare scientific, social and historical phenomena in order to yield new insights	GA 1 GA 9
		Articulate how the complexities of social differentiation, like sex, gender, disability, race, ethnicity, nation, class, and such give insights and shape intellectual projects	GA 3 GA 5 GA 8 GA 9
PLO 9	Career readiness	Choose from diverse career options available in local, national and international realms.	GA 8
		Find success in workplace, manage one's career and apply the skills learned	GA 7
		Carry out further research or pursue higher education in the country or abroad	GA 1
PLO 10	Creating collaboration with the corporate world	Cultivate relationship with mentors and advisors, whose expertise and experience can assist in the development of work	GA 3 GA 7
		Recognize and reflect on the value, effectiveness, and ethics of collaboration in different settings and situations	GA 5 GA 9
		Produce new knowledge by working at the intersection of multiple disciplines and interdisciplinary fields	GA 1

CURRICULUM TABLE

Year	Semester	Module No	Course	Course Code	Hours							Credits	Credit Points
					Lecture	Tutorial	Practical	Internship	Self-Learning	Demonstration	Total Hours		
		1.1	CC1- Organic Chemistry-I	23PC11	5	1					6	4	24
		1.2	CC2-Inorganic Chemistry- I CC-2 -Lab Course – Inorganic Chemistry Practical	23PC12	4		2				4 2	3 1	24
		1.3	CC3-1 -Lab Course – Organic Chemistry Practical	23PCP1			6				6	4	24
		1.4	DSC 1- Nano materials and Nano Technology	23PCEA	6						6	4	24
		1.5	DSC 2- Electrochemistry	23PCEC	6						6	4	24
			Total								**30**	**20**	**120**
I	II	2.1	CC4 - Organic Chemistry-II CC4 - Organic Chemistry Practical	23PC21	4		2				4 2	3 1	24
		2.2	CC 5 - Physical Chemistry I	23PC22	5	1					6	4	24
		2.3	CC6- 2 -Inorganic Chemistry Practical	23PCP4			6				6	4	24

		2.4	Elective III	23PCN1	6						6	4	24
		2.5	Elective IV	23PCEG	6						6	4	24
			Total								**30**	**20**	**120**
II	III	3.1	CC7-Inorganic Chemistry II	23PC31	5						5	4	26
		3.2	CC8-Physical Chemistry II	23PC32	5						5	4	26
		3.3	CC9- Physical Chemistry Practicals	23PC33			5				5	4	26
		3.4	DSC 5	23PCEI	5						5	4	26
		3.5	DSC 6	23PCEK	5						5	4	26
		3.6	Internship	23PCD1							0	4	26
		3.7	Project	23PCD2			5				5	4	26
			Total								**30**	**28**	**182**

II	IV	4.1	CC10-Organic Chemistry III		23PC41							6	4	26
		4.2	CC11-Inorganic Chemistry III		23PC42							6	4	26
		4.3	CC12-Physical Chemistry III		23PC43							6	4	26
		4.4	DSC 7		23PCEM							6	4	26
		4.5	DSC 8		23PCEP							6	4	26
				Total								**30**	**24**	**130**

SEMESTER – I
CC1- ORGANIC CHEMISTRY-I

Course Title: **Organic Chemistry-I**	Course Type: Theory Course code: 23PC11
Total Hours:90 Hours/Week: 6 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Dr.C.Anuba	Dr. A.Malar Retna	Dr. A. Siva
Assistant Professor	Associate Professor	Associate Professor
8098957618	94423383496	8489120875
anubacj@gmail.com	iammalar80@gmail.com	drasiva0@gmail.com

CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	To determine the reaction mechanism	1[15], 2[5]	1,2,3,8	Ap	M, C
CLO-2	Determine the impact of aromaticity in organic compounds and mechanism of electrophilic substitution reaction	1[15], 2[5]	1,2,3,8	An	M,F
CLO-3	Understand the mechanism of nucleophilic substitution reaction	1[15], 2[5]	1,2,3,8	U	M,P
CLO-4	Record the stereochemical importance of stereo active organic molecules.	1[15], 2[5]	1,2,3,8	R, E	M,F, C
CLO-5	Apply the stereochemical outcomes of various organic reactions	1[15], 2[5]	1,2,3,8	Ap	M, C, P

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**METHODS OF DETERMINATION OF REACTION MECHANISM**					
1.1	Reaction intermediates	2	1[20]	BS	Qui	1,2, 6-8
1.2	The transition state, Reaction coordinate diagrams.	2	1[10]	Lec	Sem	1,2, 6-8
1.3	Thermodynamic and kinetic requirements of reactions.	2	1[10]	TPS	MC Q	1,2, 6-8
1.4	Hammond postulate.	1	1[10]	TPS	MC Q	1,2, 6-8
1.5	Kinetic methods of determination: Rate law – Primary and secondary isotope effect.	2	1[20]	GD	Qui	1,2, 6-8
1.6	Non-Kinetic methods of determination: Testing and Trapping of intermediates, Isotopic labeling, Cross–over experiment, Product analysis and stereo chemical evidence.	2	1[20]	TPS	MC Q	1,2, 6-8
1.7	Effect of structure on reactivity: Hammett and Taft equations.	1	1[10]	TPS	MC Q	1,2, 6-8

II	**AROMATICITY, AROMATIC AND ALIPHATIC ELECTROPHILIC SUBSTITUTION**					
2.1	Aromaticity in benzenoid.	1	2[10]	Lec	MCQ	1,2, 6-8
2.2	Aromaticity in non-benzenoid.	1	2[10]	TPS	Pro	1,2, 6-8
2.3	Aromaticity in heterocyclic compounds and annulenes.	1	2[10]	Lec	Ass	1,2, 6-8
2.4	Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene.	2	2[10]	GD	Qui	1,2, 6-8
2.5	Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling	2	2[10]	Lec	MCQ	1,2, 6-8
2.6	Sulphur electrophiles: sulphonation	2	2[10]	BS	Pro	1,2, 6-8
2.7	Halogen electrophiles: chlorination and bromination	2	2[10]	Lec	Qui	1,2, 6-8
2.8	Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions.	3	2[10]	Lec	MCQ	1,2, 6-8
2.9	SE_2 and SEi, SE1- Mechanism and evidences.	2	2[20]	Lec	Sem	1,2, 6-8
III	**AROMATIC AND ALIPHATIC NUCLEOPHILIC SUBSTITUTION**					
3.1	SNAr, SN_1 and Benzyne mechanisms - Evidences – Reactivity.	2	3[20]	Lec	Qui	1,2, 6-8
3.2	Effect of structure, leaving group and attacking nucleophile.	1	3[10]	GD	MCQ	1,2, 6-8
3.3	Reactions: Oxygen and Sulphur nucleophiles, Bucherer and Rosenmund reactions, Von Richter, Sommelet Hauser and Smiles rearrangements.	2	3[20]	TPS	Qui	1,2, 6-8
3.4	SN1, ion pair, SN_2 mechanisms and evidences.	2	3[10]	Lec	MCQ	1,2, 6-8
3.5	Aliphatic nucleophilic substitutions at an allylic carbon.	2	3[10]	Lec	MCQ	1,2, 6-8
3.6	aliphatic trigonal carbon and vinyl carbon.	2	3[10]	Lec	Qui	1,2, 6-8
3.7	SN1' SN2' and SNi' mechanism and evidences.	3	3[10]	Lec	Sem	1,2, 6-8
3.8	Swain- Scott, Grunwald- Winstein relationship - Ambident nucleophiles.	2	3[10]	Lec	Sem	1,2, 6-8
IV	**STEREOCHEMISTRY-I**					
4.1	Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry.	1	4[10]	GD	MCQ	3,4, 5,9, 10
4.2	Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers.	1	4[10]	Lec	Qui	3,4, 5,9, 10

4.3	Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shape, methods of determining the configuration.	1	4[10]	Lec	Sem	3,4, 5,9, 10
4.4	Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation, D, L system	2	4[10]	Lec	MCQ, Qui	3,4, 5,9, 10
4.5	Cram's and Prelog's rules:	2	4[10]	Lec	Qui	3,4, 5,9, 10
4.6	R, S-notations, proR, proS, side phase and re phase Cahn-IngoldPrelog rules, absolute and relative configurations.	1	4[10]	Lec	Qui	3,4, 5,9, 10
4.7	Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, ansa and cyclophanic compounds binaphthyls, , exo-cyclic alkylidene-cycloalkanes.	5	4[20]	Lec	MCQ, Sem	3,4, 5,9, 10
4.8	Topicity and pro stereoisomerism, chiral shift reagents and chiral solvating reagents.	1	4[10]	Lec	MCQ	3,4, 5,9, 10
4.9	Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, destruction.	2	4[10]	Lec	Qui	3,4, 5,9, 10
V	**STEREOCHEMISTRY-II**					
5.1	Conformation and reactivity of acyclic systems	3	5[10]	Lec	MCQ	3,4, 5,9, 10
5.2	Intramolecular rearrangements, neighbouring group participation.	3	5[10]	GD	Sem	3,4, 5,9, 10
5.3	Chemical consequence of conformational equilibrium - Curtin-Hammett Principle.	2	5[10]	TPS	Ass	3,4, 5,9, 10
5.4	Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems.	2	5[20]	Lec	MCQ	3,4, 5,9, 10
5.5	Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule.	2	5[10]	BS	Sem	3,4, 5,9, 10
5.6	Optical rotation and optical rotatory dispersion, conformational asymmetry	2	5[20]	Lec	Qui	3,4, 5,9, 10
5.7	ORD curves, octant rule, configuration and conformation, Cotton effect, axial haloketone rule and determination of configuration.	2	5[20]	GD	Pro	3,4, 5,9, 10

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1. J. March and M. Smith, Advanced Organic Chemistry, 5 th edition, John-Wiley and Sons.2001.
2. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959.
3. P.S.Kalsi, Stereochemistry of carbon compounds, 8 th edition, New Age International Publishers, 2015.
4. P. Y. Bruice, Organic Chemistry, 7th edn, Prentice Hall, 2013.
5. J.Clayden, N. Greeves, S. Warren, Organic Compounds, 2 ndedition, Oxford University Press, 2014.
6. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th edition, Kluwer Academic / Plenum Publishers, 2007.
7. D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001.
8. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987.
9. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000.
10. I. L. Finar, Organic chemistry, Vol-1 & 2, 6th edition, Pearson Education Asia, 2004.

CC2- INORGANIC CHEMISTRY-I

Course Title: **Inorganic Chemistry-I**	Course Type: Theory Course code: 23PC12
Total Hours:90 Hours/Week: 6 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 54 Total Score %: 100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr. R. S. Jeba Jeevitha	Name: Dr. R. D. Femitha	Name: Dr. J. Helen Retna Monica
Designation: Assistant Professor	Designation: Assistant Professor	Designation: Associate Professor
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CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be able to*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	To predict the geometry of main group compounds and clusters.	1[15], 2[5]	1,2,3,8	E	C, M
CLO-2	To explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of cations.	1[15], 2[5]	1,2,3,8	U	C, M
CLO-3	To understand the various types of ionic crystal systems and analyze their structural features.	1[15], 2[5]	1,2,3,8	U,An	C, P
CLO-4	To explain the crystal growth methods.	1[15], 2[5]	1,2,3,8	An	P, M
CLO-5	To understand the various types of defects in crystals.	1[15], 2[5]	1,2,3,8	U	F,P

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**CHEMICAL BONDING**					
1.1	Valence Bond theory: Lewis structure – Concepts and VB theory of H_2 molecule.	2	1[10]	Lec	Ass	1,5
1.2	Stereochemistry of hybrid orbitals – Calculation of s and p characters of equivalence and non-equivalence of hybrid orbitals.	1	1[10]	Lec	Qui	1,5
1.3	VSEPR theory	1	1[10]	Lec	Ass	1,5
1.4	M.O. theory - Linear combination of Atomic orbitals (s – s, s – p, d – p, p – p and d –d overlapping) -σ, π and quadruple bond.	2	1[10]	TP S	Ass	1,5
1.5	M.O. diagrams of hetero nuclear diatomic	2	1[20]	Lec	Qui	2,6

	molecules (CO, NO, HF) and triatomic molecules (BeH_2 , H_2O, CO_2)					
1.6	Walsh diagrams - Structure and hybridization	2	1[10]	BS	Sem	2
1.7	Bents rule and Apicophilicity.	1	1[10]	Lec	Sem	5
1.8	Ionic Bond: Lattice energy - Born-Lande equation, Born Haber cycle and Kapustinskii equation.	2	1[20]	BS	Qui	4
II	**STRUCTURE OF MAIN GROUP COMPOUNDS AND CLUSTERS**					
2.1	Structure of silicates - applications of Pauling's rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates.	2	2[20]	Lec	Ass	2
2.2	One dimensional, two dimensional and three-dimensional silicates-Structure of silicones	2	2[20]	Lec	Sem	2
2.3	Structural and bonding features of B-N, S-N and P-N compounds	2	2[10]	GD	Ass	2
2.4	Poly acids – types, examples and structures	1	2[I0]	GD	Ass	3
2.5	Borane cluster: Structural features of closo, nido, arachano and klado; csarboranes, hetero and metalloboranes	2	2[20]	BS	Sem	9
2.6	Wade's rule to predict the Structure of borane cluster; main group clusters –Zintl ions	2	2[20]	Lec	Ass	5
III	**SOLID STATE CHEMISTRY – I**					
3.1	Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing	1	3[10]	Lec	Ass	2,4
3.2	Voids in crystal lattice, Radius ratio	1	3[10]	Lec	Sem	2,4
3.3	Crystal systems and Bravais lattices	1	3[10]	GD	Ass	2,4
3.4	Symmetry operations in crystals, glide planes and screw axis	3	3[20]	Lec	Ass	10,11
3.5	Point group and space group	2	3[10]	BS	Ass	2,4
3.6	X-ray diffraction technique: Bragg's law	2	3[20]	Lec	Sem	10,11
3.7	Powder diffraction method – Principle and Instrumentation	2	3[20]	Lec	Sem	2,4
IV	**SOLID STATE CHEMISTRY – II**					
4.1	Structural features of the crystal systems: Rock salt	1	4[10]	Lec	Qui	2,4
4.2	Zinc blende andwurtzite	1	4[10]	Lec	Ass	2,4
4.3	Fluorite and Anti-fluorite	1	4[10]	BS	Ass	2,4
4.4	Rutile and anatase	2	4[10]	Lec	Sem	2,4
4.5	Cadmium iodide and nickel arsenide	2	4[10]	Lec	Ass	10,11
4.6	Spinels -normal and inverse types	2	4[10]	Lec	Ass	10,11

4.7	Perovskite structures.	1	4[10]	GD	Sem	10,11
4.8	Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.	1	4[30]	Lec	Sem	2,11
V	**BAND THEORY AND DEFECTS IN SOLIDS**					
5.1	Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors.	3	5[20]	Lec	Sem	2,4
5.2	Defects in crystals	2	5[10]	Lec	Sem	2,4
5.3	Point defects -Schottky, Frenkel	2	5[10]	Lec	Sem	10,11
5.4	Metal excess and metal deficient and their effect on the electrical and optical property.	2	5[20]	Lec	Sem	4,10
5.5	Linear defects and its effects due to dislocations.	2	5[20]	Lec	Ass	2,4
5.6	Colour centers.	2	5[20]	Lec	Ass	10,11

REFERENCES

1. James E. Huheey, Ellen A. Keiter and Rich and L. Keiter, Inorganic Chemistry: Principles of structure and Reactivity, 4th Ed., Harper Collins college publishers, 1993.
2. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014.
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9. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982.
10. D. F. Shriver, P. W. Atkins and C.H. Langford; Inorganic Chemistry; 3rd ed.; Oxford University Press: London, 2001.
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LABORATORY COURSE - I

CC3-1 ORGANIC CHEMISTRY PRACTICAL –I

Course Title: **Organic chemistry Practical-1**	Course Type: Practical Course code: 23PCP1
Total Hours:90 Hours/Week: 6 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr. G.S Prabha Littis Malar	Name: Dr. S.Begila David	Name: Dr. J. Helen Retna Monica
Designation: Assistant Professor	Designation: Assistant Professor	Designation: Associate Professor
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CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	To determine the reaction mechanism	1[15], 2[5]	1,2,3,8	Ap	M, C
CLO-2	Determine the impact of aromaticity in organic compounds and mechanism of electrophilic substitution reaction	1[15], 2[5]	1,2,3,8	An	M,F
CLO-3	Understand the mechanism of nucleophilic substitution reaction	1[15], 2[5]	1,2,3,8	U	M,P
CLO-4	Record the stereochemical importance of stereo active organic molecules.	1[15], 2[5]	1,2,3,8	R, E	M,F, C
CLO-5	Apply the stereochemical outcomes of various organic reactions	1[15], 2[5]	1,2,3,8	Ap	M, C, P

1. Separation of a binary mixture

Quantitative separation of binary mixtures following a systematic procedure. The two components should not interact at room temperature. They should be sufficiently soluble in ether. Two neutral components should be avoided.The two components must be analysed systematically and derivatize them suitably and the physical constants of the two components should be determined

REFERENCE:

1. B.B. Dey, M.V. Sitaraman and T.R. Govindachari, Laboratory Manual of Organic Chemistry, Fourth Edition, Allied Publishers, New Delhi, 1992
2. J.N. Gurtu and R. Kapoor,Advanced Experimental Chemistry, Third Edition.
3. Arthur I. Vogel, Quantitative Organic Analysis Part III, Second Edition, CBS Publishers, New Delhi, 1987.Roger Adams, Laboratory experiments in Organic Chemistry.

LAB COURSE II
CC3-2 INORGANIC CHEMISTRY PRACTICAL-I

Course Title: **Inorganic Chemistry Practical-I**	Course Type: Practical Course code: 23PCP2
Total Hours:60 Hours/Week: 4 Credits: 2	
Pass-Out Policy : Minimum Contact Hours: 36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr. R. S. Jeba Jeevitha	Name: Dr. J.Premakumari	Name: Dr. J. Helen Retna Monica
Designation: Assistant Professor	Designation: Assistant Professor	Designation: Associate Professor
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CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be able to*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	To predict the geometry of main group compounds and clusters.	1[15], 2[5]	1,2,3,8	E	C, M
CLO-2	To explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of cations.	1[15], 2[5]	1,2,3,8	U	C, M
CLO-3	To understand the various types of ionic crystal systems and analyze their structural features.	1[15], 2[5]	1,2,3,8	U,An	C, P
CLO-4	To explain the crystal growth methods.	1[15], 2[5]	1,2,3,8	An	P, M
CLO-5	To understand the various types of defects in crystals.	1[15], 2[5]	1,2,3,8	U	F,P

1. Semi Micro Qualitative Analysis

Analysis of mixture containing four cations (two familiar and two less familiar).
Less familiar cations: W, Te, Se, Mo, Ce, Th, Zr, V, Ti and Li.
Familiar cations : Pb, Cu, Bi, Cd, Ni, Co, Zn, Mn, Ca, Ba, Sr and Mg

2. Estimation of metal ions by complexometric titration.

1. Estimation of Zinc
2. Estimation of Nickel
3. Estimation of Magnesium
4. Estimation of Lead

REFERENCES:

1. A.I. Vogel, A Text Book of Quantitative Inorganic Analysis, 4thEdn – ELBS, 2004.
2. G Pass and H. Sutelift, Practical Inorganic Chemistry, 2ndEdn. Longman, 1974.

DISCIPLINE SPECIFIC ELECTIVE (DSC1)

NANO MATERIALS AND NANO TECHNOLOGY

Course Title: NANO MATERIALS AND NANO TECHNOLOGY	Course Type: Theory Course code: 23PCEA
Total Hours: 90 Hours/Week: 6 Credits: 4	
Pass-Out Policy : Minimum Contact Hours:54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
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CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	To understand the concept of nano materials and nano technology	7[10],9[10]	4,5,8	U	F
CLO-2	To understand the various types of nano materials and their properties	7[10],9[10]	4,5,8	U	C
CLO-3	To understand the applications of synthetically important nano materials	7[10],9[10]	4,5,8	U	C

CLO-4	To correlate the characteristics of various nano materials synthesized by new technologies	7[10],9[10]	4,5,8	E	P
CLO-5	To design synthetic routes for synthetically used new nano materials	7[10],9[10]	4,5,8	Ap	P

Mod	Course description	Hours	%of CLOmapping with Module	Learning Activities	Assessment Tasks	Reference
I	**INTRODUCTION OF NANO MATERIALS AND NANO TECHNOLOGIES**					
1.1	Nanochemistry –Introduction	1	1[10]	Lec	Ass	1,2
1.2	Role of size	1	1[10]	Lec	Ass	1,2
1.3	Classification-OD,1D,2D,3D	2	1[10]	Lec	Ass	1,2
1.4	Consolidation of Nano powders	1	1[10]	Lec	Sem	1,2
1.5	Features of Nano structures	1	1[10]	GD	Sem	1,2
1.6	Background of Nano structures	1	1[10]	Lec	Ass	1,2
1.7	Techniques of Synthesis of Nano materials-Bottom-up and Top-down	4	1[10]	Lec	Quiz	1,2
1.8	Tools of Nano science	2	1[10]	BS	Ass	1,2
1.9	Applications of Nanomaterials and technologies	2	1[20]	TPS	Quiz	1,2
II	**SYNTHETIC METHODS**					
2.1	Bonding and structure of the nanomaterials	2	2[20]	Lec	Ass	2,3,4
2.2	Predicting the type of bonding in a substance crystal structure	1	2[10]	Lec	Quiz	2,3,4
2.3	Metallic nano particles	1	2[10]	Lec	Sem	2,3,4
2.4	Surfaces of materials	1	2[10]	GD	Sem	2,3,4
2.5	Nano particle size and properties	1	2[10]	TPS	Ass	2,3,4
2.6	Synthesis-Physical and chemical methods - inert gas condensation, arc discharge, Laser Ablation, Solgel method	2	2[10]	Lec	Quiz	2,3,4
2.7	Solvo thermal and hydrothermal-CVD –types, metallo organic ,plasma enhanced and low	2	2[10]	Lec	Quiz	2,3,4

	pressure CVD					
2.8	Micro wave assisted synthesis	1	2[10]	Lec	MCQ	2,3,4
2.9	Electro chemical synthesis	2	2[10]	Lec	Ass	2,3,4
III	**MECHANICAL PROPERTIES OF NANO MATERIALS**					
3.1	Mechanical properties of materials	1	3[10]	Lec	Sem	2,5
3.2	Theories relevant to mechanical properties	3	3[20]	Lec	Sem	2,5
3.3	Techniques to study mechanical properties of nano materials	2	3[20]	GD	Quiz	2,5
3.4	Adhesion and Friction	2	3[10]	Lec	Ass	2,5
3.5	Thermal properties of nanomaterials	1	3[10]	BS	Ass	2,5
3.6	Nano particles-gold and silver	2	3[10]	Lec	Quiz	2,5
3.7	Metal oxides –silica	1	3[10]	TPS	Sem	2,5
3.8	Iron oxide and Alumina -synthesis and properties	2	3[10]	Lec	MCQ	2,5
IV	**ELECTRICAL PROPERTIES OF NANO MATERIALS**					
4.1	Electrical properties	1	4[10]	Lec	Ass	1,4,5
4.2	Conductivity and Resistivity	2	4[10]	Lec	Sem	1,4,5
4.3	Classification of materials based on Conductivity	1	4[10]	Lec	Ass	1,4,5
4.4	Classification of Magnetic properties	1	4[10]	GD	Sem	1,4,5
4.5	Electronic properties of materials	1	4[10]	Lec	Quiz	1,4,5
4.6	Semiconductor materials-classification-Ge, Si, GaAs, SiC, GaN, GaP, CdS, PbS	2	4[10]	Lec	Sem	1,4,5
4.7	Identification of materials as p and n-type semiconductor-Hall effect-quantum and anomalous	3	4[10]	TPS	Quiz	1,4,5
4.8	Hall voltage -Interpretation of charge carrier density	2	4[10]	Lec	Sem	1,4,5
4.9	Applications of semiconductors:p-n junction as Transistors and Rectifiers Photovoltaic and photogalvanic cell	2	4[20]	Lec	Ass	1,4,5
V	**NANO COMPOSITES**					
5.1	Nano thin films	1	5[10]	Lec	Ass	1,5
5.2	Nano composites	1	5[10]	Lec	Ass	1,5
5.3	Applications of nano particles in different fields	2	5[20]	Lec	Sem	1,5
5.4	Coer shell nano particles- types, synthesis and	2	5[10]	Lec	Qui	1,5

	properties				z	
5.5	Nano composites-metal- ceramic composites-applications	2	5[10]	GD	Sem	1,5
5.6	Polymer-matrix composites- applications	1	5[10]	Lec	Ass	1,5
5.7	Characterization - SEM- principle, instrumentation and applications	2	5[10]	Lec	Ass	1,5
5.8	Characterization - TEM- principle, instrumentation and applications	2	5[10]	GD	Sem	1,5
5.9	Characterization -AFM-principle, Instrumentation and applications	2	5[10]	Lec	Sem	1,5

* Seminar & class test - 10 hrs

REFERENCES

1. S.Mohan and V.Arjunan, Principles of Materials Science, MJP Publishers, 2016
2. Arumugam, Materials Science , Anuradha Publications ,2007.
3. Giacavazzo et. Al., Fundamentals of Crystallography, International union of Crystallography. Oxford Science Publications, 2010.
4. Woolfson, An Introduction to Crystallography, Cambridge University Press,2012.
5. James F.Shackelford and Madanapalli K.Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.

NEW AND RENEWABLE ENERGY SOURCE

Course Title: NEW AND RENEWABLE ENERGY SOURCE	Course Type: Theory Course code: 23PCEB

Total Hours:90 Hours/Week: 6	Credits: 4

Pass-Out Policy : Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]

Course Creator	Expert 1	Expert 2
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CO No.	Expected Learning Outcomes Upon completion of this course, students will be able to	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	Understand the energy consumption, various energy sources and new energy technologies, the nonconventional energy sources	7[10],9[10]	4,5,8	U	C
CLO-2	Describe principles of the conversion of solar radiation into heat, measurements, various solar energy collectors	7[10],9[10]	4,5,8	E	F
CLO-3	Explain the principles of wind energy conversion, various wind energy collectors, generating systems and safety systems.	7[10],9[10]	4,5,8	An	C
CLO-4	Understand biomass conversion technologies, Photosynthesis, biogas generation and different types of biogas plants	7[10],9[10]	4,5,8	U,E	P
CLO-5	Explain the principle of hydrogen - oxygen fuel cell, types of fuel cells, properties of hydrogen fuel, various hydrogen production methods, storage, transportation and safety and management	7[10],9[10]	4,5,8	An	P

Sec	Description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**ENERGY SOURCES**					
1.1	General introduction, energy consumption, world energy future, Energy sources - coal, oil, gas	1	1[10]	Lec	Qui	1
1.2	Agricultural and organic wastes, water power, & nuclear power,	1	1[20]	TP S	Ass	1
1.3	New energy technologies – Fluidized bed combustion, Oil	1	1[20]	BS	Sem	1
1.4	Introduction to non - conventional energy sources, solar energy, wind energy, energy from bio-mass and bio-gas	1	1 [10]	Lec	Qui	1

1.5	Ocean thermal energy conversion, tidal energy Geothermal energy, hydrogen energy, Fuel cells – hydrogen oxygen fuel cell	1	2[20]	TP S	Qui	1
1.6	Advantages of renewable energy, obstacles to the implementation of renewable energy systems.	1	1[20]	BS	Ess	1
II	**SOLAR ENERGY**					
	Solar radiation and its measurement:					
2.1	Introduction, solar constant, solar radiation at the earth's surface	1	2[10]	Lec	Qui	2
2.2	Solar radiation geometry – latitude, declination, hour angle, altitude angle, zenith angle, azimuth angle, local solar time, Solar radiation measurements – pyrhelimeters, pyranometers, solar radiation data	1	2[20]	TP S	Sem	2
	Solar energy collectors:					
2.3	Introduction, physical principles of the conversion of solar radiation into heat. Flat plate collectors – liquid collector Heat transport system, air collectors, Non-porous absorber plate collectors, porous absorbers, advantages of flat-plate collectors	1	2[20]	BS	Ess	2
2.4	Transmissivity of cover system, Energy balance equation and collector efficiency.	1	2[10]	Lec	Sem	2
2.5	Thermal analysis of flat plate collector and useful heat gained by the fluid, Concentrating collector – focusing type, Non-focusing type concentrating collectors	1	2[10]	BS	Qui	2
2.6	Advantages and disadvantages of concentration collectors over flat collectors, selective absorber coatings	1	2[10]	CS	Ass	2
III	**WIND ENERGY**					
3.1	Nature of the wind, power of the wind, Forces on the blades and thrust on turbines	1	3[10]	Lec	Quiz	2
3.2	Wind energy conversion, lift and drag wind data and energy estimation, wind surveys, site selection considerations	1	3[20]	Lec	Sem	2
3.3	Basic components of WECS –rotors, transmission, generator, towers, Classification of WECS, advantages and disadvantages of WECS.	1	3[10]	Lec	Qui	2
3.4	Wind energy collectors – horizontal axis machines, Design consideration of horizontal-axis machines –rotor, torque coefficient	1	3[20]	Lec	Ass	2
3.5	Blade design, yaw control, Vertical axis machines –savonius rotor, Darrieus type	1	3[10]	Lec	Ass	2

	rotor, Analysis of aerodynamic forces acting on the blade,performance of wind machines					
3.6	Generating systems - Introduction - schemes of electric generation, Generator control, transmission control, Load control, energy storage, Applications of wind energy, Safety systems	1	3[20]	TP S	Sem	3
IV	**BIO-ENERGY**					
4.1	Introduction to biomass, bio-fuels, biogas, energy plantation, Biomass conversion technologies - wet processes, dry processes, Photosynthesis, photosynthetic efficiency	1	4[10]	Lec	Qui	3
4.2	Biogas generation –introduction, anaerobic digestion, advantages of anaerobic digestion, Factors affecting bio-digestion.	1	4[20]	Lec	Qui	3
4.3	Classification of biogas plants – continuous and batch types, dome and drum types	1	4[10]	TP S	Qui	3
4.4	Types of biogas plants - floating drum plant, fixed dome type plant, Janta biogas plant, Deenbandhu biogas plant, floating gas holder plant, Construction of main digesters, gas holder, Biogas from plant waste, wet and dry fermentation	1	4[20]	BS	Sem	3
4.5	Community biogas plants, materials used for biogas generation, Selection of site for a biogas plant, digester design considerations	1	4[10]	BS	Ass	3
4.6	Methods for maintaining biogas production, problems related with biogas plants, starting biogas plant, filling the digester for starting, Fuel properties of biogas, utilization of biogas.	1	4[20]	BS	Qui	3
V	**CHEMICAL ENERGY SOURCES**					
5.1	Fuel cells - Introduction - design and principle of operation of hydrogen - oxygen fuel cell, Classification of fuel cells, types of fuel cells – ion exchange membrane fuel cell, Molten carbonate fuel cell	1	5[10]	Lec	Qui	4
5.2	Solid oxide fuel cell, advantages and disadvantages of fuel cells, Conversion efficiency of fuel cells, polarization in fuel cells, types of polarization	1	5[10]	Lec	Qui	4
5.3	Types of electrodes –porous and non-porous electrodes, Work output and EMF of fuel cells, Applications of fuel cells.	1	5[10]	TP S	Sem	4
	Hydrogen energy:					
5.4	Introduction, properties of hydrogen, hydrogen production , Electrolytic production of hydrogen, thermo - chemical	1	5[10]	Lec	Sem	4

	methods					
5.5	Thermochemical cyclic process – Westinghouse electrochemical thermal sulphur cycle, Iodine-sulphur cycle, Fossil fuel methods, coal gasification for the production of hydrogen – fundamental physical and chemical principles	1	5[10]	BS	Qui	4
5.6	Steam gasification, coal gasification plants, Solar energy methods –biophotolysis, photo-electrolysis	1	5[10]	Lec	Sem	4

REFERENCES

1. G.D. Rai, Non-conventional sources of energy, Khanna Publishers, New Delhi, India, 2008.
2. Don Chiras, Achieving Energy Independence through Solar, Wind, Biomass and Hydropower, Mother Earth News Wiser Living, 2006
3. Jefferson W. Tester, Elisabeth M. Drake Sustainable energy, Prentice-Hall of India, New Delhi, 2006.

DISCIPLINE SPECIFIC ELECTIVE (DSC 2)
ELECTROCHEMISTRY

Course Title: **ELECTROCHEMISTRY**	Course Type: Theory Course code:23PCEC
Total Hours: 90 Hours/Week: 6 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Dr.G.R. Bella	Dr.J.Prema Kumari	Dr.J.Helen Rathna Monica
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CLO No	Upon completion of this course, the students will be able to	**% of PLO Mapping with CLO**	**CLO &PLO mapped with GA**	**Cognitive level (CL)**	**Knowledge category (KL)**
CLO-I	Understand the behaviour of electrolytes in terms of conductance, ionic atmosphere, interactions	9[15],10[5]	1,8	U	C
CLO-2	Familiarise the structure of the	9[15],10[5]	1,8	R	F

	electrical double layer of different models				
CLO-3	Compare electrodes between current density and over potential	9[15],10[5]	1,8	An	P
CLO-4	Discuss the mechanism of electrochemical reactions	9[15],10[5]	1,8	E	M
CLO-5	Highlight the different types of overvoltage's and its applications in electro analytical techniques	9[15],10[5]	1,8	An	P

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**UNIT-I IONICS**					
1.1	Arrhenius theory –limitations and Evidences	1	1[10]	Lec	Qui	3,1
1.2	Van't Hoff factor and its relation to colligative properties	1	1[10]	Lec	MCQ	3,1
1.3	Deviation from ideal behavior	1	1[10]	Lec	Sem	3,1
1,4	Ionic activity, mean ionic activity and mean ionic activity coefficient-	2	1[10]	GD	Ass	3,1
1.5	Concept of ionic, strength Debye Huckel theory of strong electrolytes	1	1[10]	BS	Ass	3,1
1.6	Activity coefficient of strong electrolytes	1	1[10]	Lec	Sem	3,1
1.7	Determination of activity coefficient ion - solvent and ion-ion interactions.	3	1[10]	TPS	Qui	3,1
1.8	Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes	2	1[10]	Lec	Sem	3,1
1.9	Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte- qualitative and quantitative verification	3	1[20]	Lec	Qui	3,1
II	**ELECTRODE-ELECTROLYTE INTERFACE**					
2.1	Interfacial phenomena - Evidences for electrical double layer,	1	2[10]	Lec	MCQ	2,4
2.2	polarizable and non-polarizable interfaces,	2	2[10]	Lec	Qui	2,4
2.3	Electrocapillary phenomena - Lippmann equation electrocapillary curves.	2	2[20]	GD	Sem	2,4
2.4	Electro-kinetic phenomena: electro-osmosis, electrophoresis, streaming and sedimentation potentials,	2	2[20]	Lec	Ass	2,4
2.5	Colloidal and poly electrolytes.	2	2[10]	Lec	Sem	2,4
2.6	Structure of double layer: Helmholtz - Perrin, Guoy- Chapman and Stern models	2	2[20]	Lec	Ass	2,4

	of electrical double layer.					
2.7	Zeta potential and potential at zero charge. Applications and limitations.	2	2[10]	BS	MCQ	2,4
III	**ELECTRODICS OF ELEMENTARY ELECTRODE REACTIONS**					
3.1	Behavior of electrodes: Standard electrodes and electrodes at equilibrium	1	3[10]	Lec	Sem	1,2
3.2	Anodic and Cathodic currents, condition for the discharge of ions.	2	3[20]	Lec	ASs	1,2
3.3	Nernst equation, polarizable and non-polarizable electrodes	2	3[10]	Lec	Sem	1,2
3.4	Model of three electrode system,	1	3[10]	GD	Ass	1,2
3.5	Over potential	1	3[10]	BS	MCQ	1,2
3.6	Rate of electro chemical reactions: Rates of simple elementary reactions.	2	3[10]	Lec	Qui	1,2
3.7	Butler-Volmer equation and Tafel equation-significance of exchange current density, net current density and symmetry factor. Low and high field approximations. symmetry factor and transfer coefficient Tafel equations and Tafel plots	3	3[30]	Lec	Sem	1,2
IV	**ELECTRODICS OF MULTISTEP MULTI ELECTRON SYSTEM**					
4.1	Rates of multi-step electrode reactions. Rate determining step, electrode polarization and depolarization.	2	4[20]	Lec	MCQ	1,2
4.2	Transfer coefficients, its significance and determination, Stoichiometric number.	2	4[10]	Lec	Qui	1,2
4.3	Reduction of I^{3-}, Fe^{2+} and dissolution of Fe to Fe^{2+}.	2	4[20]	Lec	Sem	1,2
4.4	Overvoltage - Chemical and electro chemical, Phase, activation and concentration over potentials.	3	4[20]	BS	Ass	1,2
4.5	Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan's diagrams.	3	4[30]	Lec	Sem	1,2
V	**CONCENTRATION POLARIZATION, BATTERIES AND FUEL CELLS**					
5.1	Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes.	2	5[10]	Lec	Ass	1,2
5.2	Role of supporting electrolytes. Polarography- principle and applications.	2	5[20]	Lec	Sem	1,5
5.3	Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry	3	5[30]	Lec	MCQ	1,5
5.4	Sodium and lithium-ion batteries and redox flow batteries.	2	5[20]	GD	Qui	1,5
5.5	Energy production systems: classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells.	3	5[20]	BS	Sem	1,5

Reference Books

1. D. R. Crow, Principles and applications of electrochemistry, 4thedition, Chapman & Hall/CRC, 2014.
2. J. Rajaram and J.C. Kuriakose, Kinetics and Mechanism of chemical transformations Macmillan India Ltd., New Delhi, 2011.
3. S. Glasstone, Electro chemistry, Affiliated East-West Press, Pvt., Ltd., New Delhi, 2008.
4. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajanand P.S. Raghavan, Electrochemistry-Principles and applications, S. Viswanathan Printers, Chennai,2007.
5. Joseph Wang, Analytical Electrochemistry, 2nd edition, Wiley,2004.
6. J.O.M. Bockris and A.K.N. Reddy, Modern Electro chemistry, vol.1 and 2B, Springer, Plenum Press, New York, 2008.
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8. Philip H. Rieger, Electrochemistry, 2nd edition, Springer, NewYork, 2010.
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ADVANCED QUANTUM MECHANICS

Course Title: ADVANCED QUANTUM MECHANICS	Course Type: Theory Course code: **23PCED**
Total Hours: 90 Hours/Week: 6 Credits: 4	
Pass-Out Policy : Minimum Contact Hours:54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
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CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	Understand the basic principles of Quantum mechanics, towards various systems	9[15],10[5]	1,8	U	C
CLO-	Describe the various approximation	9[15],10[5]	1,8	E	F

2	methods				
CLO-3	Learn the truncated CI theories	9[15],10[5]	1,8	An	P
CLO-4	Interpret various semi empirical theories	9[15],10[5]	1,8	E	M
CLO-5	Analyze the chemical concepts with the density functional theories	9[15],10[5]	1,8	An	P

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**THEORITICAL AND COMPUTATIONAL TREATMENT OF ATOMS AND MOLECULES, HATREE FOCK THEORY**					
1.1	Review of the principals of Quantum mechanics, Born-Oppenheimer approximation.	4	1[50]	Lec	Sem	**1-5**
1.2	Slater – Condon rule, HartreeFock equation, Koopmans and Brillonin theories, Roothan equations Guassian basis sets.	6	1[50]	TPS	MCQ	**1-5**
II	**CONFIGURATION INTERACTION MC-SCF**					
2.1	Introduction of CI	3	2[30]	Lec	MCQ	**1-5**
2.2	Full and truncated CI theories, size consistency	3	2[40]	Lec	Ass	**1-5**
2.3	Introductory treatment of coupled cluster and MC-SCF methods	4	2[30]	GD	Qui	**1-5**
III	**SEMI-EMPIRICAL THEORIES**					
3.1	A review of the Huckel , EHT and PPP treatment s, ZDO approximation,	2	3[30]	Lec	MCQ	**1-5**
3.2	Detailed treatment of CNDO and INDO theories	2	3[30]	Lec	Qui	**1-5**
3.3	A discussion of electronic energies and properties	3	3[20]	TPS	MCQ	**1-5**
3.4	An introduction to MOPAC and AMI with hands on experience on personal computers	3	3[20]	Lec	Ass	**1-5**
IV	**DENSITY FUNCTIONAL THEORY**					
4.1	Derivation of Hoxenberg-Kohn theorem,Kohn-Sham formulation , N- and V-representabilities .	3	4[30]	Lec	Ass	**1-5**
4.2	Review of the performance of the existing local (e.g.StaterXa and other methods) and non-	4	4[30]	Lec	Sem	**1-5**

	local functions					
4.3	Treatment of chemical concepts with the density functional theories	3	4[40]	Lec	MCQ	**1-5**
V	**COMPUTER EXPERIMENTS**					
5.1	Computer experiments with quantum chemistry	4	5[50]	Lec	Ass	**1-5**
5.2	Software packages such as GUASSIAN/GAMESS/ MOPAC and modeling software (e.g.MM2 /AMBER /CHARM	6	5[50]	GD	Sem	**1-5**

REFERENCES

1. N.S. Ostlund and A. Szabo , Modern Quantum Chemistry ,McGraw Hill, 2005.
2. R. Me. Weeny and B.T. Sutcliffe, Methods of Molecular Quantum Mechanics, Academic Press, 1992.
3. R.G. Parr and W. Yang, Density Functional Theory of Atoms and Molecules, Oxford Press, 1993.
4. J.B. Foresman and E. Frish ,Gaussian Inc ,Exploring Chemistry with Electron Structure method ,1996.
5. J. Pople and D.L. Beveridge, Semiempirical theory, 2012.

SEMESTER II

CC4- ORGANIC CHEMISTRY II

Course Title: Organic Chemistry-II	Course Type: Theory Course code: 23PC21
Total Hours:90 Hours/Week: 6 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
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CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	To understand the feasibility and the mechanism of various organicreactions.	1[20]	1,8	U	C
CLO-2	To comprehend the t	1[20]	1,8	Ap	P
CLO-3	To understand the concept of stereochemistry involved in organiccompounds.	1[20]	1,8	U	F
CLO-4	To correlate and appreciate the differences involved in the various types of organic reaction mechanisms.	1[20]	1,8	E	M
CLO-5	To design feasible synthetic routes for the preparation of organic compounds.	1[20]	1,8	Ap	P

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**ELIMINATION AND FREE RADICAL REACTIONS**					
1.1	Mechanisms: E2, E1, and E1cB mechanisms.	1	1[10]	BS	Qui	1-6
1.2	Syn- and anti-eliminations	2	1[10]	TPS	MCQ	1-6
1.3	Orientation of the double bond: Hoffmann and Saytzeff rules	1	1[10]	GD	Qui	1-6
1.4	Reactivity: Effect of substrate, attacking bases, leaving group and medium	2	1[10]	TPS	MCQ	1-6
1.5	Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination	2	1[10]	TPS	MCQ	1-6
1.6	Long lived and short-lived radicals – Production of radicals by thermal and photochemical reactions, Detection and stability of radicals, characteristics of free radicals	2	1[20]	PT	MCQ	1-6

1.7	Reactions of radicals: polymerization, addition, halogenations, aromatic substitutions, rearrangements	2	1[10]	GD	Qui	1-6
1.8	Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.	2	1[20]	BS	Qui	1-6
II	**OXIDATION AND REDUCTION REACTIONS**					
2.1	Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition-elimination, oxidative and reductive coupling reactions.	5	2[30]	Lec	MCQ	1-6
2.2	**Mechanism of oxidation reactions:** Dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate, lead tetraacetate, osmiumtetroxide	2	2[20]	TPS	Pro	1-6
2.3	Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allylic oxidation, oxidation by chromiumtrioxide-pyridine, DMSO-Oxalyl chloride (Swern oxidation) and Corey-K im oxidation, dimethyl sulphoxide-dicyclohexyl carbodiimide (DMSO-DCCD)	4	2[30]	Lec	Ass	1-6
2.4	**Mechanism of reduction reactions: W**olff-Kishner, Clemmenson, Rosenmund reduction with Trialkyl and triphenyltin hydrides, Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault-Blanc reduction.	3	2[20]	GD	Qui	1-6
III	**REARRANGEMENTS**					
3.1	**Rearrangements to electron deficient carbon:1** Pinacol-pinacolone and semi-pinacolone rearrangements-applications and stereochemistry, Wagner-Meerwein, Demjanov, Dienone-phenol, Benzilic acid and Wolff rearrangements.	2	3[20]	Lec	Qui	7-10
3.2	**Rearrangements to electron deficient nitrogen :** Hofmann, Curtius,Schmidt Lossen, Beckmann and abnormal Beckmann rearrangements	2	3[20]	GD	MCQ	7-10
3.3	**Rearrangements to electron deficient oxygen:** Baeyer -Villiger oxidation and Dakin rearrangements.	2	3[20]	TPS	Qui	7-10
3.4	**Rearrangements to electron rich atom:** Favorskii, Quasi-Favorskii, Stevens, [1,2]-Wittig and [2,3]-Wittig rearrangements .	5	3[20]	Lec	MCQ	7-10

	Fries and Photo Fries rearrangement.					
3.5	**Intramolecular rearrangements:** Claisen, abnormal Claisen, Cope, oxy- Cope and Benzidine rearrangements.	2	3[20]	Lec	MCQ	7-10
IV	**ADDITION TO CARBON MULTIPLE BONDS**					
4.1	**Mechanisms: Addition to carbon-carbon multiple bonds:** Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanism	2	4[20]	GD	MCQ	5-7
4.2	Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen.	2	4[10]	Lec	Qui	5-7
4.3	**Addition to carbon-hetero atom multiple bonds :** Mannich reaction, And acids, esters, nitrites, addition of Grignard reagents organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds, Wittig reaction, Prins reaction	4	4[10]	Lec	Sem	5-7
4.4	Stereochemical aspects of addition reactions	1	4[10]	TPS	MCQ	5-7
4.5	Mechanism of condensation reactions involving enolates Stobbe reactions	2	4[30]	Lec	Qui	5-7
4.6	Hydrolysis of esters and amides, ammonolysis of esters	2	4[20]	GD	Ass	5-7
V	**REAGENTS AND MODERN SYNTHETIC REACTIONS**					
5.1	Lithium diisopropylamide (LDA), Sodium cyanoborohydride ($NaBH_3CN$),	2	5[10]	Lec	MCQ	7-10
5.2	*meta*-Chloroperbenzoic acid (m-CPBA), Dimethyl aminiopyridine (DMAP), n-Bu_3SnD, Triethylamine (TEA)	3	5[10]	GD	Sem	7-10
5.3	Diethylazodicarboxylate (DEAD), *N*-bromosuccinimide (NBS)	1	5[10]	TPS	Ass	7-10
5.4	Trifluoroacetic acid (TFA), Phenyl trimethyl ammonium tribromide (PTAB)	2	5[10]	Lec	MCQ	7-10
5.5	Diazomethane and Zn-Cu, Diethyl maleate (DEM), Copper diacetylacetonate ($Cu(acac)_2$)	2	5[10]	BS	Sem	7-10
5.6	$TiCl_3$, $NaIO_4$, Pyridinium chlorochromate (PCC), Pyridinium dichromate (PDC)	2	5[10]	Lec	Qui	7-10
5.7	Meisenheimer complex**.** Suzuki coupling, Heck reaction	2	5[20]	GD	Pro	7-10
5.8	Negishi reaction, Baylis-Hillman reaction	1	5[20]	TPS	Pro	7-10

REFERENCES

1. J. March and M. Smith, *Advanced Organic Chemistry*, 5th ed.,John-Wiley and Sons. 2001.
2. E. S. Gould, *Mechanism and Structure in Organic Chemistry,* Holt,Rinehart and Winston Inc., 1959.
3. P. S. Kalsi, *Stereochemistry of carbon compounds*, 8thedn, New AgeInternational Publishers, 2015.
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6. S. H. Pine, *Organic Chemistry*, 5thedn, McGraw HillInternational Editionn, 1987.
7. L. F. Fieser and M. Fieser, *Organic Chemistry*, Asia PublishingHouse, Bombay, 2000.
8. E.S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt,Rinehart and Winston Inc., 1959.
9. T. L. Gilchrist, *Heterocyclic Chemistry*, Longman Press, 1989.
10. J. A. Joule and K. Mills, *Heterocyclic Chemistry*, 4thed., John-Wiley, 2010.

CC 5- PHYSICAL CHEMISTRY- I

Course Title: Physical Chemistry-I	Course Type: Theory Course code: 23PC22
Total Hours: 90 Hours/Week: 6	Credits: 4
Pass-Out Policy : Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
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CLO No.	Course Learning Outcomes (CLO) Upon completion of this course, students will be able to	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	Learn the eigen functions and their corresponding eigen values ,operators, commutation relationship of operators	1[20]	1,8	U,R	F
CLO-2	Understand and apply various approximation methods	1[20]	1,8	U	P
CLO -3	Know and apply the molecular and valence bond approach in quantum chemistry	1[20]	1,8	Ap	P
CLO-4	Differentiate the different spectroscopic techniques like Microwave, IR and Electronic Spectroscopy and its applications	1[20]	1,8	E	C
CLO-5	Know the laws of photochemistry and photo physical processes and its applications	1[20]	1,8	U	C

Mod	Course Description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**QUANTUM MECHANICS-I**					
1.1	Operators: Algebra of operators: Addition and subtraction, multiplication, Linear operators, The operator ▼ and $▼^2$, commuting and non–commuting operators	2	1[10]	Lec	Quiz	1,3,6
1.2	Eigen values and Eigen functions, Hermitian property of operators, Properties of a Hermitian operator	2	1[10]	Lec	Quiz	1,3,6
1.3	Hamiltonian operator and proof of Hermitian nature,	1	1[10]	GD	Ass	1,3,6
1.4	Schmidt – orthogonalisation process.	1	1[10]	Lec	Ess	1,3,6
1.5	Basic Postulates of quantum mechanics	2	1[10]	BS	Ass	1,3,6
1.6	Time-independent Schrodinger wave equation. Physical significance of the wave functions Ψ and $Ψ^2$	1	1[10]	Lec	Sem	1,3,6

1.7	Solutions of Schrodinger Equation to free particle system	1	1[10]	B S	Ass	1,3,6
1.8	Solutions of Schrodinger Equation to one dimensional box	2	1[10]	Lec	Quiz	1,3,6
1.9	Solutions of Schrodinger Equation to three dimensional rectangular box	2	1[10]	Lec	Ass	1,3,6
II	**QUANTUM MECHANICS-II**					
	Approximation Methods					
2.1	Need for approximation methods, Variation method – variation theorem,	1	2[10]	Lec	Quiz	6
2.2	Application of variation method to Hydrogen atom.	2	2[10]	Lec	Ass	6
2.3	Application of variation method to helium atom.	2	2[10]	GD	Sem	6
2.4	The Perturbation Theory –First order perturbation	2	2[20]	Lec	Quiz	6
2.5	Application of first order perturbation theory to Helium atom	2	2[10]	BS	Ess	6
2.6	Symmetric and Antisymmetric wave functions: The ground and excited states of Helium atom	2	2[10]	Lec	Ass	6
2.7	Pauli exclusion principle. Applied to ground and excited states of Helium atom.	2	2[20]	Lec	Sem	6
2.8	Hartree's self-consistent field theory (HSCF)	2	2[10]	GD	Quiz	6
III	**QUANTUM MECHANICS – III**					
3.1	Molecular orbital (MO) and valence bond (VB) theories --Postulates	2	1[10]	Lec	Qui	3
3.2	Molecular orbital theory - LCAO Approximation	2	1[20]	Lec	Qui	3
3.3	The LCAO MO wave function of H_2^+ ion (Hydrogen molecule ion)	2	1[10]	GD	Sem	3
3.4	Molecular Orbital theory of Hydrogen molecule	1	1[10]	Lec	Ass	3
3.5	Valance bond treatment of diatomic molecule – Hydrogen molecule	2	1[10]	Lec	Sem	3
3.6	Shape of molecules: Principle of hybridization - sp, sp^2 and sp^3 hybridisation	2	1[10]	Lec	MC Q	3
3.7	The Huckel Molecular orbital (HMO) theory	2	1[20]	BS	Ass	3
3.8	Application of HMO theory to simple π – system Ethylene, and Allyl system.	2	1[10]	Lec	Quiz	3
IV	**MOLECULAR SPECTROSCOPY-I**					
	1.MICROWAVE SPECTROSCOPY					
3.1	Rotation of molecules. Rotational spectra	2	3[10]	Lec	Sem	10

	of diatomic molecules.					
3.2	Intensity of spectral lines, effect of isotopic substitution.	1	3[10]	Lec	Ass	10
3.3	Non-rigid rotator. Rotational spectra of polyatomic molecules.	2	3[10]	Lec	Ass	10
	2. INFRA-RED SPECTROSCOPY:					
3.4	Simple harmonic oscillator and Anharmonic oscillator.	2	3[10]	Lec	Qui	10
3.5	Diatomic vibrating rotator-vibrations of polyatomic Molecules.	2	3[10]	Lec	Sem	10
3.6	Fourior Transform Infrared Spectroscopy	1	3[10]	PT	Ass	10
	3.ELECTRONIC SPECTROSCOPY:					
3.7	Born-Oppenheimer approximation, progressions.	1	3[10]	Lec	Sem	10
3.8	Frank-Condon Principle, dissociation energy and dissociation spectra.	2	3[10]	Lec	Sem	10
3.9	Rotational fine structure, Fortrat diagram, predissociation.	2	3[10]	GD	Ass	10
V	**PHOTOCHEMISTRY**					
5.1	Physical properties of electronically excited molecules, nature of changes in electronic excitation.	2	5[5]	Lec	Ass	14
5.2	Potential energy diagram, shapes of absorption bands and Franck-Condon Principle.	2	5[5]	Lec	Sem	14
5.3	Crossing of potential energy surface.	1	5[10]	GD	Ass	14
5.4	Excited state - dipole moment, acidity constants and redox potentials.	1	5[10]	Lec	Ess	14
5.5	Photo physical processes in electronically excited molecules – types of Photo physical pathways – Jablonski diagram.	2	5[20]	Lec	Sem	14
5.6	Radiationless transitions – internal conversion and intersystem crossing.	1	5[5]	BS	Quiz	14
5.7	Fluorescence emission and structure.	1	5[5]	Lec	Ass	14
5.8	Triplet states and Phosphorescence emission.	1	5[5]	Lec	Ess	14
5.9	Stern Volmer equation, delayed fluorescence.	1	5[5]	Lec	Ass	14
5.10	Chemical lasers – Photo explosion and dissociation laser.	1	5[10]	GD	Sem	14
5.11	Experimental techniques – chemical actinometry and flash photolysis.	1	5[10]	Lec	Ess	14
5.12	Photochemical conversion of solar energy.	1	5[10]	Lec	Ass	14

Reference Books

1. A.K. Chandra, Introductory Quantum Chemistry, Tata McGraw Hill publishing Company Limited New Delhi, Fourth Edition, 1999.
2. Donald A. McQuarrie, Quantum chemistry, Viva Books, New Delhi, 2003.
3. R.K. Prasad, Quantum Chemistry, New Age International (P) Ltd. Publishers, New Delhi, 2007.
4. I.N. Levine, Quantum Chemistry, Prentice Hall, New Delhi, 1994.
5. John L Powel, Bernd Crasemann, Quantum Mechanics, Narosa Publishing House, New Delhi, 1965.
6. Henry Eyring, Jognwalter, George E. Kimball, Quantum Chemistry, Wiley International Edition, 1994.
7. P.W. Atkins, Molecular Quantum Mechanics, Clarendon press, Oxford, 2006.
8. Linus pauling, E. Bright Wilson, Introduction to Quantum Mechanics. McGraw – Hill Rogukusha Ltd. 1985.
9. Donald A. McQuarrie, Quantum Chemistry, Viva Books, New Delhi, 2003.
10. C.N. Banwell, Fundamentals of Molecular Spectroscopy, Tata McGraw –Hill, New Delhi, 1990.
11. R. Chang, Basic Principles of Spectroscopy, McGraw-Hill, New Delhi, 1971.
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13. G. Aruldhas, Molecular structure and Spectroscopy, PHI Learning Pvt. Ltd., 2011.
14. K.K. Rohotgi, Mukherjee, Fundamentals of Photochemistry, New International Publishers, 1997.

CC6-1 ORGANIC CHEMISTRY PRACTICALS –II

Course Title: Organic chemistry Practical-1I	Course Type: Practical Course code: 23PCP3
Total Hours:60 Hours/Week: 4	Credits: 2
Pass-Out Policy : Minimum Contact Hours: 36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr. G.S Prabha Littis Malar	Name: Dr. S.Begila David	Name: Dr. J. Helen Retna Monica
Designation: Assistant Professor	Designation: Assistant Professor	Designation: Associate Professor
Mobile : 9965134136	Mobile: 9487785342	Mobile: 9443407575
Email id: jaiprabha246@gmail.com	Email id: begilarobin@gmail.com	Email id: jhmonica@yahoo.com

CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	To understand the feasibility and the mechanism of various organicreactions.	1[20]	1,8	U	C
CLO-2	To comprehend the	1[20]	1,8	Ap	P
CLO-3	To understand the concept of stereochemistry involved in organiccompounds.	1[20]	1,8	U	F
CLO-4	To correlate and appreciate the differences involved in the various types of organic reaction mechanisms.	1[20]	1,8	E	M
CLO-5	To design feasible synthetic routes for the preparation of organic compounds.	1[20]	1,8	Ap	P

1. **Quantitative estimation of the following in an organic substance. (to be performed in cycle).**
   a. Volumetric determination of amino acids by formal titration method.
   b. Estimation of NO_2 groups.
   c. Percentage of hydroxyl groups in a polyhydric alcohol by phthalation method.
   d. Estimation of ketone (nonvolatile) by oxime method.
   e. Determination of glucose using methylene blue as internal indicator.

2. **Preparation of a solid compound in two stages**

a. Aspirin from Methyl salicylate
b. Anthranilic acid from Phthalic anhydride
c. Tribromobenzene from Aniline
d. Phthalimide from Phthalic acid
e. S-benzylisothiouronium chloride from Thiourea
F m-nitro benzoic acid from benzaldehyde
G p-bromoaniline from acetanilide

REFERENCE

1. B.B. Dey, M.V. Sitaraman and T.R. Govindachari, Laboratory Manual of Organic Chemistry, Fourth Edition, Allied Publishers, New Delhi, 1992
2. J.N. Gurtu and R. Kapoor,Advanced Experimental Chemistry, Third Edition.
3. Arthur I. Vogel, Quantitative Organic Analysis Part III, Second Edition, CBS Publishers, New Delhi, 1987.Roger Adams, Laboratory experiments in Organic Chemistry.

CC6-2 INORGANIC CHEMISTRY PRACTICALS –II

Course Title: Inorganic Chemistry Practical-II	Course Type: Practical Course code: 23PCP4
Total Hours:60 Hours/Week: 4 Credits: 2	
Pass-Out Policy : Minimum Contact Hours: 36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr. R. S. Jeba Jeevitha	Name: Dr. J.Premakumari	Name: Dr. J. Helen Retna Monica
Designation: Assistant Professor	Designation: Assistant Professor	Designation: Associate Professor
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CLO-No.	Expected Learning Outcomes On successful completion of this course, student should be able to:	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	Attain the skill in quantitative estimation of metal ions present in all samples by volumetric and gravimetric methods.	2[10],3[10]	1,2,3,5	Ap	C
CLO-2	Apply the principles of complex formation in preparation of metal complexes using different ligands.	2[10],3[10]	1,2,3,5	Ap	P
CLO 3	Analyze the complex by spectroscopic techniques	2[10],3[10]	1,2,3,5	AP	P

Estimation of components in a mixture

1.Estimation of Copper(V) and Nickel(G)
2.Estimation of Copper(V) and Zinc(G)
3.Estimation of Calcium(V) and Barium(G)
4.Estimation of Calcium(V) and Magnesium(G)
5.Estimation of Iron (V) and Nickel(G)
6.Estimation of Iron(V) and Copper(G)

V=Volumetric G=Gravimetric

2. Preparation of inorganic metal complexes

a) Potassium tri(oxalate)ferrate(III)trihydrate

b) Sulphato tris(thiourea)zinc(II)
c) Hexammine nickel(II)chloride
d) Chloropentammine cobalt(III)chloride
e) Potassium bis(oxalate)copper(II)dehydrate
f) Hexa(thiourea)lead(II)nitrate
g) Tris(thiourea)copper(I)sulphate
h) Tetrammine copper(II)sulphate
i) Dioxalato diaqua chromate(III)
j) Ammonium hexachlorostannate(V)

3. Spectral Analysis

Recording UV-Visible spectrum of two coordination complexes and interpretation of the spectra

REFERENCES:

1. A.I. Vogel, A Text Book of Quantitative Inorganic Analysis, 4thEdn – ELBS, 2004.
2. G Pass and H. Sutelift, Practical Inorganic Chemistry, 2ndEdn. Longman, 1974.

DISCIPLINE SPECIFIC ELECTIVE COURSE-(DSC 3)
MATERIAL SCIENCE
(FOR CHEMISTRY DISCIPLINE)

Course Title:	MATERIAL SCIENCE	Course Type: Theory Course code: 23PCEF
Total Hours: **60**	Hours/Week: **5**	Credits: **4**
Pass-Out Policy : Minimum Contact Hours:**36** Total Score %:100 Internal: **40** External: **60** Minimum Pass %: **50** [No Minimum for Internal]		
Course Creator:	Expert :	
Dr. H. AdlinMahiba	Dr. A. Hudson Oliver	
Assistant Professor	Assistant Professor	
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CLO-No.	Course Learning Outcome *Upon completion of this course, students will be able to:*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
1	Acquire knowledge on optoelectronic materials	7[10],8[10]	1,4,5,7	U	F
2	Be able to prepare ceramic materials	7[10],8[10]	1,4,5,7	U	P
3	Be able to understand the processing and applications of polymeric materials	7[10],8[10]	1,4,5,7	U	P
4	Be aware of the fabrication of composite materials	7[10],8[10]	1,4,5,7	An	C
5	Be knowledgeable of shape memory alloys, metallic glasses and nanomaterials.	7[10],8[10]	1,4,5,7	E	C

Module	Course Description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**OPTOELECTRONIC MATERIALS**					
1.1	Importance of optical materials – properties	1	1[10]	Lec	SA	1
1.2	Light interactions with solids	1	1[10]	Lec	SA	1
1.3	Band structure, energy levels, Band gap and lattice matching	2	1[15]	GD	MCQ	1
1.4	Optical Properties of materials - Absorption, reflection, transmission and other properties	2	1[15]	Lec	SA	1
1.5	Optical processes in quantum structures	1	1[10]	GD	Ess	1
1.6	Organic semiconductors	1	1[10]	Lec	Ess	1
1.7	Light propagation in materials – Electro-optic effect and modulation	2	1[15]	Lec	Ess	1

1.8	Optoelectronic Devices – LED, Photodiode, Solar cell	2	1[15]	Lec	SA	1
II	**CERAMIC MATERIALS**					
2.1	Ceramic processing	1	2[15]	Lec	Ess	2,5
2.2	Powder processing	2	2[15]	Lec	Ess	2,5
2.3	Milling and sintering	2	2[15]	Lec	SA	2,5
2.4	Traditional ceramics	1	2[10]	GD	MCQ	2,5
2.5	Structural ceramics	1	2[10]	GD	SA	2,5
2.6	Mechanical properties of ceramics	2	2[15]	GD	SA	2,5
2.7	Refractories	1	2[10]	Lec	SA	2,5
2.8	Glass and glass ceramics	2	2[10]	Lec	SA	2,5
III	**POLYMERIC MATERIALS**					
3.1	Polymeric Materials – introduction and classification	1	3[10]	Lec	Ess	2,5
3.2	Molecular structure of polymers	1	3[10]	Lec	Ess	2,5
3.3	Polymerization techniques	1	3[10]	Lec	Ess	2,5
3.4	Mechanical Properties of Polymers - Elasticity, viscosity, rheology, Thermal Stability and degradation	2	3[15]	GD	Ass	2,5
3.5	Polymer Processing Techniques	2	3[10]	GD	SA	2,5
3.6	Copolymers	1	3[10]	GD	SA	2,5
3.7	Applications: conducting polymers	2	3[15]	Lec	Ass	2,5
3.8	Biopolymers	1	3[10]	Lec	Ass	2,5
3.9	High temperature polymers	1	3[10]	Lec	Ess	2,5
IV	**COMPOSITE MATERIALS**					
4.1	Particle reinforced composites	1	4[15]	Lec	Sem	2,4

4.2	Fiber reinforced composites	2	4[15]	Lec	Sem	2,4
4.3	Mechanical behavior	1	4[10]	GD	Sem	2,4
4.4	polymer matrix composites	2	4[15]	Lec	Ass	2,4
4.5	metal matrix composites	2	4[15]	Lec	Ass	2,4
4.6	Carbon/carbon composites	2	4[10]	Lec	SA	2,4
4.7	Nanocomposites	1	4[10]	Lec	Sem	2,4
4.8	Applications	1	4[10]	GD	Sem	2,4
V	**NEW MATERIALS**					
5.1	Shape memory alloys	1	5[10]	Lec	Sem	3,4
5.2	Mechanisms of one-way and two-way shape memory effect	1	5[10]	Lec	Ess	3,4
5.3	Thermo-elasticity and pseudo-elasticity Examples and applications	2	5[15]	Lec	SA	3,4
5.4	Superconducting materials and piezoelectric materials	1	5[10]	GD	MCQ	3,4
5.5	Amorphous Metals	2	5[10]	GD	Sem	3,4
5.6	Nanomaterials: classification	1	5[10]	Lec	Ass	3,4
5.7	Size effect on structural and functional properties	1	5[10]	Lec	Ass	3,4
5.8	Processing and properties of Nano crystalline materials	1	5[10]	GD	Sem	3,4
5.9	Materials of Importance—Biodegradable and Bio-renewable Polymers/Plastics	2	5[15]	Lec	Sem	3,4

BOOKS FOR REFERENCE:

1. Jasprit Singh, Electronic and optoelectronic properties of semiconductor structures, Cambridge University Press, 2007.
2. William D. Callister, David G. Rethwisch, Materials science and engineering : an introduction, 10th edition, John Wiley & Sons
3. William F. Smith, JavadHashemi, 6th Edition, Foundations of Materials Science and Engineering, McGraw-Hill Education
4. V. Raghavan, 2003, Materials Science and Engineering, 4th Edition, Prentice- Hall India, New Delhi.
5. G.K. Narula, K.S. Narula and V.K. Gupta, 1988, Materials Science, Tata McGraw-Hill
6. https://onlinecourses.nptel.ac.in/noc20_mm02/preview
7. https://nptel.ac.in/courses/112104229
8. https://archive.nptel.ac.in/courses/113/105/113105081
9. https://nptel.ac.in/courses/113/105/113105025/
10. https://eng.libretexts.org/Bookshelves/Materials_Science/Supplemental_Modules_(Materials_Science)/Electronic_Properties/Lattice_Vibrations

MEDICINAL CHEMISTRY (FOR PHYSICS DISCIPLINE)

Course Title: **MEDICINAL CHEMISTRY**	Course Type: Practical Course code: 23PCN1
Total Hours:75 Hours/Week: 5 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 45 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
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CLO No.	Expected Learning Outcomes Upon completion of this course, students will be able to	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO - 1	Define drug and know drug discovery and design Know the QSAR, Hammett equation Craig plot, Hansch equation and Taft equation	7[5],8[10]	1,4,5,7	U	F
CLO-2	Illustrates the routes, distribution, metabolism and dosing of drug	7[5],8[10]	1,4,5,7	Ap	F
CLO - 3	Explain some of the medicinally important compounds, sulphonamides and the action of anesthetics	7[5],8[10]	1,4,5,7	E	C
CLO-4	Understand the classification, structure and synthesis of antineoplastic agents and antimalarial drugs	7[5],8[10]	1,4,5,7	U	C
CLO-5	Know the structure and synthesis of antibiotics and analgesic	7[5],8[10]	1,4,5,7	U	C

Sec	Description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**DRUG DISCOVERY AND DESIGN**					
1.1	Drug – definition, requirements of an ideal drug.	1	1[10]	Lec	Qui	1
1.2	Drug discovery of Penicillin	1	1[10]	Lec	Mcq	2
1.3	Discovery of lead compounds, Natural sources, Analogues and prodrugs	1	1[20]	Lec	Sem	1
1.4	Concepts of lead molecules with example Factors governing drug designs	1	1[10]	TPS	Ass	2
1.5	The method of variation - drug design through disjunction, conjunction	1	1[10]	BS	Ass	3
1.6	Hammett equation, Taft equation	2	1(10)	Lec	Quiz	2
1.7	Hansch equation, QSAR, Craig plot	2	1[20]	TPS	Ass	2
1.8	Computer – Assisted design.	1	1[10]	GD	Ass	3
II	**PHARMACOKINETICS**					
2.1	Pharmacokinetics (ADME) – Introduction	1	2[10]	Lec	Qui	4
2.2	Routes of administration of drugs	2	2[10]	Lec	Qui	4

2.3	Oral administration of drugs	1	2[10]	BS	Sem	4
2.4	Administration of drugs through injection	1	2[10]	TPS	Ass	4
2.5	Drug absorption – oral routes.	1	2(10)	Lec	Mcq	1
2.6	Drug distribution to tissues, cells, blood – brain barrier, placental barrier	2	2[20	Lec	Qui	1
2.7	Drug Metabolism –Phase I transformation, Phase II transformation.	2	2[10]	TPS	Ass	2
2.8	Drug excretion through lungs, bile duct and kidneys.	1	2[10]	Lec	Sem	2
2.9	Drug dosing – drug half – life, steady state concentration and drug tolerance	1	2[10]	BS	Ass	2
III	**ANTIMALARIAL, ANAESTHETIC AND SULPHA DRUGS**					
3.1	Antimalarial drugs-introduction and classification	1	3[20]	Lec	Qui	3
3.2	Structure and synthesis of chloroquine, primaquine, proguanil, pyrimethamine, camoquine, novacaine, methylisoquine and pamaquine	1	3[20]	Lec	Sem	3
3.3	Structure and uses of Narcotic drugs - Morphine, Non-Narcotic drugs –Ibuprofen	1	3[20]	BS	Ass	3
3.4	Preparation and uses of local Anaesthetics-chloroform,cocaine	1	3[20]	Lec	Mcq	3
3.5	Chemistry of sulphonamides – sulfothiazole Sulphadiazine, Prontosil – Preparation and uses	2	3[20]	Lec	Sem	3
IV	**CHEMOTHERAPEUTIC AGENT**					
4.1	Antineoplastic agents Introduction	2	4[10]	Lec	Qui	4
4.2	Classification	2	4(20)	Lec	Sem	4
4.3	Structure and synthesis of cyclophosphamide, Ifosfamide, Chlorambucil, Busulfan	3	4[20]	Lec	Sem	4
4.4	Structure and synthesis of Decarbazine, Fluorouracil, Cisplatin and Carboplatin	2	4[20]	TPS	Mcq	4
4.5	Cancer Chemotherapy	4	4[20]	TPS	Ass	4
V	**ANALGESICS, ANTIBIOTICS AND ANTI DIABETIC DRUGS**					
5.1	Antidiabetic Agents :Introduction,Types of diabetics, Drugs used for the treatment, chemical classification,	2	5[20]	Lec	Sem	4
5.2	Mechanism of action, Treatment of diabetic mellitus, Chemistry of insulin and sulfonyl urea	2	5[20]	Lec	Qui	4
5.3	Antibiotics –Introduction structure and impotance of Penicillin, Cephalosporin, Streptomycin, Terramycin , Erythromycin, Chloramphenicol	3	3(20)	Lec	Sem	4
5.4	Analgesics-Introduction ,Classification	4	5[20]	BS	Qui	4
5.5	Structure of Aspirin, Salol, Antifebrin, Phenacetin, Novalgin, Cinchophen	3	5[20]	Lec	Sem	4

REFERENCES

1. Graham L. Patrick, Introduction to Medicinal Chemistry, Oxford University press 1995.
2. Graham L. Patrick, Instant notes on Medicinal Chemistry, Series Edn. B. P. Hawes Viva book, (P) Ltd. 2002
3. G, C.D. Krupadanam, D. Vijaya Prasad, K.V. Rao, K.L.N. Reddy and C. Sudhakar, Drug, university presses India Ltd. 2001.
4. Asuthosh Kaur, Medicinal chemistry. New Age International publishers, 2009
5. V.K. Ahluwalia, Madhu Chopra, Ane's student's 2nd Edition. Medicinal chemistry 2012.
6. R.S. Satoskar and S.P. Bhandarkar, Pharmacology and Pharamatherapeutics , Wiley Eastern Ltd., 1995.
7. Gurdeep and Chatwal Goel, Synthesis Drugs Publishing Company, 1996.
8. G.R. Chatwal, A Text Book of Pharmaceutical Chemistry, Himalaya publishing House, 1986.
9. P.Parimoo,A Text book of Medical Chemistry,Newdelhi,CBS Publishers,1995
10. Foye"sPrincles of Medicinal Chemistry,Lipincott Williams,SeventhEdition,2012

DISCIPLINE SPECIFIC ELECTIVE COURSE (DSC 4)
BIOINORGANIC CHEMISTRY

Course Title: **Bioinorganic Chemistry**	Course Type: Theory Course Code:23PCEG
Total Hours: 60 Hours/Week: 5 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr. R. S. Jeba Jeevitha	Name: Dr. S. Begila David	Name: Dr. J. Helen Retna Monica
Designation: Assistant Professor	Designation: Associate Professor	Designation: Associate Professor
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CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be able to*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	Understand the effect of essential trace elements and oxygen	7[10],10[10]	1,4,5	U	F

	transport and uptake proteins				
CLO-2	Recognize the importance of electron transport proteins.	7[10],10[10]	1,4,5	R	F
CLO-3	Understand the, role of enzymes in biological systems.	7[10],10[10]	1,4,5	U	C
CLO-4	Appreciate the functions of biological redox reactions.	7[10],10[10]	1,4,5	E	P
CLO-5	Understand the metals and chelation in medicine.	7[10],10[10]	1,4,5	U	C

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**ESSENTIAL TRACE ELEMENTS ,OXYGEN TRANSPORT AND UPTAKE PROTEINS**					
1.1	Essential and trace elements in biological systems.	1	1[5]	Lec	Qui	2
1.2	Importance and toxicity of trace elements.	2	1[5]	Lec	Qui	2,4
1.3	Porphyrin – Metal complex system.	1	1[5]	Lec	Sem	2
1.4	Haemoglobin, myoglobin–oxygen binding.	2	1[20]	TPS	MCQ	2,4
1.5	Iron proteins - hemerythrin-structure and reactivity	2	1[20]	Lec	Sem	2
1.6	Copper protein-hemocyanin-structure and reactivity.	2	1[10]	Lec	Ess	1,2
1.7	Vitamin B_{12} and coenzyme	2	1[25]	BS	Ass	1,2
1.8	Iron Storage and transport –Ferritin, Transferrins and Siderophores.	2	1[10]	Lec	Qui	2,4
1.9	Synthetic oxygen carriers-vaska's complex, cobalt (II) dioxygen complex, perfluorochemicals	2	1[10]	TPS	Ass	2,4
II	**ELECTRON TRANSPORT PROTEINS**					
2.1	Electron transfer agents – cytochromes Fe-S proteins -Ferridoxins and Rubredoxins	2	2[20]	Lec	Qui	2,4
2.2	Blue Copper proteins - plastocyanin, azurin,.	2	2[20]	Lec	Qui	2,4
2.3	Stellocyanin, and ascorbic oxidase	2	2[10]	BS	Sem	2,4

2.4	Non blue copper oxidase proteins-galactose oxidase(GO)- structure and reactivity.	2	2[10]	TPS	Ass	2,4
2.5	Amine oxidase-structure and reactivity.	2	2[10]	Lec	Qui	2,4
2.6	Cytochromes structural features and classification, cytochrome c.	2	2[10]	Lec	Qui	2,4
2.7	Cytochrome c oxidase, cytochrome P-450-structure and reactivity.	2	2[20]	TPS	Ass	2,4
III	**METAL-CONTAINING ENZYME**					
3.1	Peptide hydrolysis and peptidases.	1	3[10]	Lec	Qui	4,6
3.2	Role of enzymes in biological systems – inhibition and poisoning	1	3[10]	Lec	Sem	4,6
3.3	Zinc enzymes- carboxy-peptidase A, carbonic anhydrase –structure and reactivity.	2	3[20]	BS	Ass	4,6
3.4	Superoxide dismutase-superoxidase toxicity, structure of Cu, Zn-SOD- enzymatic activity and mechanism.	2	3[30]	Lec	Qui	4,6
3.5	Catalase and peroxidase-structure and reactivity.	2	3[20]	Lec	Qui	4,6
3.6	DNA polymerase- structure and reactivity.	1	3[10]	TPS	Ass	4,6
IV	**BIOLOGICAL REDOX REACTIONS**					
4.1	Oxidative phosphorylation	1	4[10]	Lec	Qui	4,6
4.2	Nitrogen fixation-thermodynamic and kinetic aspects.	2	4[10]	Lec	Sem	4,6
4.3	Dinitrogen complexes and activation of dinitrogen through complexation.	2	4[20]	TPS	Ass	4,6
4.4	Nitrogenase in biological nitrogen fixation	2	4[20]	TPS	Ass	4,6
4.5	Photosynthesis reaction-light phase and dark phase.	2	4[20]	BS	Sem	4,6
4.6	Chlorophyll- structural features.	2	4[20]	TPS	Ass	4,6
V	**METALS AND CHELATION IN MEDICINE**					
5.1	Diseases due to metal deficiency and its treatment-Fe, Zn, Cu and Mn.	2	5[10]	Lec	Sem	4,5
5.2	Chelation therapy- metal complexes as drugs, anticancer and antiarthritic agent.	2	5[10]	Lec	Qui	4,5
5.3	Chelation and role of metal complexes in conventional drug resistant malaria.	2	5[10]	BS	Qui	4,5
5.4	Antirheumatic agents: Gold containing drugs and their action.	2	5[10]	Lec	Sem	4,5
5.5	Psychopharmacological drugs : lithium drugs and their mode of action.	2	5[20]	TPS	Ass	4,5
5.6	Metals used in diagnosis: radio diagnostic agents and neutron capture therapy.	2	5[20]	Lec	Qui	4,5
5.7	Magnetic resonance imaging (MRI), X-Ray contrast agents.	2	5[20]	Lec	Sem	4,5

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ENVIRONMENTAL CHEMISTRY

Course Title: ENVIRONMENTAL CHEMISTRY	Course Type: Theory Course Code:23PCEH
Total Hours: 60 Hours/Week: 5	Credits: 4
Pass-Out Policy : Minimum Contact Hours: 36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr. R. S. Jeba Jeevitha	Name: Dr. S. Begila David	Name: Dr. J. Helen Retna Monica
Designation: Assistant Professor	Designation: Associate Professor	Designation: Associate Professor
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Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**ENVIRONMENT AND ECOSYSTEM**					
1.1	Introduction to environmental chemistry	2	1[20]	Lec	Sem	1-8
1.2	Concepts and scope	2	1[20]	TPS	MCQ	1-8
1.3	Environmental segments – atmosphere, hydrosphere, lithosphere and biosphere	2	1[30]	Lec	Ass	1-5
1.4	Environment and ecology-definitions, components, classification ,ecological factors, ecological pyramid	3	1[30]	TPS	Sem	1-5
II	**ATMOSPHERE AND AIR POLLUTION**					
2.1	Evolution , chemical and structural composition of atmosphere	2	2[20]	Lec	MCQ	1-5
2.2	Chemical and photochemical reactions in atmosphere –oxides of S,C,C and its effect	1	2[10]	Lec	Ass	1-5
2.3	Green house gases and global warming	2	2[20]	GD	Qui	1-5
2.4	Photochemical smog, acid rain and ozone hole formation	1	2[10]	Lec	MCQ	1-5
2.5	El Nino phenomenon, particulates and radioactivity in atmosphere	1	2[10]	BS	Pro	1-5
2.6	Analysis and control of air pollutants	1	2[10]	Lec	Qui	1-5
2.7	Air pollution episodes –TCDD, Bhopal gasiragedyand Chernobyl disaster	2	2[20]	Lec	Sem	1-5
III	**HYDROSPHERE AND WATER POLLUTION**					
3.1	Water resources and their characteristics	1	3[10]	Lec	MCQ	4-8
3.2	Water pollution-Source of pollutants- organic, inorganic and radioactive pollutants, sampling and analysis of water pollutants.	1	3[10]	Lec	Qui	4-8
3.3	Water quality parameters and their determination-water quality standards (Indian and WHO)	1	3[10]	TPS	MCQ	4-8
3.4	Fluorosis and defluoridation	1	3[10]	Lec	Ass	4-8
3.5	Water treatment processes and preservation-electrodialysis, ion exchange, reverse osmosis, desalination process	1	3[10]	Lec	MCQ	4-8
3.6	Removal of iron, manganese, phosphorus, calcium and nitrogen.	1	3[10]	Lec	Qui	4-8
3.7	Treatment of water for industrial purpose Sedimentation, coagulation, flocculation, filtration, adsorption and disinfection of	2	3[10]	TPS	MCQ	4-8

	water.Sewage treatment-physical and chemical methods.					
3.8	Some case study of water pollution- metal toxicity, biodegradation of pollutants.	1	3[10]	GD	Ass	4-8
3.9	Oil in fresh and marine water-sources of oil pollution, effect on aquatic organisms and communities.	1	3[10]	Lec	Ass	4-8
3.10	Treatment and disposal technology - Biodegradation	1	3[10]	GD	Qui	4-8
IV	**LITHOSPHERE AND SOIL POLLUTION**					
4.1	Chemical composition –micro and macro nutrients in soil	2	4[10]	Lec	Ass	4-8
4.2	Soil Pollution by fertilizers, pesticides, plastics and heavy metal compounds and radio nucleides.	2	4[10]	Lec	Sem	4-8
4.3	Effect on nature, properties of soil, crops, plants and terrestrial animals.	3	4[20]	Lec	MCQ	4-8
4.4	Plants as indicators of soil pollution. Treatment and abatement procedures for soil pollution.	3	4[20]	Lec	Qui	4-8
V	**ENVIRONMENTAL RESTORATION**					
5.1	Environmental restoration-water disposal and their management by chemical and biological methods, recycling and further use of waste.	2	5[20]	Lec	Ass	4-8
5.2	Conservation of forests and wild life.	1	5[20]	GD	Sem	4-8
5.3	The state of global environment and earth summit	2	5[20]	Lec	MCQ	4-8
5.4	India's effort in environmental protection-the environmental act 1986 and its amendment	2	5[20]	Lec	MCQ	4-8
5.5	Participation of voluntary agencies in environmental protection.	3	5[20]	BS	Sem	4-8

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SEMESTER – III
CC 7 -INORGANIC CHEMISTRY- II

Course Title: **Inorganic Chemistry-II**	Course Type: Theory Course Code:23PC31
Total Hours:90 Hours/Week: 6 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr. A. Yardily	Name: Dr. S. Begila David	Name: Dr. J. Helen Retna Monica
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CLO-No.	**Course Learning Outcomes (CLO)** *Upon completion of this course, students will be able to*	**% of PLO Mapping with CLO**	**CLO &PLO mapped with GA**	**Cognitive level (CL)**	**Knowledge category (KL)**
CLO 1	Interpret electronic spectroscopy in solving inorganic systems.	1[20]	1,8	E	M
CLO 2	Understand the principles and applications of ORD, CD and Mossbauer Spectroscopy.	1[20]	1,8	U	F
CLO 3	Predict the geometry of inorganic compounds using NMR & ESR.	1[20]	1,8	An	C
CLO 4	Study the stability and importance of Organo metallic compounds.	1[20]	1,8	Ap	M
CLO 5	Apply Organometallic compounds, in suitable synthetic processes.	1[20]	1,8	Ap	F

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**ELECTRONIC SPECTROSCOPY**					
1.1	LS coupling and j-j coupling schemes	1	1[5]	Lec	Qui	1,2
1.2	Hund's rule, Term symbols and Microstates	3	1[5]	Lec	Qui	2,7
1.3	Selection rules for electronic transition and hole formalism, splitting of terms	2	1[5]	Lec	Sem	1,2
1.4	Interpretation of electronic spectra of complexes – Orgel diagrams - Tanabe Sugano diagrams	2	1[20]	TPS	Ass	2,7
1.5	Charge transfer spectra, Electronic spectra of lanthanide and actinide complexes.	1	[10]	Lec	Ess	1,2
1.6	Photoelectron Spectroscopy - Core level PES, Valence electron PES ,Chemical shift in PES, and Fine structure in PE bands	1	1[15]	BS	Ass	2,7
1.7	UPES spectra of O_2 and N_2 and its application to inorganic systems.	2	1[15]	Lec	Quiz	2,7
1.8	Koopmans' theorem, Auger electron emission.	2	1[15]	TPS	Ass	1,2
II	**OPTICAL ROTATORY DISPERSION, CIRCULAR DICHROISM AND MOSSBAUER SPECTORSCOPY**					
2.1	Optical isomerism in octahedral chelate complexes	1	2[10]	Lec	Qui	4,5
2.2	Determination of absolute configuration of octahedral chelate complexes from ORD and CD methods	2	2[10]	Lec	Qui	4,5
2.3	Stereochemistry and Conformation of chelate complexes.	1	2[10]	BS	Sem	4,5
2.4	MB spectroscopy- Principle, Minimizing recoiling energy and recording MB spectroscopy	2	2[20]	TPS	Ass	4,5
2.5	Doppler broadening, Isomer shift, Quadrupole splitting and Magnetic interactions in MB	2	2[20]	Lec	Qui	5,6

	spectroscopy.					
2.6	MB spectroscopy of octahedral high and low spin Fe (II) and Fe (III) complexes.	2	2[10]	Lec	Qui	5,6
2.7	Applications of MB spectroscopy to identify the oxidation state and Pi- back co-ordination.	1	2[10]	TPS	Ass	5,6
2.8	M.B spectral studies in iron compounds, ^{119}Sn compounds, halides of Tin (II) and Tin (IV) compounds.	2	2[10]	Lec	Sem	5,6
III	**NUCLEAR MAGNETIC RESONANCE AND ELECTRON PARAMAGNETIC RESONANCE SPECTROSCOPY**					
3.1	NMR active nuclei, Chemical shift	2	3[5]	Lec	Qui	1,5
3.2	Application of chemical shift and spin-spin coupling to structural determination using multiprobe NMR (^{1}H, ^{15}N,^{19}F, ^{31}P)	1	3[10]	Lec	Sem	2,5
3.3	Effect of quadrupolar nuclei on NMR spectra.	1	3[10]	BS	Ass	2,5
3.4	NMR studies on chemical exchange and dynamic processes in inorganic and organo metallic compound.	1	3[15]	Lec	Qui	2,5
3.5	NMR studies on fluxional molecules.	1	3[10]	Lec	Sem	2,5
3.6	Paramagnetic NMR and contact shift - Lanthanide shift reagents	1	3[10]	TPS	Ass	1,5
3.7	Application of hyperfine splitting constant and g-factor in structural determinations.	2	3[10]	TPS	Ass	2,5
3.8	Zero-field splitting (Kramer's degeneracy).	1	3[10]	Lec	Qui	1,2
3.9	Covalency of M-L bonding by EPR studies.	1	3[10]	GD	Qui	1,2
3.10	Application of EPR in the study of J-T distortion in Cu (II) complexes.	2	3[10]	Lec	Sem	1,2
IV	**ORGANOMETALLIC CHEMISTRY – I**					
4.1	Introduction- EAN rule and its correlation to stability.	1	4[5]	TPS	Ass	1,2
4.2	Metal carbonyls- synthesis, properties, structure and bonding in metal carbonyls	1	4[5]	BS	Sem	1,2
4.3	Polynuclear carbonyl complexes	1	4[5]	TPS	Ass	1,2
4.4	IR study of metal carbonyls.	1	4[10]	Lec	Qui	1,2
4.5	Carbonylate ions and carbonyl hydrate complexes.	2	4[10]	Lec	Qui	1,2
4.6	Isolobal analogy -parallels with non- metal chemistry –isolobal fragments	1	4[5]	Lec	Qui	1,2
4.7	Preparation, applications and structural	1	4[20]	Lec	Sem	1,2

	features of metal complexes with alkene and alkynes.					
4.8	Preparation, applications and structural features of metal complexes with allyl and arene.	1	4[10]	Lec	Qui	1,2
4.9	Metallocenes – Synthesis and properties of metallocenes.	1	4[10]	Lec	Qui	1,2
4.10	Bonding in ferrocene.	1	4[10]	Lec	Sem	1,2
4.11	Covalent versus ionic bonding in beryllocene.	2	4[10]	Lec	Qui	1,2
V	**ORGANOMETALLIC CHEMISTRY – II**					
5.1	Oxidative addition in Organometallic Chemistry	1	5[5]	Lec	Sem	1,2
5.2	Reductive elimination in Organometallic Chemistry	1	5[5]	Lec	Qui	2,5
5.3	Insertion and elimination reactions.	1	5[5]	BS	Qui	1,2
5.4	Nucleophilic and electrophilic attack of co-ordinating ligands	1	5[5]	Lec	Sem	1,2
5.5	Homogeneous catalysis - Wilkinson's catalyst, alkene hydrogenation	1	5[10]	TPS	Ass	2,5
5.6	Catalysis reactions of synthesis gas.	1	5[20]	Lec	Qui	1,2
5.7	Hydroformylation reactions	1	5[10]	Lec	Sem	1,2
5.8	Carbonylation of alcohols	1	5[10]	Lec	Sem	1,2
5.9	Wacker process - oxygenation of olefins.	1	5[10]	Lec	Qui	1,2
5.10	Heterogeneous catalysis - Fischer Tropsch process	1	5[10]	BS	Qui	1,2
5.11	Ziegler-Natta Polymerization and mechanism of Stereoregular polymer synthesis	2	5[10]	Lec	Sem	1,2

REFERENCES

1. Albert. Cotton Wilkinson, Geoffery Culos A, Murillo MgneelBochman, Advanced Inorganic Chemistry, Wiley Interscience Publication 6th Edn., New York 1999
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(CC 8) PHYSICAL CHEMISTRY – II
GROUP THEORY, CHEMICAL KINETICS AND MOLECULAR SPECTROSCOPY

Course Title: Group Theory,Chemical Kinetics And Molecular Spectroscopy	Course Type: Theory Course Code:23PC32
Total Hours:90 Hours/Week: 6 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr.T.Sumitha Celin	Name Dr.I.Starlet Thanjam	Name: Dr. J. Helen Retna Monica
Designation:Assistant Professor	Designation: Associate Professor	Designation : Associate Professor
Mobile :9486540793	Mobile:9442008516	Mobile 9443407575
Email id: sumithaezhil77@gmail.com	Email id: istarletthanjam@gmil.com	Email id: jhmonica@yahoo.com

CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	Cope with the hidden mystery of bonding and spectra by group theoretical approach	1[20]	1,8	An	P
CLO-2	Study the hybridization of molecules and interpret the wave function of molecules using Huckel's MOT	1[20]	1,8	U	F
CLO-3	Discuss various theories of reaction rate	1[20]	1,8	E	M
CLO-4	Explain the mechanism of chain reaction	1[20]	1,8	E	C
CLO-5	Understand NQR,ESR, Laser Raman Spectroscopy	1[20]	1,8	U	P

Mod	Course Description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**GROUP THEORY – I**					
1.1	Symmetry elements and symmetry operations. Identity, proper axis of rotation, plane of symmetry, centre of symmetry, Improper axis of rotation.	2	1[10]	Lec	Sem	1-4
1.2	Group postulates and types of groups.	2	1[10]	PT	Quiz	1-4
1.3	Abelian, non-abelian and cyclic groups.	1	1[20]	Lec	Ass	1-4
1.4	Multiplication tables, order, subgroups, isomorphic groups.	1	1[30]	BS	MCQ	1-4
1.5	Similarity transformations and class of a group.	2	1[20]	Lec	sem	1-5
1.6	Point groups – Schoenflies notation.	1	1[30]	PT	ass	1-5
1.7	group theory and optical activity. Matrices for symmetry operations.	1	1[20]	Lec	Sem	1-4
1.8	Representations of a group – reducible and irreducible representations.	1	1[20]	GD	Quiz	1-4
1.9	Great orthogonality theorem and its consequences.	1	1[20]	Lec	Ass	1-4
1.10	Construction of character tables (C_2v, C_2h and C_3v) –assignment of symmetry species to translational motion, rotational motion and d – orbitals.	2	1[20]	Lec	MCQ	1-4
1.11	Standard reduction formula.	1	1[10]	PT	Quiz	1-4
II	**GROUP THEORY – II**					
2.1	Molecular vibrations – symmetries of normal modes of vibration of molecules and predicting their IR and Raman activity: NH_3 molecule (C_3v), trans N_2F_2 molecule (C_2h), H_2O molecule (C_2v).	3	2[30]	Lec	ass	5,6
2.2	Hybridization scheme for sigma orbitals. (Tetrahedral, trigonal planar, trigonal bipyramid).	2	2[30]	Lec	sem	1-4
2.3	Wave functions as basis for irreducible representations.	2	2[30]	BS	Quiz	4,5, 6
2.4	Direct product representation, direct product of non–degenerate representations.	2	2[20]	PT	Ass	4,5, 6
2.5	Direct products of a degenerate and a non–degenerate representation. Direct product	1	2[10]	GD	Sem	4,5, 6

	of two degenerate representations.					
2.6	Vanishing and non-vanishing matrix elements.	1	2[10]	PS	Sem	4,5, 6
2.7	Symmetry selection rules for electronic transitions in simple molecules (ethylene, formaldehyde and benzene).	2	2[20]	Lec	ass	1-6
2.8	Symmetry selection rules for IR and Raman spectra.	1	2[30]	BS	Sem	1-6
2.9	Rule of mutual exclusion Projection operators.	1	2[30]	GD	Quiz	1-6
2.10	Simplification of Huckel's molecular orbital calculations using group theory.	1	2[20]	Lec	Ass	1-6
2.11	Molecular wave functions for ethylene.	1	2[20]	GD	MCQ	65,
2.12	Molecular wave functions and delocalisation energy for butadiene and cyclopropenyl systems.	2	2[20]	Lec	sem	5,6
III	**CHEMICAL KINETICS**					
3.1	Arrhenius equation. Simple collision theory.	2	1[10]	Lec	Ass	7
3.2	Transition state theory. Absolute reaction rate theory (ARRT) – Statistical and thermodynamic treatments.	3	1[20]	BS	MCQ	7
3.3	Principle of microscopic reversibility.	1	3[10]	GD	MCQ	7
3.4	Application of ARRT – atom-atom reaction and simple bimolecular reactions.	3	1 [20]	Lec	Ass	7
3.5	Theory of unimolecular reaction – Lindemann, Hinshelwood.	3	1[30]	Lec	Qui	7
3.6	Rice – Ramsbergs – Kassal (RRK) and Slater treatment.	4	1[10]	Lec	Sem	7
3.7	Reactions rates in solutions. ARRT to reactions in solution. Solvent effects on reaction rates.	1	2[10]	Lec	Ass	7
3.8	Influence of reaction rate - internal pressure, dielectric constant, ionic strength (Primary and secondary salt effect). Volume of activation and its significance.	2	2[10]	BS	Sem	7
3.9	Chain reaction – H_2 – Br_2, decomposition of N_2O_5,	2	2[20]	GD	Quiz	7
3.10	Decomposition of Acetaldehyde	1	2[20]	Lec	MCQ	7
3.11	Gold finger – Letort – Niclause rules	1	2[30]	Lec	Ass	7
3.12	Explosive reaction – H_2 – O_2.	1	2[30]	BS	MC	7
IV	MOLECULAR SPECTROSCOPY-II					
	RAMAN SPECTROSCOPY AND NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY					
4.1	Quantum theory of Raman effect.	1	3[10]	Lec	Sem	9
4.2	Classical theory of Raman effect, pure	1	3[10]	Lec	Sem	9

	rotational Raman spectra.					
4.3	Vibrational Raman spectra, polarized and depolarized Raman lines.	2	3[10]	Lec	Ass	9
4.4	Structural determination from Raman and IR spectroscopy.	2	3[10]	PT	Ass	9
4.5	Theory of NMR – nature of spinning particles.	1	3[10]	GD	Pro	9
4.6	Interaction between spin and magnetic field, population of energy level.	1	4[20]	GD	Ass	4
4.7	Larmor precession, relaxation times.	2	4[30]	Lec	Qui	4
4.8	NMR spectroscopy of H – nuclei.	1	4[20]	PT	Qui	4
4.9	Chemical shift, spin - spin coupling, coupling constant.	2	4[30]	Lec	Mcq	4
4.10	Bloch equations.	1	4[30]	Lec	Sem	4
4.11	Double Resonance – INDOR, spin tickling	1	4[20]	PT	Sem	4
V	**NQR, ESR AND LASER RAMAN SPECTROSCOPY**					
	1.NQR					
5.1	Principles, comparison with NMR, electric field gradient.	1	5[10]	Lec	Ass	6
5.2	Quadrupolar splitting of energy levels in symmetric and asymmetric fields.	2	5[30]	Lec	Qui	6
5.3	Quadrupolar coupling in atoms and molecules, asymmetry parameter.	1	5[30]	Lec	Sem	6
5.4	Applications – Hydrogen bonding, phase transition, substituent effect and structural information	1	5[20]	GD	Pro	6
	2. **ESR**					
5.5	ESR-Theory, hyperfine interactions in ESR.	1	5[10]	Lec	Ass	6
5.6	Zero-field splitting and Kramer's degeneracy – fine structure.	1	5[30]	Lec	Sem	6
5.7	Double resonance – (ENDOR, ELDOR), Mc Connell's relation.	1	5[30]	GD	Qui	6
5.8	Verification of the relation for cyclic polyene radical and calculation of electron density.	2	5[20]	PT	Pro	6
	3. LASER RAMAN SPECTROSCOPY					
5.9	Einstein treatment of absorption and emission phenomena. Einstein's coefficients.	2	5[30]	Lec	Ass	4
5.10	Probability of induced emission and its application to lasers.	1	5[30]	Lec	Sem	4
5.11	Conditions for laser action, Properties and Types of laser	2	5[20]	Lec	Ess	4
5.12	Laser Raman spectroscopy- Instrumentation. advantages of laser Raman spectroscopy	1	5[30]	GD	Qui	4
5.13	Photoacoustic spectroscopy	1	5[20]	PT	Ess	4

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5. R.S. Thakur, Role of symmetry, Groups and Matrices in chemistry, Atlantic publisher and Distributors (p) Ltd. 2007.
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LABORATORY COURSE -5
(CC 9) PHYSICAL CHEMISTRY PRACTICAL

Course Title:	**CP6- Physical Chemistry Practical**	Course Type: **Practical** Course Code :23PCP6
Total Hours: **60**	Hours/Week: **4**	Credits: **4**
Pass-Out Policy: Minimum Contact Hours 36 Total Score %: **100** Internal: **40** External: **60** Minimum Pass %: **40** [No Minimum for Internal]		

Course Creator:	**Expert 1:**	**Expert 2:**
Dr.I.Starlet Thanjam	T.Sumitha celin	Dr.T.F.Abbs Fen Reji
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I. CONDUCTOMETRY

Conductometric Acid – Base and Displacement Titrations

1. NH_4Cl – NaOH - (NH_4Cl + HCl)
2. NH_4Cl – NaOH - (CH_3COOH + HCl)
3. Determination of strengths of components in a buffer mixture

   CH_3COONa – HCl - (CH_3COONa + CH_3COOH) Mixture
4. Determination of dissociation constant of a weak acid, CH_3COOH.

II. POTENTIOMETRY

1. **Redox Titrations**

   KI- $KMnO_4$ – KI
2. **Precipitation Titration**

   KCl – $AgNO_3$-(KCl + KI) mixture
3. **Solubility Product**

   Determination of Solubilty product of AgCl and AgI by Chemical cell Method.
4. **Dissociation constant of a weak acid**

   Determination of dissociation constant of CH_3COOH

III. ADSORPTION

Studies on the adsorption of oxalic acid/acetic acid on charcoal.

IV. pHmetry

1. Determination of i. pKa of acetic acid.

ii. pH of acetic acid with sodium acetate buffer by pH metry

V. 1.Verification of Beer Lambert's Law by Photo calorimetric method (UV)

Spectrophotometric method to be demonstrated.

2. Estimation of sodium and potassium using Flame photometry.
3. Determination of coefficient of viscosity by Randells method.

REFERENCE

1. J.N. Gurthu and R. Kapoor, "Advanced Experimental Chemistry", S. Chand and Co., 1987.
2. Sundaram, Krishnan, Raghavan, "Practical Chemistry (Part II)", S. Viswanathan and Co, Pvt., 1996.
3. David P. Shoemaker Edition, McGraw- Hill Book Company, 1989.

DISCIPLINE SPECIFIC ELECTIVE COURSE (DSC 5)
CHEMISTRY OF NATURAL PRODUCTS

Course Title: CHEMISTRY OF NATURAL PRODUCTS	Course Type: Theory Course Code: 23PCEI
Total Hours: 60 Hours/Week: 5 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Dr.R.Ragel Mabel Saroja	Dr. G. Allen Gnana Raj	Dr. A. Siva
Associate Professor	Associate Professor	Associate Professor
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CO	Upon completion of this course, the students will be able to	**% of PLO Mapping with CLO**	**CLO &PLO mapped with GA**	**Cognitive level (CL)**	**Knowledge category (KL)**
CLO-1	To learn the basic concepts and biological importance of biomolecules and natural products	8[20]	1,7	U	P
CLO 2	To explain various functions of carbohydrates, proteins, nuclic acids, steroids and harmones	8[20]	1,7	E	C
CLO3	To understand the functions of alkaloids and terpenoids.	8[20]	1,7	U	M
CLO4	To elucidate the structure determination of biomolecules and natural products	8[20]	1,7	Ap	F
CLO5	To extract and construct the structure of alkaloids and terpenoids from different methods	8[20]	1,7	Ap	C

Module	Description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**ALKALOIDS**					
1.1	Introduction, occurrence, classification Isolation and functions of alkaloids	1	1[10]	Lec	Ass	1,2
1.2	General methods of structural elucidation	2	1[10]	Lec	Ass	1,2
1.3	Constitution and synthesis of Phenyl ethylamine alkaloids; Ephedrin and Adrenaline	1	1[10]	Lec	Sem	1,2
1.4	Piperidine alkaloids- Pelletierine, Isopelletierine and Pseudopelletierine	1	1[10]	GD	Sem	1,2
1.5	Isoquinoline alkaloids : Papaverine	1	1[10]	Lec	Ass	1,2
1.6	Indole alkaloids :Strychine and Ergotamine	4	1[10]	Lec	Quiz	1,2
1.7	Structural elucidation of Phenantherene alkaloids: Morphine	2	1[10]	BS	Ass	1,2
1.8	Structural elucidation of Cocaine and Atropine					
II	**TERPENOIDS AND CAROTENOIDS**					
2.1	**Terpenoids :** Introduction, Occurrence, Isoprene rule and classification	2	2[20]	Lec	Ass	2,3,4
2.2	General methods of determining structure of Terpenoids	1	2[10]	Lec	Quiz	2,3,4
2.3	Structural determination of Camphor and Abietic acid	1	2[10]	Lec	Sem	2,3,4
2.4	Structural determination of Cadinene Squalene and Zingiberin	1	2[10]	GD	Sem	2,3,4
2.5	**Carotenoids** : Introduction, classification and geometrical isomerism	1	2[10]	TPS	Ass	2,3,4
2.6	Structure, functions and synthesis of β carotene and vitamin-A	2	2[10]	Lec	Quiz	2,3,4
III	**ANTHOCYANINES AND FLAVONES**					
3.1	**Anthocyanines**: Introduction, properties and classification of anthocyanines		3[10]	Lec	Sem	2,5
3.2	Detection, isolation and functions of anthocyanin	3	3[20]	Lec	Sem	2,5
3.3	Determination of the structure of	2	3[20]	GD	Quiz	2,5

	anthocyanins					
3.4	Structural elucidation of Cyanin	2	3[10]	Lec	Ass	2,5
3.5	General methods for the synthesis of anthocyanidine	1	3[10]	BS	Ass	2,5
3.6	**Flavones** – Introduction, properties, isolation and separation of flavones	2	3[10]	Lec	Quiz	2,5
3.7	General methods for the elucidation of structure of flavones, flavonols, quercetin and catechin	1	3[10]	TPS	Sem	2,5
3.8	Structural relationship between flavonols, anthocyanidine and catechine.	2	3[10]	Lec	MCQ	2,5
IV	**PURINES AND STEROIDS**					
4.1	**Purines**: Introduction, occurrence and isolation of Purines	1	4[10]	Lec	Ass	1,4,5
4.2	Classification ,Spectral properties and its biological importance	2	4[10]	Lec	Sem	1,4,5
4.3	Structure and synthesis of Uric acid and Caffeine	1	4[10]	Lec	Ass	1,4,5
4.4	**Steroids**: Introduction, occurrence, nomenclature, configuration of substituents	1	4[10]	GD	Sem	1,4,5
4.5	Classification, Diels Hydrocarbon and stereochemistry	1	4[10]	Lec	Quiz	1,4,5
4.6	Biological importance and colour reactions of sterols	2	4[10]	Lec	Sem	1,4,5
4.7	Cholestreol – Occurrence, tests , Physiological activity	3	4[10]	TPS	Quiz	1,4,5
4.8	Structural elucidation of Cholesterol	2	4[10]	Lec	Sem	1,4,5
V	**PROTEINS AND NATURAL DYES**					
5.1	Introduction and classification of dyes	1	5[10]	Lec	Ass	1,5
5.2	Isolation, Purification and properties of dyes	1	5[10]	Lec	Ass	1,5
5.3	Colour and constitution	2	5[20]	Lec	Sem	1,5
5.4	Structural determination and synthesis of indigoitin and alizarin	2	5[10]	Lec	Quiz	1,5
5.5	Proteins – Polypeptides – primary structure of proteins	2	5[10]	GD	Sem	1,5
5.6	Terminal group Analysis – Edman degradation – DNP method	1	5[10]	Lec	Ass	1,5
5.7	Secondary and tertiary structures of proteins	2	5[10]	Lec	Ass	1,5
5.8	Structural elucidation of Insulin and Oxytocin	2	5[10]	GD	Sem	1,5

REFERENCES

Recommended Text	1. G. K. Chatwal, Organic Chemistry on Natural Products, Vol. 1, Himalaya Publishing House, Mumbai, 2009. 2. G. K. Chatwal, Organic Chemistry on Natural Products, Vol. 2, Himalaya Publishing House, Mumbai,2009. 3. O. P. Agarwal, Chemistry of Organic Natural Products, Vol. 1, Goel Publishing House, Meerut,1997. 4. O. P. Agarwal, Chemistry of Organic Natural Products, Vol. 2, Goel Publishing House, Meerut,1997. 5. I. L. Finar, Organic Chemistry Vol-2, 5th edition, Pearson Education Asia, 1975.
Reference Books	1. I. L. Finar, Organic Chemistry Vol-1, 6th edition, Pearson Education Asia,2004. 2. Pelletier, Chemistry of Alkaloids, Van Nostrand Reinhold Co,2000. 3. Shoppe, Chemistry of the steroids, Butterworthes,1994. 4. I. A. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad,2004.
Website and e-learning source	https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic

PHYTOCHEMISTRY AND PHARMACOGNOSY

Course Title: PHYTOCHEMISTRY AND PHARMACOGNOSY	Course Type: Theory Course Code: 23PCEJ
Total Hours: 60 Hours/Week: 4 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr.J.Prema Kumari	Name Dr.I.Starlet Thanjam	Name Dr.J. Helen Rathna Monica,
Designation: Associate Professor	Designation: Associate Professor	Designation Associate Professor
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Email id: premarussel@rediffmail.com	Email id: istarletthanjam@gmail.com	Email id jhmonica@yahoo.com

CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	Understand the basic concepts of Phytochemistry	8[20]	1,7	U	C
CLO-2	Elaborate the study of Phytopharmaceuticals	8[20]	1,7	E	C
CLO-3	Indepth study of various chemical constituents	8[20]	1,7	U	P
CLO-4	Acquire knowledge about marine pharmacognosy	8[20]	1,7	Ap	F
CLO-5	Explain various methods of Phyto pharmacological Screening	8[20]	1,7	E	M

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**INTRODUCTION TO PHYTOCHEMISTRY ANDPHARMACOGNOSY**					
1.1	Preliminary Phytochemical screening - Successive solvent extraction	2	1[10]	Lec	Ass	2
1.2	Qualitative chemical examination-	2	1[20]	Lec	Sem	2
1.3	Detection of different classes ofphytoconstituents	2	1[20]	GD	Quiz	2
1.4	Test for identification and uses of various phytopharmaceuticals	3	1[20]	Lec	Sem	2
1.5	Importance of pharmacognosy with special	3	1[30]	TPS	Quiz	2
II	**SOURCES, CHEMICAL STRUCTURES WITHDESCRIPTION OF PHYTOPHARMACEUTICALS -I**					
2.1	Morphine and a brief account of its derivativesand analogues	2	2[20]	Lec	Sem	1
2.2	Ergot alkaloids and semi synthetic derivatives	2	2[20]	Lec	Ass	1
2.3	Caffeine, Theophylline, Reserpine	2	2[20]	GD	Quiz	1

2.4	Quinine and Quinidine	3	2[20]	Lec	Quiz	1
2.5	Atropine, Hyoscyamine And Scopolamine	3	2[30]	Lec	Quiz	1
III	**SOURCES, CHEMICAL STRUCTURES WITH DESCRIPTION OF PHYTOPHARMACEUTICALS-II**					
3.1	Vincristine and Vinbalstine	2	3[10]	BS	Sem	1
3.2	Taxol, Camptothecin	2	3[20]	TPS	Ass	1
3.3	Podophyllotoxin and semi synthetic derivatives	2	3[20]	Lec	Ass	1
3.4	Lanatoside c, Digoxin, Ouabain, Ginsenosides 8-Methoxypsoralen and other Psoralens	3	3[30]	Lec	Quiz	1
3.5	Gaultheria oil , Eucalyptus oil, Menthol andEugenol	3	3[20]	Lec	Quiz	1
IV	**MARINE PHARMACOGNOSY**					
4.1	Definition, Present status,	2	4[20]	Lec	Ass	2
4.2	Classification of important bioactive agents with special reference to marine origin	2	4[20]	Lec	Ass	2
4.3	General methods of isolation and purification ofmarine natural compounds	4	4[30]	TPS	Sem	2
4.4	Study of important bioactive agents including chemistry and uses of marine origin	4	4[30]	GD	Quiz	2
V	**PHYTOPHARMACOLOGICAL SCREENING**					
5.1	Introduction of advanced screening methods	4	5[10]	Lec	Sem	3
5.2	Toxicity studies as per OECD guidelines	2	5[20]	Lec	Ass	3
5.3	Study of phyto pharmacological screening of Anti-inflammatory , Antiulcer drugs	2	5[20]	BS	Quiz	3
5.4	Study of phytopharmacological screening of Antifertility, Anticancer drugs	2	5[30]	TPS	Quiz	3
5.5	Study of phytopharmacological screening of Anti diabetics , and Antihepatotoxic drugs	2	5[20]	Lec	Quiz	3

REFERENCES

1. Cutler S.J and Cutler H.G., Biologially Active Natural Products: Pharmaceuticals,CRC Press, London, 1999
2. Evans V.C., Trease and Evans Pharmacognosy, Harcourt Publishers Ltd., Sydney,16th edition 2017
3. Vogel H.J., Drug Discovery and Evaluation, Springer , Berlin, 2002.

DISCIPLINE SPECIFIC ELECTIVE COURSE (DSC 6)
GREEN AND SUPRA MOLECULAR CHEMISTRY

Course Title: **GREEN AND SUPRA MOLECULAR CHEMISTRY**	Course Type: Theory Course code: 23PCEK
Total Hours: 60 Hours/Week: 5 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr.A.Jeena Pearl	Name Dr.S.Begila David	Name Dr.T.F.Abbs Fen Reji
Designation: Assistant Professor	Designation: Associate Professor	Designation Associate Professor
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Email id: jeenapearl@rediffmail.com	Email id: begilarobin@gmail.com	Email id abbsfen@gmail.com

CLO No.	Expected Learning Outcomes Upon completion of this course, students will be able to:	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO - 1	Learn the basic principles of green chemistry and synthesize molecules using green reagents	7[15],10[5]	1,4,5	U	P
CLO-2	Understand the importance of Supramolecules in chemistry	7[15],10[5]	1,4,5	U	C
CLO - 3	Apply the fundamental principles of different techniques in analytical Chemistry	7[15],10[5]	1,4,5	Ap	M
CLO-4	Learn the synthetic and applications of graphene	7[15],10[5]	1,4,5	U	F
CLO-5	Have an insight of nanochemistry in developing new molecules	7[15],10[5]	1,4,5	E	P

Sec	Description	Hours	%of CLOmapping with Module	Learning Activities	Assessment Tasks	Reference
I	**GREEN CHEMISTRY I**					
1.1	Introduction, Need for Green chemistry,Goals of Green chemistry, Limitations of green chemistry	1	1[10]	Lec	Qui	2,3
1.2	Chemical accidents,Terminologies	1	1[10]	Lec	Qui	2,3
1.3	International green chemistry organizations.	1	1[10]	Lec	Sem	2,3
1.4	Basic principles of green chemistry.	1	1[20]	GD	Ass	2,3
1.5	Calculation of atom economy.	1	1[10]	Lec	Sem	2,3
1.6	Yield mass intensity for different types of reactions.	1	1[20]	Lec	Ess	2,3
1.7	Selectivity concerned with yield and atom economy.	1	1[10]	PT	Ass	2,3
1.8	CFC alternatives- CO_2 as an alternative solvent.	1	1[10]	Lec	Quiz	2,3
II	**GREEN CHEMISTRY II**					
2.1	Choice of starting materials,Reagents, Catalysts and Solvents in detail.	1	1[10]	GD	Ass	2,3
2.2	Green chemistry in day today life.	1	2[20]	Lec	Qui	2,3
2.3	Designing green synthesis-Green reagent: DMC, Polymer supported reagents.	1	2[20]	Lec	Qui	2,3
2.4	Green solvents-water, ionic liquids-general method of preparation, Effect on organic reaction.	1	2(10)	BS	Sem	2,3
2.5	Supercritical CO_2-properties, Advantage and Drawbacks .	1	2(20)	Lec	Ass	2,3
2.6	A few examples of organic reactions in Super critical CO_2	1	2(20)	Lec	Ass	2,3
III	**GREEN CHEMISTRY –III**					

3.1	Use of microwave oven in organic synthesis.	2	3 [10]	Lec	Qui	7
3.2	Ultra sound assisted organic synthesis.	2	3[10]	Lec	Sem	7
3.3	Sonochemistry – Instrumentation, Cavitation theory	2	3[10]	TPS	Ass	7
3.4	Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction.	1	3[10]	BS	Sem	7
3.5	Applications in organic synthesis	1	3[20]	TPS	Ass	7
3.6	Green catalyst -TAML, acid catalyst, oxidation catalyst, basic catalyst.	1	3[10]	Lec	Qui	7
3.7	Polymer supported catalysts-Poly styrene aluminiumchloride,Polymeric super acid catalysts.	1	3[10]	Lec	Qui	7
3.8	Polymer supported photosensitizers.	1	3[10]	Lec	Qui	7
IV	**SUPRAMOLECULAR CHEMISTRY**					
4.1	History – definition – classification – molecular recognition.	1	4[10]	Lec	Qui	4
4.2	Host – Guest chemistry – coordination and the lock and key analogy.	1	4[20]	Lec	Qui	4
4.3	Chelate - macro cyclic and template effect.	1	4[10]	BS	Sem	4
4.4	Crown ether – Spherands.	1	[10]	TPS	Ass	4
4.5	Lariat ethers and podants – Cryptands.	1	2[10]	Lec	Qui	5
4.6	Fullerenes	1	2[20	Lec	Qui	5
4.7	Cyclodextrin as a microvessel.	1	2[10]	TPS	Ass	5
4.8	Zeolites, Dendrimers	1	2[10]	Lec	Sem	5
V	**GRAPHENE FUNCTIONALIZATION**					
5.1	Introduction – Fabrication of graphene, mechanical cleavage – reduction of graphene oxide, Chemical vapor deposition.	1	4(20)	Lec	Qui	1,4
5.2	Synthesis of grapheme nano ribbons (GNR).	1	4[20]	Lec	Sem	1,4
5.3	Functionalization of graphene with organic species, with macromolecules (grafting from methods, grafting to	2	4[20]	TPS	Ass	1,4

	methods) with inorganic nanoparticles (direct mixing, insitu synthesis).					
5.4	Functionalized graphene polymer nanocomposities (FPNs)	1	4[20]	TPS	Ass	1,4
5.5	Mechanical properties and electrical properties of graphene.	1	4[20]	BS	Sem	1,4

REFERENCE

1. C.N.R. Rao, A. Muller and A.K. Cheetham, The Chemistry of Nanomaterials Synthesis, properties and Application, Wiley – VCH – Verlog GMOH & Co., Wilhelm, 2004
2. K.R. Desai, Green Chemistry (Microwave Synthesis), Himalaya Publishing House, Mumbai, 2005
3. Sanghi and M.M. Srivastava, Green Chemistry, Narosa Publishing House, New Delhi, 2003.
4. K.R. Desai, Green Chemistry (Microwave Synthesis), Himalaya Publishing House, Mumbai, 2005
5. Sanghi and M.M. Srivastava, Green Chemistry, Narosa Publishing House, New Delhi, 2003.
6. Charles P. Poole, Jr and Frank, Owens, Introduction to Nanotechnology, Wiley – Inter science, A. John Wiley & sons Inc., Publications, Canada, 2003
7. Ahluwalia, V.K and Kidwai, M.R. New trends in green chemistry, Anamalaya publishers,2005.
8. A.K.De,Environmental chemistry, New Age Publications,2017

ADVANCED PHARMACEUTICAL OPERATIONS AND DISPENSING

Course Title: Advanced Pharmaceutical Operations And Dispensing	Course Type: Theory Course code: 23PCEL
Total Hours: 60 Hours/Week: 5 Credits: 4	
Pass-Out Policy : Minimum Contact Hours:36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr.A.Jeena Pearl	Name Dr.S.Begila David	Name Dr.T.F.Abbs Fen Reji
Designation: Assistant Professor	Designation: Associate Professor	Designation Associate Professor
Mobile : 9487352164	Mobile: 9487785342	Mobile 9488884898
Email id: jeenapearl@rediffmail.com	Email id: begilarobin@gmail.com	Email id abbsfen@gmail.com

CLO No.	Expected Learning Outcomes Upon completion of this course, students will be able to	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	Understand the principles of pharmacognosy	7[15],10[5]	1,4,5	U	P
CLO-2	Discuss the drug delivery systems	7[15],10[5]	1,4,5	U	C
CLO-3	Explain the different drug acts	7[15],10[5]	1,4,5	Ap	M
CLO-4	Discuss the various pharmaceutical operations	7[15],10[5]	1,4,5	U	F
CLO-5	Understand the diagnostic tests and agents	7[15],10[5]	1,4,5	E	P

Sec	Description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**PHARMACOGNOSY**					
1.1	Pharmacognosy of the official drugs frequently used in pharmacy- their sources and constituents. Eg. Cinnamon, Cinchona, Ginger, Cloves, Cardamom, Cumin, Fennel, Opium, Aloes, Asafoetida	3	1[20]	Lec	Qui	**2**
1.2	Fixed oils and essential oils used in pharmacy- their sources. Extraction, constituents, composition and analysis of fixed oils	4	1[20]	Lec	Sem	2
1.3	Fixed oils- Castor oil, Olive oil, Shark liver oil	3	1[20]	GD	Sem	2
1.4	Essential oils- Eucalyptus oil, Turpentine oil	3	1[20]	Lec	Sem	2
1.5	A brief study of the substances used as pharmaceutical necessities- starch, gum acacia, gum tragacanth, agar- agar, gelatine.	3	1[20]	PT	Mcq	2
II	**DISPENSING**					
2.1	Principles of dispensing medicaments	3	2[20]	GD	Sem	4

2.2	Preparation of pills, tablets, capsules, i	3	2[20]	Lec	Mcq	4
2.3	Injectables, suppositories, coating of tablets	3	2(20)	Lec	Lec	4
2.4	Newer drug delivery systems- site specific drug delivery systems in cancer chemotherapy	3	2[20]	PT	Sem	4
2.5	Drug delivery system to brain and CNS, to GIT, to kidney and urinary tract	3	2(20)	Lec	Lec	4
III	**FORENSIC PHARMACY**					
3.1	Pharmaceutical legislation in India.	2	3[20]	Lec	Sem	7
3.2	Legal aspects of trade in drugs	1	2(20)	Lec	Qui	7
3.3	Drug act and drug rules. Pharmacy act, dangerous drug act and rules. Drugs and cosmetic act and rules	4	3[20]	GD	Ass	7
3.4	Introduction to pharmacopeia B.P, I.P and general standard analysis	3	3[20]	GD	Ass	7
3.5	Intellectual property rights, Patents, Trademarks, Copy rights, Patent acts- relevant sections	3	3[20]	Lec	Qui	7
IV	**PHARMACEUTICAL OPERATIONS**					
4.1	Principle involved, apparatus and machinery used in general pharmaceutical operations of IP/ BP- Evaporation, extraction, Crystallization, Distillation	46 - 49	4[20]	Lec	Mcq	6
4.2	Evaporation, extraction, Crystallization, Distillation	50 - 54	4(20)	PT	Sem	6
4.3	Chromatographic techniques- theory of chromatography, applications of adsorption, partition, t	55 - 58	4[20]	Lec	Sem	6
4.4	thin layer and column chromatographic methods.	59	4(20)	GD	Qui	6
4.5	Column matrices, Detectors. Affinity and chiral columns, Electrophoresis- General ideas	60 - 62	4[20]	PT	Sem	6
V	**DIAGNOSTIC AGENTS AND TESTS**					
5.1	Radiopaques- Organoiodo compounds.	63 - 65	5[20]	Lec	Qui	8
5.2	Compounds used function tests, Dyes radio isotopes, RIA, ELISA	66 - 69	5[20]	GD	Sem	8
5.3	Dyes used in pharmacy- fluorescein, mercurochrome, acridine dyes	70 - 72	5[20]	PT	Mcq	8

5.4	Colouring agents- official colours, colour code	73 - 74	5[20]	Lec	Qui	8
5.5	Liver and gastric function tests and kidney function tests	75	5[20]	Lec	Ass	8

REFERENCES:

1. T.E. Wallis, Text Book of Pharmacognosy, 5thEdn., J & A Churchil, 1967
2. W.C Evans, Trease and Evans, Pharmacognosy, 15thEdn., Bailliere Tindall, 2002
3. C.K. Kokate, A.P. Purohit and S.B Gokhlae, Pharmacognosy, NiraiPrakashan, 2007.
4. S.S Kadam, K.R Mahadik, K.G Bothra, Principles of Medicinal Chemistry, Vol. 1, 18thEdn. NiraliPrakashan, 2007.
5. A. Kar, Medicinal Chemistry, New age International, 2007.
6. N.K Jain, A Text Book of Forensic Pharmacy, 6thEdn., Vallabh Prakashan, 2003.
7. P. Ganguli, Intellectual Property Rights; Unleashing the knowledge economy, Tata Mc. Graw Hill, 2001.
8. D.M Vasudevan, S. Sree Kumari, V. Kannan, Text book of bio chemistry for medical students, 6thEdn ., JP Medical, 2010.

23PCED1-PROJECT

Course Objective

This course is designed to reinforce the theoretical concepts with analytical techniques. It will provide a platform for students to have a hands on experience with instruments and present a report on a research topic.

Course outcome

Upon completion of this course, the students will be able to

1. Design and conduct experiments to analyze and interpret results and scientifically report.
2. Develop interdisciplinary solutions to a variety of chemical problems.
3. Communicate effectively in a variety of forms
4. Extend knowledge and understanding of a variety of chemical concepts in a range of contexts.

Students will select a project work on a tittle approved by the respective project supervisor. Students will maintain daily records and present oral reports while doing the project.All the above processes will be duly assessed by the project supervisor. They will submit the thesis at the end of the semester.

SEMESTER – IV
CC 10- ORGANIC CHEMISTRY-III

Course Title: ORGANIC CHEMISTRY III	Course Type: Theory Course Code: 23PC41
Total Hours: 90 Hours/Week: 6 Credits: 5	
Pass-Out Policy : Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
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CLO-No.	**CourseLearning Outcomes (CLO)** *Upon completion of this course, students will be*	**% of PLO Mapping with CLO**	**CLO &PLO mapped with GA**	**Cognitive level (CL)**	**Knowledge category (KL)**
CLO-1	Understand the principles and applications of UV- Visible and IR spectroscopy.	1[20]	1,8	U	P
CLO-2	Understand the methodology of NMR	1[20]	1,8	U	C
CLO-3	To understand the molecular complexity of carbon skeletons and the presence of functional groups and their relative positions. To study various synthetically important reagent for any successful organic synthesis. To apply disconnection approach and identifying suitable synthons to effect successful organic synthesis.	1[20]	1,8	U	M
CLO-4	To learn the concepts of Pericyclic reaction mechanisms.	1[20]	1,8	E	F
CLO-5	To gain the knowledge of photochemical reactions.	1[20]	1,8	An	P

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**UV-VISIBLE SPECTROSCOPY AND IR SPECTROSCOPY**					
1.1	Basic Principles of electronic transition.	1	1[10]	Lec	Qui	1
1.2	Absorption spectra of conjugated dienes and α, β unsaturated carbonyl compounds - Woodward and Fieser rule, Fieser and Khun rule. Scott's rule, Nielson rule.	3	1[20]	Lec	Qui	2
1.3	Role of solvent in polyenes and enones.	1	1[10]	Lec	Sem	1
1.4	Application of UV Visible Spectroscopy to problems in organic chemistry.	2	1[20]	TPS	Ass	2
1.5	Absorption of infrared radiation and molecular vibration.	2	1[10]	Lec	Ess	3
1.6	Frequency of vibration of a diatomic molecule and its vibration with force constant and relative masses.	1	1[10]	BS	Ass	3
1.7	Factors affecting the IR frequency.	2	1[10]	Lec	Quiz	2
1.8	Interpretation and application of IR spectroscopy.	2	1[10]	TPS	Ass	2
II	**NMR SPECTROSCOPY AND MASS SPECTROMETRY**					
2.1	^{1}HNMR Instrumentation- principle of NMR-	1	2[10]	Lec	Qui	4
2.2	Anisotropic effects, spin -spin coupling, delta (and tau) values of aliphatic - olefinic, aldehydic, aromatic, carboxylic, enolic, phenolic and alcoholic protons	3	2[20]	Lec	Qui	4
2.3	Solvents, chemical exchange.	1	2[20]	BS	Sem	4
2.4	Simplification of complex spectra-double resonance- shift reagents.	1	2[20]	TPS	Ass	4
2.5	^{13}C NMR Spectroscopy-Principle-Chemical shift	1	2[20]	Lec	Qui	5
2.6	Broad band decoupling and off resonance decoupling-coupling constants of aliphatic, aromatic and carbonyl carbons.	1	2[20	Lec	Qui	5

2.7	2D-NMR, NOE, COSY, DEPT, MRI .applications	3	2[20]	TPS	Ass	5
2.8	NMR spectra- Karplus equation, Vicinal coupling (^3J), Geminal coupling (^2J), NOE.,			Lec	Qui	5
2.9	MASS SPECTROMETRY- Basic principle- Instrumentation	1	2[10]	Lec	Sem	5
2.10	Production of ions, EI, CI, FAB, ESI, MALDI -Molecular ion peak.	1	2[20]	BS	Ass	5
2.11	Base peak, metastable peak. Isotopic peaks- importance	1	2[20]	Lec	Qui	5
2.12	Nitrogen rule - Even electron rule Mc Lafferty rearrangement- applications	1	2[20]	Lec	Sem	7
2.13	Retro Diels- Alder reaction.	1	2[20]	GD	Sem	7
2.14	Fragmentation pattern of simple organic compounds.	1	2[20]	BS	Ass	7
2.15	Applications of mass spectrometry	2	2[]	TPS	Ass	7
III	**PLANNING AN ORGANIC SYNTHESIS AND CONTROL ELEMENTS:**					
3.1	Preliminary Planning – knowns and unknowns of the synthetic system studied	1	3[10]	BS	Qui	9-17
3.2	analysis of the complex and interrelated carbon framework into simple rational precursors	2	3[10]	TPS	MCQ	9-17
3.3	Retrosynthetic analysis, alternate synthetic routes	1	3[10]	GD	Qui	9-17
3.4	key intermediates that would be formed available starting materials and resulting yield of alternative methods	2	3[20]	TPS	MCQ	9-17
3.5	Linear *vs* convergent synthesis.	1	3[10]	TPS	MCQ	9-17
3.6	Use of protective groups, activating groups and bridging elements	2	3[10]	PT	MCQ	9-17
3.7	Examples on retro synthetic approach, calculation of yield, advantages of convergent synthesis.	2	3[20]	PT	MCQ	9-17
3.8	Synthesis of stereochemistry-controlled products	1	3[10]	GD	Qui	9-17
IV	**PERICYCLIC REACTIONS**					
4.1	Woodward Hoffmann rules	1	4[10]	Lec	MCQ	9-14
4.2	The Mobius and Huckel concept, FMO, PMO method and correlation diagrams	2	4[10]	TPS	Pro	9-14
4.3	Cycloaddition and retrocycloaddition	2	4[20]	Lec	Ass	9-14

	reactions; [2+2], [2+4], [4+4, Cationic, anionic, and 1,3-dipolar cycloadditions					
4.4	Cheletropic reactions	1	4[10]	GD	Qui	9-14
4.5	Electrocyclization and ring opening reactions of conjugated dienes and trienes	2	4[10]	TPS	MC Q	9-14
4.6	Sigmatropic rearrangements: (1,3), (1,5), (3,3) and (5,5)-carbon migrations	2	4[10]	GD	Qui	9-14
4.7	Degenerate rearrangements. Ionic sigmatropic rearrangements. Group transfer reactions.	2	4[20]	TPS	MC Q	9-14
4.8	Regioselectivity, stereoselectivity and periselectivity in pericyclic reactions	1	4[10]	GD	Qui	9-14
V	**ORGANIC PHOTOCHEMISTRY**					
5.1	Reactions of electronically excited ketones; * triplets	2	5[10]	Lec	Qui	9-17
5.2	Norrish type-I and type-II cleavage reactions	2	5[20]	GD	MC Q	9-17
5.3	Photo reductions; Paterno-Buchi reactions;	2	5[10]	TPS	Qui	9-17
5.4	Photochemistry of α,β-unsaturated ketones; cis-trans isomerisation.	2	5[20]	Lec	MC Q	9-17
5.5	Photon energy transfer reactions,	2	5[10]	Lec	MC Q	9-17
5.6	Photochemistry of aromatic compounds	2	5[10]	Lec	MC Q	9-17
5.7	Photo-stationery state; di-π-methane rearrangement.	2	5[20]	Lec	MCQ	9-17

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CC 11- INORGANIC CHEMISTRY-III

Course Title: **Inorganic Chemistry-III**	Course Type: Theory Course Code: 23PC42
Total Hours:90 Hours/Week: 6 Credits: 5	
Pass-Out Policy : Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr. R. D. Femitha	Name: Dr. S. Begila David	Name: Dr. J. Helen Retna Monica
Designation: Assistant Professor	Designation: Associate Professor	Designation: Associate Professor
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CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be able to*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
1.	Identify the chemical bonding and structure of different inorganic compounds, clusters and fluxional molecules	1[20]	1,8	U	P
2.	Relate the coordination theories in the application of CST	1[20]	1,8	Ap	C

3.	Apply the stability of complexes and polydentate ligands in medicine	1[20]	1,8	Ap	F
4.	Acquire knowledge on transition elements.	1[20]	1,8	E	M
5.	Understand the chemistry of lanthanides and actinides with a new perspective.	1[20]	1,8	U	C

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**COORDINATION CHEMISTRY**					
1.1	Metal-ligand bond – V.B theory and its applications	1	1[10]	Lec	Ass	1,2
1.2	Electro neutrality principle and back bonding	2	1[5]	Lec	Qui	1,2
1.3	Crystal field effects for octahedral and tetrahedral symmetries	2	1[10]	GD	Ess	1,2
1.4	Crystal field effects for square planar and tetragonal symmetries	1	1[15]	Lec	MCQ	1,2
1.5	Spectrochemical series and Nephelauxetic effect	1	1[10]	TPS	MCQ	2,5
1.6	Application of Crystal field theory – Magnetic properties of metal complexes	1	1[10]	TPS	MCQ	1,2
1.7	Calculation of CFSE	1	1[5]	Lec	Qui	1,2
1.8	Thermodynamic effects of CFSE	1	1[10]	BS	Sem	2,5
1.9	Static and Dynamic John – Teller effect	1	1[10]	BS	Qui	1,2
1.10	M.O. theory for octahedral complexes	1	1[10]	Lec	Qui	1,2
1.11	π-bonding and MOT	1	1[5]	Gd	Ass	1,2
II	**STABILITY OF COMPLEXES AND DESIGN OF SPECIALIZED LIGANDS**					
2.1	Stability of complexes, Stepwise and overall stabilities	1	2[10]	Lec	Qui	3,4
2.2	Factors affecting stability of complexes.	1	2[10]	Lec	Qui	3,4
2.3	Determination of stability constant by Potentiometric method and Spectrophotometric method	1	2[10]	GD	Ass	
2.4	HSAB concept and symbiosis	1	2[10]	GD	Ass	3,4
2.5	Theoretical basis of softness and hardness	1	2[10]	BS	Sem	3,4
2.6	Chelate effect	1	2[5]	BS	Pro	3,4
2.7	Macrocyclic effect	1	2[5]	Lec	MCQ	3,4

2.8	Crown ethers – structures of common crown ethers	1	2[10]	TPS	Sem	3,4
2.9	Cryptands– structure, properties and uses	1	2[5]	Lec	Qui	3,4
2.10	Sepulchrates – reactions with examples	1	2[5]	Lec	Qui	3,4
2.11	Conformations of chelate rings and biochemical applications	1	2[10]	GD	Sem	3,4
III	**NON – AQUEOUS SOLVENTS**					
3.1	General properties of solvents.	1	3[10]	Lec	MCQ	1,4
3.2	Classification of solvents.	1	3[10]	Lec	Qui	1,4
3.3	Self-ionization and leveling effect	1	3[20]	GD	Pro	1,4
3.4	Reactions in non-aqueous solvents. Solute – solvent interaction.	2	3[20]	Lec	Ass	1,4
3.5	Reaction in liquid ammonia, liquid HF, liquid SO_2, liquid halogens, inter halogens and liquid H_2SO_4	2	3[20]	BS	Ass	1,4
3.6	Molten salts as non- aqueous solvents.	2	3[10]	Lec	Qui	1,4
3.7	Titration in non-aqueous solvent - acid, base and redox.	2	3[10]	Lec	MCQ	1,4
IV	**CHEMISTRY OF d-BLOCK AND f-BLOCK ELEMENTS**					
4.1	Zr and Hf – Occurrence, extraction- Oxidation states	2	4[5]	Lec	Qui	6,7
4.2	ZrO_2 and mixed oxides, halides	1	4[5]	Lec	Ass	6,7
4.3	Niobium and Tantalum – occurrence, isolation, halides	1	4[10]	BS	Qui	6,7
4.4	Nitrogen – Ligand complexes of Ru	2	4[10]	Lec	Qui	6,7
4.5	Creutz – Taube and related complexes	1	4[15]	Lec	Ass	6,7
4.6	Wilkinson's catalyst - Pt complexes in the treatment of cancer	1	4[15]	Lec	MCQ	7,8
4.7	Properties of lanthanides and actinides - Electronic configuration, Common and uncommon oxidation states	2	4[10]	Lec	Qui	7,8
4.8	Lanthanide contraction - consequences, causes, spectral and magnetic characteristics of lanthanides and actinides	1	4[10]	PT	Ess	7,8
4.9	Use of lanthanide complexes as shift reagents	1	4[20]	Lec	MCQ	7,8
V	**ELECTRON TRANSFER AND PHOTOCHEMICAL REACTIONS IN COMPLEXES**					
5.1	Electron transfer reactions in octahedral complexes	2	5[10]	Lec	Qui	6,9
5.2	Outer sphere electron transfer reactions and Marcus –Hush theory.	2	5[10]	Lec	Qui	6,9
5.3	Inner sphere electron transfer reaction- nature of bridging ligand.	2	5[20]	PT	MCQ	6,9
5.4	Photo-redox reaction in complexes and their applications.	1	5[20]	Lec	Ass	6,9
5.5	Photo-substitution reaction in complexes and their applications	2	5[20]	Lec	Sem	6,9
5.6	Photo- isomerisation reaction in complexes and their applications	2	5[20]	Lec	Ass	6,9

REFERENCES

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(CC 12)PHYSICAL CHEMISTRY-III

Course Title: Physical Chemistry III	Course Type: Theory Course code:
Total Hours:90 Hours/Week: 6 Credits: 5	
Pass-Out Policy : Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Name : Dr.T.Sumitha Celin	Name Dr.I.Starlet Thanjam	Name: Dr.J. Helen Rathna Monica
Designation:Assistant Professor	Designation: Associate Professor	Designation Associate Professor
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CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	Theoretise the reaction rates and enhance them or retard them.	1[15],3[5]	1,3,5,8	An	P
CLO-2	Explain the mechanism of chain reactions and the techniques of fast reactions	1[15],3[5]	1,3,5,8	E	C
CLO-3	To acquire knowledge about irreversible thermodynamics.	1[15],3[5]	1,3,5,8	U	M
CLO-4	Know the basics of Statistical Thermodynamics, MB,FD, BE statistics and heat capacity of solids.	1[15],3[5]	1,3,5,8	U	F
CLO-5	Acquire knowledge polymer Chemistry and its applications and dendrimers	1[15],3[5]	1,3,5,8	Ap	C

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**SURFACE CHEMISTRY**					
1.1	Adsorption – types of adsorption, adsorption isotherms	1	4[10]	Lec	Ess	1,2, 7,8
1.2	Freundich's adsorption isotherm, Langmuir adsorption isotherm- derivation.	2	4[10]	Lec	Ass	1,2, 7,8
1.3	BET adsorption isotherm derivation, determination of surface area.	2	4[10]	Lec	Quiz	1,2, 7,8
1.4	Application of adsorption	2	4[5]	GD	Quiz	1,2, 7,8
1.5	Gibb's adsorption isotherm– derivation.	1	4[10]	Lec	Sem	1,2, 7,8
1.6	Heterogeneous Catalysis - Mechanism of heterogeneous catalysis.	2	4[10]	Lec	Sem	1,2, 7,8
1.7	Langmuir–Hinshelwood, Langmuir - Rideal mechanisms.	2	4[10]	BS	Ass	1,2, 7,8
1.8	Adsorption on semiconductor surfaces.	1	4[10]	Lec	Ess	1,2, 7,8
1.9	Kinetics of chemisorption.	1	4[10]	GD	Quiz	1,2, 7,8

1.10	Transition state theory of surface reaction – rates of chemisorption.	2	4[10]	Le c	Ass	1,2, 7,8
1.11	Hertz– Knudson equation.	2	4[5]	Le c	Ess	1,2, 7,8
II	**KINETICS OF FAST REACTIONS AND CATALYSIS**					
2.1	Fast reactions - Techniques for study of fast reactions. Relaxation kinetics.	1	2[10]	PT	Ass	3,7, 9
2.2	Flow methods for fast reactions- continuous flow method, Stopped flow method.	1	2[10]	GD	Sem	3,7, 9
2.3	Relaxation techniques – temperature jump, pressure jump.	1	2[10]	PT	Ass	3,7, 9
2.4	Pulse Methods-Flash Photolysis, Pulse Radiolysis	1	2[10]	PT	MCQ	3,7, 9
2.5	Electrochemical Relaxation Methods-Introduction, various types of perturbation of a system, basic principle, Experimental arrangement, Applications	1	2[10]	GD	Qui	3,7, 9
2.6	Catalysis - Homogeneous catalysis.	1	2[10]	GD	Ass	7,8
2.7	General catalytic mechanism, acid-base catalysis.	1	2[10]	PT	Qui	7,8
2.8	Acidity functions. Bronsted relationships	1	2[10]	GD	Sem	7,8
2.9	Catalysis by enzymes – influence of concentration (single substrate, double substrate), inhibition.	1	2[10]	PT	MCQ	7,8
2.10	Influence of pH and temperature.	1	2[10]	GD	sem	7,8
III	**IRREVERSIBLE THERMODYNAMICS**					
3.1	Theories of conservation of mass and energy	1	3[20]	GD	Sem	4,7
3.2	Entropy production in open systems by heat, matter and current flow, force and flux concepts.	1	3[10]	PT	Ass	4,7
3.3	Onsager theory-validity and verification-Onsager reciprocal relationships.	2	3[20]	Le c	Ess	4,7
3.4	Principle of microscopic reversibility and Onsager reciprocal relations.	1	3[20]	Le c	Ass	4,7
3.5	Electro kinetic effect and thermo mechanical effects	1	3[10]	GD	Qui	4,7
3.6	Application of irreversible thermodynamics to biological systems.	1	3[10]	BS	MCQ	4,7
3.7	Nonlinear thermodynamics of linear processes	1	3[10]	GD	Qui	4,7

IV	**STATISTICAL THERMODYNAMICS**					
4.1	Aim of statistical thermodynamics, Permutation and combinations.	1	4[5]	Le c	Ass	5-8
4.2	Probability theorems, ensembles, microstates, macrostates and phase space.	1	4[10]	BS	Ass	5-8
4.3	Maxwell – Boltzmann statistics-derivation.	1	4[5]	GD	Qui	5-8
4.4	Relationship between entropy and probability, statistical meaning of third Law of thermodynamics.	1	4[10]	Le c	Sem	5-8
4.5	Partition functions - translational, rotational and vibrational partition functions of diatomic molecules and polyatomic molecules, electronic partition function.	2	4[10]	Le c	MCQ	5-8
4.6	Derivation of thermodynamic quantities E, S, A, H, G, P, Cp and Cv using partition function.	2	4[10]	Le c	sem	5-8
4.7	Sacker –Tetrode equation.	1	4[10]	BS	ass	5-8
4.8	Quantum Statistics – Fermi – Dirac and Bose – Einstein statistics.	1	4[5]	Le c	MCQ	5-8
4.9	Population inversion, negative Kelvin temperature.	1	4[10]	GD	ass	5-8
4.10	Heat capacity of solids – Einstein's theory of heat capacities of solids	2	4[10]	Le c	ass	5-8
4.11	Debye's theory of heat capacities of solids	2	4[10]	PT	sem	5-8
V	**POLYMER CHEMISTRY**					
5.1	Homopolymers – Hetero chain Polymers – copolymers, Stereo Chemistry of Polymers.	1	5[10]	GD	ass	10-12
5.2	Mechanism of co-ordination polymerization Ziegler – Natta catalysts. Bimetallic and monometallic mechanism	2	5[10]	PT	Quiz	10-12
5.3	Kinetics of non – Catalyst polycondensation, Acid – catalysed polycondensation.	2	5[10]	Le c	Ass	10-12
5.4	Ring opening polymerisation, Electrochemical polymerization, Metathetical polymerization	2	5[10]	Le c	sem	10-12
5.5	Electronically conducting polymers-Poly(sulphur Nitride), polyacetylene, poly(paraphenylene),Flory-Huggins Theory	1	5[10]	PT	quiz	10-12
	DENDRIMERS AND DENDRITIC POLYMERS					
5.6	Basic concepts and terminology: Dendrons, star shaped and starbust polymers, dendrimer formation and generations	1	5[10]	BS	ass	10-12
5.7	Various types of dendrimers	1	5[5]	GD	MCQ	10-12
5.8	Synthesis of dendrimers-convergent and	1	5[10]	Le	ass	10-

	divergent approaches, methods and mechanism.			c		12
5.9	Properties of dendrimers- polydispersity, mechanical properties, viscoelastic properties. Determination of physical properties.	1	5[10]	GD	MCQ	10-12
5.10	Characterization of dendrimers: GPC, osmosis, TG, DSC, magnetic resonance spectroscopy (proton and carbon-13 NMR), mass spectral studies (MALDI and TOF).	2	5[10]	BS	Quiz	10-12
5.11	Applications of dendrimers	1	5[5]	GD	ass	10-12

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DISCIPLINE SPECIFIC ELECTIVE COURSE (DSC 7)
RESEARCH METHODOLOGY

Course Title: Research Methodology	Course Type: Theory Course Code: 23PCEM
Total Hours:60 Hours/Week: 5 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Dr.G.S.Praba Littis Malar	Dr.G.Allen Gnana Raj	Dr. A. Siva
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CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	Understand the various aspects of literature survey and thesis writing.	4[15],5[10]	1,2,6,7, 9	U	C
CLO-2	Attempt statistical computation of errors in Analytical data	41[5],5[10]	1,2,6,7, 9	E	F
CLO-3	Understand various aspects and applications of AI in chemistry	4[15],5[10]	1,2,6,7, 9	U	P
CLO-4	Explain various techniques of analytical chemistry	4[15],5[10]	1,2,6,7, 9	E	M
CLO-5	Beware of intellectual property rights, their use and abuses	4[15],5[10]	1,2,6,7, 9	Ap	P

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**LITERATURE SEARCHING AND PREPARATION OF PROJECT REPORT**					
1.1	Sources of information– primary, Secondary and tertiary sources	1	1[10]	Lec	Quiz	1
1.2	Methods of collection of primary data, Sources of secondary data, Published sources and unpublished sources, Documents, Journals, Database –types	2	1[10]	Lec	Sem	1
1.3	Books, Newspapers, Library, Government documents, Conference proceedings, Dissertations, Thesis – components of thesis, evaluation, News groups, record keeping, reference	2	1[10]	BS	Ass	1
1.4	Internet, discussion groups, Overhead projector, use of OHP, transparency preparation	1	1[10]	TPS	Quiz	1
1.5	E–searching: Search techniques, Keywords, Boolean searching, combining words, database searching/ Truncation, wild card searching.	2	1[10]	Lcc	Sem	1
1.6	Science Search engines-SCIRUS, SCOPUS.	1	1[20]	Lec	Ass	1
1.7	Preparation of seminar topic, project report, Power point presentation, making power point slides	2	1[20]	TPS	Sem	1
1.8	Writing assignment – introduction, body, conclusion. International scientific conventions	1	1[10]	Lec	Quiz	1
II	**STATISTICAL ANALYSIS AND CHEMINFORMATICS**					
2.1	Errors-Types of errors, Sources and Minimization of determinate errors and indeterminate errors	2	2[10]	Lec	Quiz	2,3
2.2	Evaluation of analytical data–mean, median, mode, range, mean deviation, Relative mean deviation, Standard deviation, Precision and Accuracy - Problems	2	2[10]	BS	Sem	2,3
2.3	Curve fitting, methods of curve fitting – method of least squares, Confidence Limits, Tests of significance, Students t-test, F-test	2	2[20]	TPS	Ass	2,3

2.4	Regression Analysis and Correlation Analysis	1	2[10]	Lec	Quiz	2,3
2.5	Basics of Cheminformatics: Problems solved by cheminformatics, Difference between chem informatics and bioinformatics	1	2[10]	TPS	Sem	4,5
2.6	Molecular representation : coding the constitution, matrix representation, connection table, Line notation: WLN SMILES – rules of SMILES coding InChI, Query language – SMARTS: canonicalization, indexing, NP Complete	1	2[10]	BS	Sem	4,5
2.7	Molecular similarity – methods of representation: 2D and 3D representations – methods of 3D representations: Cartesian coordinate system, example CH4,Z-matrix system –example CH_2Cl-CH_2Cl	2	2[10]	Lec	Quiz	4,5
2.8	Chemical registration systems, Chemical structure drawing software- standalone applications- CACTVS, Chem Draw, Chem Sketch, JME Molecular Editor, Molecular Viewers	1	2[20]	BS	Ass	4,5
III	**ARTIFICIAL INTELLIGENCE AND ITS APPLICATIONS IN CHEMISTRY**					
3.1	Introduction-Definition- Role of AI in Chemistry	1	3(10)	TPS	Ass	6,7
3.2	Future of Artificial Intelligence in Chemistry, Machine learning in Chemistry	1	3(10)	GD	Sem	6,7
3.3	AI – Based Research tools in Chemistry,	1	3(10)	BS	Lec	6,7
3.4	Advantages and Limitations of AI in chemistry	1	3[10]	Lec	Sem	6,7
3.5	Applications of Artificial Intelligence In Drug Discovery	1	3(10)	BS	Qui	8,9
3.6	AI in Material Science, Chem informatics, Reaction Optimization, Spectroscopy and Analytical chemistry	2	3[10]	Lec	Ass	8,9
3.7	AI in Laboratory automation and Robotics, AI in Green Chemistry	2	3[10]	BS	Quiz	8,9
3.8	Ethical and Regulatory considerations of AI in Chemistry	1	3[10]	Lec	Sem	8,9
3.9	Techniques for explaining AI Predictions in Chemical Applications	2	3[10]	TPS	Ass	8,9
IV	**EXPERIMENTS IN ANALYTICAL CHEMISTRY**					
4.1	Spectro analytical Techniques: Calorimetry, Spectrophotometry.	3	4(20)	Lec	Qui	16

4.2	Flame Techniques: Flame Emission, Atomic Absorption	3	4(20)	TPS	Ass	17, 18
4.3	Light Scattering Techniques: Nephelometry, Turbidimetry	3	4(20)	BS	Sem	17, 18
4.4	Ultrasonic Interferometry: Magnetic Susceptibility-Quincke' s Method	3	4(30)	Lec	Qui	19, 20
V	**INTELLECTUAL PROPERTY RIGHTS AND PLAGIARISM**					
5.1	Introduction-Basic concepts in IPR-objectives	1	5[10]	Lec	Qui	10, 11
5.2	Types of IPR- patents, trademarks, copyrights, geographic indications, industrial designs, trade secrets, protection of new plant variety	2	5[10]	BS	Ass	10, 11
5.3	Concept related patents-Types of patent, Role of international organization, Indian patent act 1970, patentability, patent infringement, patent licensing	2	5[10]	TPS	Sem	10, 11, 12
5.4	Applications of IPR	1	5[20]	BS	Sem	10, 11, 12
5.5	Definition and types of Plagiarism-examples	1	5[10]	Lec	Ass	13, 14
5.6	Avoiding plagiarism- plagiarism analysis	2	5[10]	BS	Sem	13, 14
5.7	Plagiarism detection-Different methods and their citation analysis	1	5[10]	TPS	Qui	13, 14
5.8	Plagiarism checker software, Plagiarism control	2	5[20]	BS	Ass	13, 14

REFERENCES

1. F.W. Billmeyer, Textbook of Polymer Science, John Wiley and Sons, 1984
2. M.P. Stevens, Polymer Chemistry, Oxford University Press 1990.
3. V.R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Polymer Science, New Age International Pvt. Ltd. 2002.
4. Raymond B. Seymour, C.E. Carraher, Polymer Chemistry, Marcel Dekker Inc. 1992.
5. M.S. Bhatnagar, A text book of polymers, Vol. I, S. Chand and company Ltd, 2004.

DISCIPLINE SPECIFIC ELECTIVE COURSE -DSC-7
ANALYTICAL INSTRUMENTATION TECHNIQUES

Course Title: Analytical Instrumentation Techniques	Course Type: Theory Course Code: 23PCEN
Total Hours:60 Hours/Week: 5 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Dr.G.S.Praba Littis Malar	Dr.G.Allen Gnana Raj	Dr. A. Siva
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CLO-No.	Course Learning Outcomes (CLO) *Upon completion of this course, students will be*	% of PLO Mapping with CLO	CLO &PLO mapped with GA	Cognitive level (CL)	Knowledge category (KL)
CLO-1	To design chromatographic methods for identification of species.	7[10],8[10]	1,,4,5,7	U	C
CLO-2	To analyze different constituents through instrumental methods of analysis.	7[10],8[10]	1,,4,5,7	E	F
CLO-3	To evaluate different contaminants in materials using turbidimetry and conductivity measurements.	7[10],8[10]	1,,4,5,7	U	P
CLO-4	To design experiments for analysis of inorganic and organic materials.	7[10],8[10]	1,,4,5,7	E	M
CLO-5	To analyze constituents in materials using emission and absorption techniques.	7[10],8[10]	1,,4,5,7	Ap	P

Course Outline	**UNIT-I:** 1. Determination of the equivalent conductance of a weak acid at different concentrations and verifying Ostwald dilution law. Calculation of the dissociation constant of the acid. 2. Determination of the equivalent conductance of a strong electrolyte at different concentrations and examining the validity of the Onsager's theory as limiting law at high dilutions. 3. Conductometric titration of a mixture of HCl and CH_3COOH Vs NaOH. 4. Conductometric titration of NH_4Cl Vs NaOH. 5. Conductometric titration of CH_3COONa Vs HCl. 6. Potentiometric titration of a mixture of HCl and CH_3COOH Vs NaOH 7. Determination of pK_a of weak acid by EMF method. 8. Potentiometric titration of FAS Vs $K_2Cr_2O_7$ 9. Potentiometric titration of KI Vs $KMnO_4$. 10. Potentiometric titration of a mixture of Chloride and Iodide Vs $AgNO_3$. 11. Determination of the pH of buffer solution by EMF method using Quinhydrone and Calomel electrode. **12.** Study of the inversion of cane sugar in the presence of acid by Polarimetric method.
	UNIT-II: 1. Estimation of Fe, Cu and Ni by colorimetric method. 2. Estimation of Na and K by flame photometric method. 3. Determination of spectrophotometrically the mole ratio of the ferrithiocyanate complex and equilibrium constant for the complex formation. 4. Determination of the amount (mol/L) of ferricyanide present in the given solution using cyclic voltammetry. 5. Determination of the diffusion coefficient of ferricyanide using cyclic voltammetry. 6. Determination of the standard redox potential of ferri-ferrocyanide redox couple using cyclic voltammetry. 7. Estimation of the amount of sulphate present in the given solution using Nephelometric turbidimeter. 8. Estimation of the amount of nitrate present in the given solution using spectrophotometric method. 9. Heavy metal analysis in textiles and textile dyes by AAS 10. Determination of caffeine in soft drinks by HPLC 11. Analysis of water quality through COD, DO, BOD measurements. 12. Assay of Riboflavin and Iron in tablet formulations by spectrophotometry 13. Estimation of chromium in steel sample by

	spectrophotometry 14. Determination of Stern-Volmer constant of Iodine quenching by fluorimetry 15. Determination of ascorbic acid in real samples using Differential Pulse Voltammetry and comparing with specifications 16. Separation of (a) mixture of Azo dyes by TLC (b) mixture of metal ions by Paper chromatography 17. Estimation of chlorophyll in leaves and phosphate in waste water by colorimetry. 18. Estimation of Fe(II) by 1,10 phenonthroline using spectrophotometry
	UNIT-III: Interpretation and identification of the given spectra of various organic compounds arrived at from the following instruments 1.UV-Visible 2.IR 3.Raman 4.NMR 5.ESR 6.Mass etc.,
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	*1.* Vogel's Text book of Practical Organic Chemistry, 5th Ed, ELBS/Longman, England, 2003. 2. G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney, *Vogel's Textbook of Quantitative Chemical Analysis*; 6th ed., ELBS, 1989. 3. J. D. Woollins, *Inorganic Experiments*; VCH: Weinheim, 1995. 4. B. Viswanathan and P.S.Raghavan, Practical Physical Chemistry, Viva Books, New Delhi, 2009. 5.Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996.

Reference Books	1. N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Labmanual, S. Viswanathan Co. Pvt. Ltd, 2009. 2. J. N. Gurtu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 2011. 3. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001. 4. G.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th edition, McGraw Hill, 2009. 5. J. N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987.
Website and e-learning source	1. https://bit.ly/3QESF7t 2. https://bit.ly/3QANOnX

DISCIPLINE SPECIFIC ELECTIVE COURSE - (DSC 7)
INDUSTRIAL CATALYSIS

Course Title: Industrial Catalysis	Course Type: Theory Course code: 23PCEO
Total Hours: 60 Hours/Week: 4 Credits: 4	
Pass-Out Policy : Minimum Contact Hours: 36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]	

Course Creator	Expert 1	Expert 2
Ms.R.D Femitha	Dr.R.S.Jeba Jeevitha	Dr.J. Helen Rathna Monica,
Assistant Professor Scott Christian College (Autonomous) Nagercoil-629003	Assistant Professor Scott Christian College (Autonomous) Nagercoil-629003	Assistant Professsor of Chemistry, The American College(Autonomous), Madurai.
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CLO-No.	**Course Learning Outcomes (CLO)** *Upon completion of this course, students will be*	**% of PLO Mapping with CLO**	**CLO &PLO mapped with GA**	**Cognitive level (CL)**	**Knowledge category (KL)**
CLO-1	Learn the various types and aspects of catalysis in the industrial area	9[5],10[55]	1,8	U	F
CLO-2	Know the kinetics of catalysis, thereby controlling the rate of reaction.	9[5],10[55]	1,8	U	C

CLO-3	Have knowledge about theory of adsorption andelectronic structure in metals to effectively handle metals.	9[5],10[55]	1,8	An	P
CLO-4	Understand the zeolites catalysis and their nature.	9[5],10[55]	1,8	U	M
CLO-5	Have an in depth knowledge about petroleum cracking and catalyst for environmental protection.	9[5],10[55]	1,8	Ap	C

Mod	Course description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**CATALYSIS**					
1.1	Catalysis - types of catalysis, homogeneous and heterogeneous catalysis, characteristics of catalysis.	2	1[20]	Lec	Quiz	2
1.2	Adsorption - physical adsorption, potential theory, activated adsorption	2	1[20]	Lec	Quiz	2
1.3	Efficiency of catalyst in colloidal state.	2	1[20]	Lec	Quiz	1
1.4	Catalytic promoters, Catylitic poisons, Induced catalyst, Negative catalysis and Inhibition.	2	1[20]	Lec	Ass	1
1.5	Selectivity of catalyst, Active centers on catalyst surfaces	2	1[20]	GD	Sem	2
II	**ADSORPTION AND CATALYSIS**					
2.1	Adsorption and reaction rate, strength of adsorption band and catalysis	2	2[30]	Lec	Quiz	3
2.2	Experimental methods of determining gas adsorption- manometric method, gravimetric method.	2	2[20]	Lec	Sem	3
2.3	Surface films- Langmuirs' method- Application and limitations.	3	2[30]	BS	Ass	3
2.4	Kinetics of heterogeneous catalysis (diffusion controlling) –diffusion and reaction in pores	3	2[20]	Lec	Ess	3
III	**CATALYSIS BY METALS AND SEMICONDUCTORS**					
3.1	Electronic structure of metals –Molecular orbital approach	1	3[10]	Lec	Sem	1
3.2	Valence bond approach, Effect of electronic structure of metals on chemisorptions and catalysis.	1	3[10]	Lec	Quiz	1
	Blandinsmultiplet theory , boundary layer	2	3[20]	Lec	Ass	1

3.3	theory of chemisorptions and catalysis					
3.4	Wolkenstein's theory, electron transition in chemisorptions, equilibrium between various forms of chemisorption	2	3[20]	Lec	Ess	1
3.5	Catalysis by semiconductors, surface states and catalysis.	1	3[10]	GD	Quiz	2
3.6	Role of support – preparation and structure of supports.	1	3[10]	Lec	Sem	2
3.7	Silica, alumina, silica- alumina, carbon, monolithic supports.	1	3[10]	BS	Ass	2
3.8	Surface properties, catalyst manufacture size and shape, pretreatments, deactivation process -sintering, poisoning and fouling.	1	3[10]	Lec	Ess	2
IV	**ZEOLITES**					
4.1	Zeolites –General methods of manufacture, composition, structure, Zeolite A,X and Y	2	4[10]	Lec	Sem	5
4.2	Pentasil type zeolite –ZSM-5,ZSM-11 ,Active sites in zeolites	2	4[20]	Lec	Ass	5
4.3	Shape selective catalysis and Zeolites	2	4[20]	Lec	Ess	5
4.4	Determination of surface acidity of amorphous zeolites by IR method.	2	4[20]	GD	Quiz	5
4.5	Classification of zeolites on the basis of pore opening size- classification- primary building, secondary building units.	2	4[20]	Lec	Sem	5
4.6	Purpose of laboratory reactor-fluid bed reactor and tubular fixed bed reactors	2	4[10]	Lec	Ass	5
V	**PETROLEUM CRACKING**					
5.1	Cracking-catalytic cracking, steam cracking, hydro treatment-hydro cracking, hydro desulphurization.	3	5[20]	Lec	Quiz	4
5.2	Catalytic reforming, synthesis of hydrocarbon from synthesis gas-Fischer –Tropsch process	2	5[20]	BS	Sem	4
5.3	Conversion of methanol to gasoline hydrocarbon-purification of gasoline.	2	5[20]	Lec	Ass	4
5.4	Catalysis for environmental protection-removal of pollutant from exhausts, mobile and static sources, Effluent clean up analysis	3	5[20]	Lec	Ess	4
5.5	Application in the production of fertilizers, acetic acid, formaldehyde, washing powder , additives , pharmaceuticals	2	5[20]	Lec	Sem	4

REFERENCES

1. A .Clark, Theory of adsorption and catalysis, Academic Press, 1970.
2. E.K. Rideal , Concepts in Catalysis, Academic Press, 1968.
3. R. Pearce, W.R Patterson, Catalysis and Chemical Processes, Blackie and Sons Ltd., 1981.
4. J.M. Betty Applied Industrial Catalysis, Edn, Bruce E Leah, Academic Press, New York, 1983.
5. D.W. Breck , Zeolite Molecular Sieves, John Wiley ,New York ,1974.

DISCIPLINE SPECIFIC ELECTIVE COURSE DSC-8
BIOMOLECULES AND HETEROCYCLIC COMPOUND (23PCEP)

Course Title: BIOMOLECULES AND HETEROCYCLIC COMPOUND (23PCEP)	Course Type: Theory Course code: 23PCEP

Total Hours: 60 Hours/Week: 4 Credits: 4

Pass-Out Policy : Minimum Contact Hours: 36 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr.R.Ragel Mabel Saroja	DrG.Allen Gnana Raj	Dr.J. Helen Rathna Monica,
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CLO-No.	**Course Learning Outcomes (CLO)** *Upon completion of this course, students will be*	**% of PLO Mapping with CLO**	**CLO &PLO mapped with GA**	**Cognitive level (CL)**	**Knowledge category (KL)**
CLO-1	Learn the various types and aspects of catalysis in the industrial area	9[10],10[10]	1,8	U	F
CLO-2	Know the kinetics of catalysis, thereby controlling the rate of reaction.	9[10],10[10]	1,8	U	C
CLO-3	Have knowledge about theory of adsorption andelectronic structure in metals to effectively handle metals.	9[10],10[10]	1,8	An	P
CLO-4	Understand the zeolites catalysis and their nature.	9[10],10[10]	1,8	U	M
CLO-5	Have an in depth knowledge about petroleum cracking and catalyst for environmental protection.	9[10],10[10]	1,8	Ap	C

Mod	Course Description	Hours	%of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
I	**Chemistry and metabolism of carbohydrates:**					
1.1	Definition, classification and biological role of carbohydrates.	2	1[20]	Lec	Quiz	1,5
1.2	Monosaccharides: Linear and ring structures (Haworth formula) of ribose, glucose, fructose and mannose (structure determination not required), physical and chemical properties of glucose and fructose.	2	1[30]	Lec	Quiz	1,5
1.3	Disaccharides: Ring structures (Haworth formula) –occurrence, physical and chemical properties of maltose, lactose and sucrose.	1	1[20]	GD	Ass	1,5
1.4	Polysaccharides: Starch, glycogen and cellulose – structure and properties, glycolysis of carbohydrates.	1	1[30]	Lec	Ess	1,5
II	**Steroids and Hormones**:					
2.1	Steroids-Introduction, occurrence, nomenclature, configuration of substituents.	2	2[20]	Lec	Quiz	4
2.2	Diels'hydrocarbon, stereochemistry, classification, Diels' hydrocarbon, biological importance, colour reactions of sterols,	2	2[30]	Lec	Ass	4
2.3	Cholesterol- occurrence, tests, physiological activity, biosynthesis of cholesterol from squalene.	3	2[30]	BS	Quiz	4
2.4	Hormones-Introduction, classification, functions of sex hormones- androgens and estrogens, adrenocortical hormones- cortisone and cortisol structure and functions of non-steroidal hormones- adrenaline and thyroxin.	3	2[20]	GD	Sem	4
III	**Proteins and nucleic acids:**					
3.1	Separation and purification of proteins – dialysis, gel filtration and electrophoresis.	2	3[20]	Lec	Qui	1,3
3.2	Catabolism of amino acids - transamination, oxidative deamination and decarboxylation.	3	3[20]	Lec	Qui	1,3

3.3	Biosynthesis of proteins: Role of nucleic acids. Amino acid metabolism and ureacycle.	2	3[10]	GD	Sem	1,3
3.4	Structure, methods for the synthesis of nucleosides - direct combination, formation of heterocyclic base and nucleoside modification, conversion of nucleoside to nucleotides.	3	3[10]	Lec	Ass	1,3
3.5	Primary and secondary structure of RNA and DNA, Watson-Crick model,	2	3[30]	Lec	Sem	1,3
3.6	Solid phase synthesis of oligo nucleotides.	2	3[10]	GD	Ass	1,3
IV	**BIOSYNTHESIS OF NATURAL PRODUCTS**					
4.1	Introduction to Biosystems -Concept of biosynthesis and biogenesis.	1	5[10]	lec	Sem	4
4.2	Biosynthesis of alkaloids - tropane alkaloids - cocaine and tropine.	1	5[20]	Lec	Sem	4
4.3	Biosynthesis of steroids – cholesterol and Bile acids.	2	5[20]	BS	Quiz	4
4.4	Biosynthesis of terpenoids – monoterpenoids – α pinene, and α terpineol.	1	5[10]	TPS	Sem	4
4.5	Biosynthesis of carbohydrates – sucrose and starch.	2	5[20]	Lec	Qui	4
4.6	Biosynthesis of lipids and fatty acids.	1	5[10]	BS	Sem	4
V	**Fused Ring Heterocyclic Compounds:**					
5.1	Benzofused five membered rings: Indole, isoindole, benzofuran and benzothiophene, Preparation and properties.	2	5[40]	Lec	Ass	2,6
5.2	Benzofused six membered rings: Quinoline and isoquinoline: Preparation by ring closure reactions,	2	5[40]	Lec	Sem	2,6
5.3	Reactions: Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions	1	5[20]	GD	Ass	2,6

Recommended Text	T. K Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH, North America,2007. I. L. Finar, Organic Chemistry Vol-2, 5th edition, Pearson Education Asia, 1975. V. K. Ahluwalia and M. Goyal, Textbook of Heterocyclic compounds, Narosa Publishing, New Delhi,2000. M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2014. V. K. Ahluwalia, Steroids and Hormones, Ane books pub., New Delhi,2009.

Reference Books	I. L. Finar, Organic Chemistry Vol-1, 6th edition, Pearson Education Asia, 2004. Pelletier, Chemistry of Alkaloids, Van Nostrand Reinhold Co, 2000. Shoppe, Chemistry of the steroids, Butterworthes,1994. I. A. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad,2004. M. P. Singh. and H. Panda, Medicinal Herbs with their formulations, Daya Publishing House, Delhi,2005. O.P. Agarwall, Organic Chemistry Natural Products, Krishna Prakashan media (p), Ltd, Meerut, 2008.
Website and e-learning source	tps://www.organic-chemistry.org/ tps://www.studyorgo.com/summary.php tps://www.clutchprep.com/organic-chemistry

Add on Course - Role of Chemistry in industry

Course Title:	**Role of Chemistry in Industry**	Course Type: **Theory** Course Code :
Total Hours: 30 Credits: 1	Hours/Week: 2	
Pass-Out Policy: Minimum Contact Hours: 18 Total Score %: 100 Internal: 40 External: 60 Minimum Pass %: 50 [No Minimum for Internal]		
Course Creator:	**Expert 1:**	**Expert 2:**
Dr.R.D.Femitha,	Dr.A.Jeena Pearl,	Dr.T.F.Abbs Fen Reji
Assistant Professor	Assistant Professor	Associate Professor
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CLO No.	Expected Learning Outcomes Upon completion of this course, students will be able to	% of PLO Mapping with CLO	CLO & PLO Mapping with GA#	Cognitive Level (CL)	Knowledge Category (KC)
CLO-1	To understand paint and its components	5(12),6(8)	1,3,2,7	An	M,F,C

CLO-2	Understand the chemistry involved in Rubber Industry	5(12),6(8)	1,3,2,7	U	F,C
CLO-3	Identify the use of chemicals in Petrochemical industries	5(12),6(8)	1,3,2,7	R	M,C
CLO-4	To learn about sugar industry	5(12),6(8)	1,3,2,7	R	M,C
CLO-5	To know about ceramic and glass industry	5(12),6(8)	1,3,2,7	R	M,C

I	**PAINT INDUSTRY**
1.1	Characteristics of paints - constituents of paints and their functions
1.2	Emulsion paints, Luminescent paints, Fire retardant paints,
1.3	Outline of the preparation of white lead, lithopone, titanium dioxide,
1.4	Ultramarine blue, red lead, chrome green
1.5	Varnish - general characteristics, types - enamel, properties - emulsion - water based paints
II	**RUBBER INDUSTRY**
2.1	Natural rubber - latex - natural rubber processing
2.2	Vulcanization - compounding, materials used in compounding
2.3	Synthetic rubber - properties and uses of nitrile rubber, BUNA-S, neoprene, butyl rubber, polysulphide rubber,
2.4	Chlorosulphonated polyethylene rubber, polyurethane rubber, silicone rubber -
2.5	Manufacturing process of rubber products
III	**PETROLEUM AND PETROCHEMICAL INDUSTRY**
3.1	Refining of petroleum, composition and uses of main petroleum fractions
3.2	Gasoline - Cracking - thermal, catalytic - Advantages of catalytic cracking
3.3	Polymerization - knocking - octane rating - antiknock agents -
3.4	Diesel - diesel knock and cetane rating - antidiesel knock agents
3.5	Petrochemicals - preparation of vinyl acetate caprolactum, naphthalene, linear alkyl benzenes and their sulphates
IV	**SUGAR INDUSTRY**
4.1	Manufacture of sugar from molasses and beetroot – sugar industries in India.
4.2	Fermentation: Manufacture of spirits and wines
4.3	Distillation: Manufacture of vinegar and ethyl alcohol.
4.4	Double sulphitation process, refining and grading of sugar
4.5	Saccharin: synthesis and use as a sugar substitute - aspartame
V	**CERAMIC AND GLASS INDUSTRY**
5.1	Introduction, general properties, classification of ceramic products, raw materials for ceramics

5.2	Outline of manufacturing process - glazing, colouring,
5.3	Manufacture of ceramic products - white ware, porcelain, sanitary ware,
5.4	Advanced polymer based ceramic products, ceramic coating
5.5	Glass: definition, composition of glass, glass manufacturing process, different types of glasses, application of glasses.

Reference Books:

1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi.
4. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
5. P. C. Jain & M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
7. B. K. Sharma: Engineering Chemistry, Goel Publishing House, Meerut

Computational Softwares for Chemists

Objectives:

To impart skills on use of various chemistry tools that are essential for any student with chemistry as a major subject.
To learn the techniques of molecular simulations which will enhance the students' employability in academia and industry.

UNIT I - BASICS

Basic idea of Molecular Modelling – A brief introduction about computational methods and their applications in chemistry – Basic terminologies used in computational methods (relevant to the exercises given in UNIT II). Computing software - introduction and stepwise approach to Chemdraw, ACD/Chemsketch, Argus Lab, AVOGADRO, Molinspiration, preADMET, SwissADME, SwissDock, 1 – Click online server, Autodock, and Crystal Explorer. Origin for analytical data analysis.

[Compulsory Lectures and training includes entire process of downloading and installation of the software]

UNIT II - HANDS ON EXERCISES

Chemistry related activities done by using basic softwares which are usefulfor chemists and learners of chemistry.

Section A: Structure of Molecules and Reaction Schemes

Use **Chemdraw or ACD/Chemsketch**. [All Experiments should be Completed]

1. A Simple Molecule with any one functional group
2. A molecule with more than one functional groups
3. An aromatic compound
4. An alkaloid and a terpenoid
5. An amino acid
6. A simple peptide/protein
7. A simple Polymer

8. A simple reaction
9. Mechanism for any chemical reaction – minimum 3 steps or 5 transitions/conversions

Section B: Calculation of Chemical and Reaction Properties

Use **Argus Lab or ACD/Chemsketch or Avogadro Molecular Editor or Gaussian software**.[Minimum 8 experiments should be completed]

1. Geometry optimization and single point energy calculations of simple organic molecules.
2. Calculation of energy gap between HOMO and LUMO in simple molecules and visualization of molecular orbitals.
3. Calculation of dipole moment in polar organic molecules.
4. Calculation of electrostatic charges of atoms in organic molecules using population analysis.
5. Calculation of Resonance energy of aromatic compounds.
6. Prediction of the stability of ortho, meta, para products of nitration of aromatic ring using computational chemistry calculations.
7. Calculation of IR stretching frequencies of groups and visualization of normal modes of vibration in organic molecules.
8. Calculation of dimerization energy of carboxylic acids.
9. Perform the conformational analysis of butane using potential energy scan.
10. Find the transition state of simple organic reactions and plot the reaction profile.
11. Determination of heat of hydration of organic molecules.
12. Find the Gibbs free energy of simple gaseous phase reactions and calculate equilibrium constant.
13. Spectral analysis (UV, IR and NMR) of simple organic molecules.
14. Calculation of pKa of simple organic molecules and compare it with experimental values.
15. Calculation of electrophilicity index in hard-soft acids and bases.

Section C: Prediction of molecular properties, bioactivity and drug analysis[One example in all 5 predictions]

1. Calculation of molecular properties and bioactivity of the simple drug molecules like aspirin, paracetamol, and the drugs of your choices using the online server molinspiration.
2. Prediction of drug likeliness, ADME and Toxicity of the drug classes like antibiotics, antihistamines, anesthetics and drug molecules of your choice using online serverspreADMET or SwissADME or SwissDock.

Section D: Molecular Docking of Drug molecules, Crystal Studiesand Origin

[One docking and origin graph compulsory]

1. Perform molecular docking of your choice using 1-click docking online server tool at mcule.com. Website: https://mcule.com/. First register at the site and perform molecular docking. Similarly, Autodock tools or AutodockVina or Argus Lab can be used for molecular docking.
2. Learn to generate Hirshfeld surfaces, study the interaction energies and draw the electrostatic potential map using Crystal Explorer Software.
3. Draw types of graphs using Origin software. Complete some analytical calculations which you have come across in your UG and PG Chemistry syllabus.