Department of Chemistry

B.Sc. (Hons.) Chemistry
Curriculum and Syllabus

(Applicable to the students admitted during AY: 2022-23)

School of Engineering and Sciences
SRM University *AP*, Andhra Pradesh

Department Vision

To emerge as a world-class research and teaching department which equips students with creative thinking and social skills to positively impact the scientific community, industry, and society by generating new knowledge and fostering innovations.

Department Mission

1. Deliver high-quality education at various levels to promote a deep understanding of chemical principles.
2. Contribute to scientific knowledge and industry through cutting-edge chemistry research.
3. Create an atmosphere that encourages innovation and entrepreneurship, leading to the development of modern technologies and applications.

Program Educational Objectives (PEO)

1. Equip graduates with a comprehensive understanding of the fundamental principles of chemical sciences and prepare them to enter the real world to take up the profession of their passion.
2. Train the graduates to design and conduct experiments, analyse data, make scientific observations and interpret to bring out their impactful innate skills for the benefit of society.
3. To develop critical thinking and to prepare graduates for careers in various fields, including research, industry, education, and innovation, by offering opportunities for internships, and research projects.

Mission of the Department to Program Educational Objectives (PEO) Mapping

	PEO 1	PEO 2	PEO 3
Mission Statement 1	3	1	2
Mission Statement 2	3	3	2
Mission Statement 3	2	1	3

Program Specific Outcomes (PSO)

1. Illustrate core chemical concepts, principles, chemical reactions, mechanisms at a molecular level, analytical techniques, and their applications.
2. To provide an in-depth training to gain expertise in laboratory techniques, including handling of chemicals, use of instrumentation, data collection, and analysis.
3. Train them to present scientific ideas and findings effectively through written reports, and oral presentations.

Mapping Program Educational Objectives (PEO) to Program Learning Outcomes (PLO)

Program Learning Outcomes (PLO)															
PEOs	POs												PSOs		
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
PEO 1	3	3	1	3	2	1	1	1	3	1	3	2	3	3	1
PEO 2	1	2	1	3	3	3	3	3	2	1	2	2	3	2	1
PEO 3	3	3	3	1	1	1	1	1	2	1	3	3	2	3	3

Category Wise Credit Distribution			
Course Sub-Category	**Sub-Category Credits**	**Category Credits**	**Learning hours**
Ability Enhancement Courses (AEC)		6	180
University AEC	0		
School AEC	6		
Value Added Courses (VAC)		4	120
University VAC	4		
School VAC	0		
Skill Enhancement Courses (SEC)		13	390
School SEC	13		
Department SEC	0		
SEC Elective	0		
Foundation / Interdisciplinary courses (FIC)		25	750
School FIC	25		
Department FIC	0		
Core + Core Elective including Specialization (CC)		80	2400
Core	60		
Core Elective (Inc Specialization)	20		
Minor (MC) + Open Elective (OE)	18	18	540
Research / Design / Internship/ Project (RDIP)		17	510
Internship / Design Project / Startup / NGO	5		
Internship / Research / Thesis	12		
Total		**163**	**4890**

Semester wise Course Credit Distribution Under Various Categories										
Category	**Semester**									
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**	**%**
Ability Enhancement Courses - AEC	0	4	2	0	0	0	0	0	6	4
Value Added Courses - VAC	0	0	0	0	0	4	0	0	4	2
Skill Enhancement Courses - SEC	1	2	2	2	3	3	0	0	13	8
Foundation / Interdisciplinary Courses - FIC	20	5	0	0	0	0	0	0	25	15
CC / SE / CE / TE / DE / HSS	0	8	12	16	16	16	12	0	80	49
Minor / Open Elective - OE	0	3	3	3	3	3	3	0	18	11
(Research / Design / Industrial Practice / Project / Thesis / Internship) - RDIP	0	0	0	0	0	0	5	12	17	10
Grand Total	**21**	**22**	**19**	**21**	**22**	**26**	**20**	**12**	**163**	**100**

Note: L-T/D-P/Pr and the class allocation is as follows.

a) Learning Hours : 30 learning hours are equal to 1 credit.

b) Lecture/Tutorial : 15 contact hours (60 minutes each) per semester are equal to 1 credit.

c) Discussion : 30 contact hours (60 minutes each) per semester are equal to 1 credit.

d) Practical : 30 contact hours (60 minutes each) per semester are equal to 1 credit.

e) Project : 30 project hours (60 minutes each) per semester are equal to 1 credit.

SEMESTER - I								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	FIC	S FIC	BIO 114	A Primer to Biology	3	0	0	3
2	FIC	S FIC	BIO 114L	Practical Biology	0	0	2	1
3	FIC	S FIC	CHE 115	Introduction to Chemistry	3	1	0	4
4	FIC	S FIC	CSC 108	Introduction to computer science and programming using C	3	0	0	3
5	FIC	S FIC	CSC 108L	Introduction to Computer Science and Programming Using C Lab	0	0	2	1
6	SEC	S SEC	ISES 101	Industry Specific Employability Skills-I	0	0	1	1
7	FIC	S FIC	MAT 104	Introduction to Mathematics	4	0	0	4
8	FIC	S FIC	PHY 103	Introduction to Physics	3	0	0	3
9	FIC	S FIC	PHY 103L	Introduction to physics lab	0	0	2	1
				Semester Total	**17**	**1**	**6**	**21**

SEMESTER - II								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	AEC	S AEC	EGL 100	Introduction to Communicative English	4	0	0	4
2	SEC	S SEC	ENTR 100	Exploratory Learning and Discovery	0	0	1	1
3	FIC	S FIC	ENV 100	Environmental sciences	4	0	0	4
4	SEC	S SEC	ISES 102	Industry Specific Employability Skills - II	1	0	0	1
5	SEC	S SEC	RM 100	Introduction to Research	1	0	0	1
6	Core	CC	CHE 113	Physical Chemistry - I	4	0	0	4
7	Core	CC	CHE 114	Inorganic Chemistry - I	4	0	0	4
8	Elective	OE	BIO 215	Biomolecules	3	0	0	3
				Semester Total	**21**	**0**	**1**	**22**

SEMESTER - III								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	AEC	U AEC	AEC 108	Problem-Solving Skills	1	0	1	2
2	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2*
3	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2*
4	SEC	D SEC	SEC 102	Digital Literacy	1	1	0	2
5	Core	CC	CHE 201	Fundamentals of Organic Chemistry	3	0	1	4
6	Core	CC	CHE 202	Chemistry of Elements	3	0	1	4
7	Core	CC	CHE 203	Chemical Thermodynamics and Chemical Kinetics	3	0	1	4
8	OE	OE	OE	Open Elective / Minor	3	0	0	3
				Semester Total	**16**	**1**	**8**	**19**

SEMESTER - IV								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2*
2	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2*
3	SEC	D SEC	SEC 106	Leadership for Professionals	2	0	0	2
4	Core	CC	CHE 204	Basic Concepts in Analytical Chemistry	3	1	0	4
5	Core	CC	CHE 205	Transition Metal and Bioinorganic Chemistry	3	0	1	4
6	Core	CC	CHE 206	Chemistry of Functional Groups in Organic Molecules: Structure and Reactivity	3	0	1	4
7	Core	CC	CHE 207	Chemistry of Solutions	3	0	1	4
8	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**17**	**1**	**7**	**21**

SEMESTER - V								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2*
2	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2*
3	SEC	E SEC		Career Skills - I	3	0	0	3
4	Core	CC	CHE 301	Aromatic Compounds and Heterocycles	3	0	1	4
5	Core	CC	CHE 302	Spectroscopy and Statistical Thermodynamics	4	0	0	4
6	Core	CC	CHE 303	Principles of Instrumental Analysis	4	0	0	4
7	Core	CC	CHE 304	An Introduction to Quantum Chemistry	4	0	0	4
8	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**21**	**0**	**1**	**22**

SEMESTER - VI								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2
2	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2
3	SEC	E SEC		Career Skills - II	3	0	0	3
4	Core	CC	CHE 305	Introduction to Modern Organic Synthesis	3	1	0	4
5	Core	CC	CHE 306	Supervised Learning	0	0	4	4
6	Elective	CE	CHE 331	Polymer Materials	4	0	0	4
7	Elective	CE	CHE 332	Structural Methods and Analysis	4	0	0	4
8	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**17**	**1**	**8**	**26**

SEMESTER - VII								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Elective	CE	CHE 433	Selected Topics in Organic Synthesis	4	0	0	4
2	Elective	CE	CHE 434	Chemistry on Computers: Molecular Modelling	4	0	0	4
3	Elective	CE	CHE 435	Chemistry in Life and Medicine	4	0	0	4
4	RDIP	RDIP	CHE 401	Project - I	0	0	5	5
5	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**15**	**0**	**5**	**20**

SEMESTER - VIII								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	RDIP	RDIP	CHE 402	Project II	0	0	12	12
				Semester Total	**0**	**0**	**12**	**12**

Core Elective								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Elective	CE	CHE 331	Polymer Materials	4	0	0	4
2	Elective	CE	CHE 332	Structural Methods and Analysis	4	0	0	4
3	Elective	CE	CHE 433	Selected Topics in Organic Synthesis	4	0	0	4
4	Elective	CE	CHE 434	Molecular Modelling	4	0	0	4
5	Elective	CE	CHE 435	Chemistry in Life and Medicine	4	0	0	4

Open Electives								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	OE	OE	CHE 241	Principles of Chemistry - I	3	0	0	3
2	OE	OE	CHE 253	Principles of Chemistry - II	3	0	0	3
3	OE	OE	CHE 252	Introduction to Computational Chemistry	3	0	0	3
4	OE	OE	CHE 242	Fundamental of Nanoscience	3	0	0	3
5	OE	OE	CHE 245	Renewable Energy	3	0	0	3
6	OE	OE	CHE 246	Environmental Chemistry	3	0	0	3
7	OE	OE	CHE 250	Supramolecular Architectures: Engineering Logic Gates, Sensors, Devices and Machines	3	0	0	3
8	OE	OE	CHE 251	Chemistry in Machines, Materials and Computers	3	0	0	3

Career Skills Courses								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	SEC	E SEC	SEC 130	Career Skills for Life Sciences	3	0	0	3

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

A Primer to Biology

Course Code	BIO 114	**Course Category**	Core Course (CC)	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Department of Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- Understanding the importance of studying biology and the evolution of complex biomolecules and life on Earth provides a foundation for science students to appreciate the biological principles and systems that utilise many fundamental processes from other branches of natural sciences.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	Explain the importance of studying biology and the evolution of complex biomolecules and life on Earth.	2	80%	75%
Outcome 2	Explain the structure and functions of prokaryotic and eukaryotic cells, including organelles, and recognize the diversity of life.	2	80%	70%
Outcome 3	Describe membrane transport processes, cellular respiration, energy generation, photosynthesis, enzymes, vitamins, and hormones.	2	80%	70%
Outcome 4	Describe the structure and organization of DNA and chromosomes, and comprehend the central dogma of DNA replication, transcription, and translation.	2	75%	70%
Outcome 5	Explain the principles and applications of genomics, transcriptomics, proteomics, and metabolomics.	2	75%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1		1							3			3	1	2
Outcome 2	2	3								3			3	3	2
Outcome 3	2	3	2	2					1				3	2	3
Outcome 4	2	3	2	2						3		2	3	2	2
Outcome 5	2	3		3	1	2			1			3	3	2	3
Course Average	**1.8**	**3**	**1.7**	**2.3**	**1**	**2**			**1**	**3**		**2.5**	**3**	**2**	**2.4**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**Life: Origin, composition and chemistry**	**5**		
	Origin of complex Biomolecules and primitive cells	1	1	1, 2
	Chemical basis of life	1	1	1, 2
	Importance of carbon - synthesis by polymerization; importance of self assembly;	1	1	1, 2
	Importance of Water- synthesis by polymerization; importance of self assembly;	1	1	1, 2
	Selectively permeable membranes	1	1	1, 2
Unit 2	**Cell Biology**	**12**		
	Prokaryotes and eukaryotes (cell structures and organelles);	2	1, 2	1, 2
	Virus- lysogenic and lytic cycles;	3	2	1, 2
	Bacteria- typical bacterial cells, bacterial gene transfer- conjugation, transformation, and transduction	3	2	1, 2
	Antibiotic resistance- an emerging threat; Microbiome	3	2	1, 2
	Cell cycle- mitosis and meiosis.	1	2	1, 2
Unit 3	**Energy harvesting reactions by life forms**	**10**		
	The importance of energy in biological systems; Gibbs free energy ($\triangle$ G);	2	1,3	1, 2
	Biological reactions: Enzymes and their equilibrium constants (Keq);	2	3	1, 2
	Energy harvesting: Chemotrophic, Phototrophic;	2	3	1, 2
	Metabolism: Glycolysis, anaerobic and aerobic cellular respiration.	2	3	1, 2
	Fate of food in cellular energy cycle.	2	3	1, 2
Unit 4	**Molecular Biology**	**9**		
	Structure of DNA and organization of chromosomes;	2	4	1, 2
	Central dogma- replication, transcription, and translation in prokaryotes.	3	4	1, 2
	Mutations, cancer and hereditary diseases.	2	4	1, 2
	Introduction to genetic manipulation- concepts of restriction digestion, cloning	2	4	1, 2
Unit 5	**Bioinformatics**	**9**		
	Biological sequences and evolution of sequencing technologies.	3	5	3
	Utilization of sequence information in personalized medicine and disease detection.	3	5	3
	Structural Biology: Biomolecular structures and their databases.	3	5	3
Total Contact Hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (15%)	
		Th	Th	Th	Th	Th
Level 1	Remember	100%	100%	100%	100%	100%
	Understand					
Level 2	Apply					
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Becker's World of the Cell, Global Edition, 9th Edition (2017). Jeff Hardin, Gregory Paul Lewis J. Kleinsmith. Pearson
2. Life: The Science of Biology, 11th Edition (2017). David Sadava, David M. Hillis, H. Craig Heller, Sally D. Hacker. SINAUER ASSOCIATES MACMILLAN.
3. Introduction to Bioinformatics (Chapman & Hall/CRC Computational Biology Series) (2006) by Anna Tramontano.

Other Resources

1. No data given

Course Designers

1. All Faculty Members, Department of Biological Sciences, SRM University – AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Practical Biology

Course Code	BIO 114L	Course Category	Core Course (CC)	L	T	P	C
				0	0	2	1
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Biological Sciences	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Understand and implement lab safety rules and proficiently handle micropipettes and pH meters for secure laboratory practices.
- Develop skills in buffer preparation and gain familiarity with basic laboratory instruments, including microscopes, autoclaves, spectrophotometers, centrifuges, incubators, and laminar air-flow cabinets.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Demonstrate a thorough understanding of lab safety protocols and proficiently handle essential laboratory equipment, ensuring a secure working environment.	3	80%	75%
Outcome 2	Develop precision in using micropipettes and pH meters, successfully prepare buffers and growth media, and acquire skills in observing mitosis stages in onion root tips and thin plant specimens under a microscope.	3	70%	65%
Outcome 3	Gain competence in the operation and safety procedures of fundamental laboratory instruments, including microscopes, autoclaves, spectrophotometers, centrifuges, incubators, and laminar air-flow cabinets.	3	70%	65%
Outcome 4	Acquire practical expertise in culturing microorganisms from various sources (air, soil, coins, and skin), observe the preparation of growth media and plates through a demonstration, and master cell counting using a hemocytometer.	3	70%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	3		1		3	3			3	1	3
Outcome 2	3	2	3	3	3		1	1	3				3	3	2
Outcome 3	3	3	3	3	3		1		3	3			3	3	3
Outcome 4	3	2	3	3	3		1	1	3	3			3	3	2
Average	**3**	**2.3**	**3**	**3**	**3**		**1**	**1**	**3**	**3**			**3**	**2.5**	**2.5**

Course Unitization Plan

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	Lab safety introduction Handling micropipettes and pH meter	5	1	1
2.	Preparation of buffers; Introduction to basic instrumentation: microscope, autoclave, spectrophotometer, centrifuge, incubators, and laminar air-flow cabinets	5	2	1
3.	Observing stages of mitosis in onion root tip. Observing thin specimens of plant samples under the microscope	5	3,4	1
4.	Preparation of growth media and plates (demonstration)	5		
5.	Culturing microorganisms from air, soil, coins, and skin	5	3,4	1
6.	Cell counting using hemocytometer	5	3,4	1
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			End Semester Exam (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember	50%		50%	50%
	Understand				
Level 2	Apply	50%	100%	50%	50%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Practical Manual of Biochemistry. Sattanathan, Padmapriya, Balamuralikrishnan.

Other Resources

1. https://amrita.edu/course/biochemistry-practical/

Course Designers

1. Dr. Anil K Suresh, Associate Professor, Department of Biological Sciences, SRM University – AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Chemistry

Course Code	CHE 115	**Course Category**	Foundation Course	**L**	**T**	**P**	**C**
				3	1	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Chemistry	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- To distinguish the types of bonding and predict the shape of the molecules using the valence shell electron pair (VSEPR) model and molecular orbital (MO) theory.
- To classify the states of matter and discuss their behavior and properties.
- To explain the redox reactions and demonstrate their applications in the electrochemical cells
- To explain the classification, nomenclature, and electronic properties of organic compounds.
- To describe the different types of organic reactions and their purification techniques.
- To discuss the structures and the properties of carbohydrates, amino acids, proteins and vitamins, and nucleic acids and list the toxicity of the metals

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Distinguish the types of bonding and predict the shape of the molecules using the valence shell electron pair (VSEPR) model and molecular orbital (MO) theory.	2	80%	85%
Outcome 2	Classify the states of matter and their behavior and properties	2	80%	80%
Outcome 3	Explain the redox reactions and demonstrate their application in the electrochemical cells.	3	80%	75%
Outcome 4	Classify electronic properties of organic compounds and reactions.	2	80%	70%
Outcome 5	Discuss the structures and the properties of carbohydrates, amino acids, proteins and vitamins, nucleic acids and can list the toxicity of the metals.	2	80%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	2	2		2	2	1	3	2	2	2	2	2	2
Outcome 2	2	2	2	1		2	2	1	1	3	2	2	2	2	2
Outcome 3	2	2	1	1		2	3	3	3	3	2	1	2	2	1
Outcome 4	2	3	2	2		2	2	1	3	2	2	1	2	2	3
Outcome 5	2	2	1	1		2	3	3	2	2	2	1	2	2	2
Average	**2**	**2**	**2**	**1**		**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Chemical Bonding and Molecular Structure**	**8**		
	Importance and scope of chemistry (Central Science)	1	1	2
	Valence electrons, ionic bond, covalent bond, Hydrogen bond	1	1	2
	Valence bond theory	1	1	2
	The geometry of covalent molecules	1	1	
	VSEPR theory	1	1	2
	The concept of hybridization involving *s, p,* and *d* orbitals	1	1	2
	Shapes of some simple molecules	1	1	2
	Molecular orbital theory of homonuclear diatomic molecules (qualitative idea only)	1	1	2
	Tutorial 1	3	1	2
Unit 2	**States of Matter**	**12**		
	Three states of matter, intermolecular interactions Gases: The behavior of gases, changes in the volume of a gas with pressure; Boyle's law	1	2	1
	Change in volume of a gas with temperature; Charles's law	1	2	1
	Gay Lussac's law, Avogadro's law, Ideal gas law	1	2	1
	Empirical derivation of gas equation, Kinetic molecular theory	1	2	1
	Deviation from ideal gas law.	1	2	1
	Liquids – Liquid State – Vapour pressure, viscosity, and surface tension	1	2	1
	Introduction to solutions, different types of solutions	1	2	1
	Raoult's Law (change of state),	1	2	1
	Constant boiling mixtures (azeotropic mixtures (distillation)	1	2	1
	Nature and different types of solids including covalent, non-covalent ionic, and metallic solids	1	2	1
	Solids and their bonding, Band theory	1	2	1
	Application of crystalline materials in electronic devices.	1	2	1
	Tutorial 2	3	1	1
Unit 3	**Redox Reactions**	**8**		
	Concept of oxidation and reduction, redox reactions	1	3	2
	redox reactions	1	3	2
	Oxidation number, balancing redox reactions in terms of loss and gain of electron and change in oxidation numbers	1	3	2
	Applications of redox reactions	1	3	2
	Nomenclature applicable to electrochemical cells, viz., electromotive force, electrochemical series.	2	3	2
	Evolution of electrochemical cells: from voltaic cells to Li-ion battery	2	3	2
	Tutorial 3	3	3	2
Unit 4	**Basic Principles of Organic Chemistry**	**12**		
	General introduction, classification	1	4	3,4
	IUPAC nomenclature of organic compounds.	2	4	3,4
	Electronic displacements in a covalent bond	1	4	3,4
	Inductive effect, electrometric effect, resonance, and hyperconjugation	2	4	3,4
	Homolytic and heterolytic fission of a covalent bond	1	4	3,4
	Free radicals, carbocations, carbanions	1	4	3,4
	Electrophiles and nucleophiles	1	4	3,4
	Types of organic reactions	1	4	3,4
	Purification methods: Qualitative and quantitative analysis	2	4	3,4
	Tutorial 4	3	4	3,4
Unit 5	**Chemistry of Life**	**5**		
	Carbohydrates, Amino acids, peptide bonds	1	5	3,4
	Secondary and tertiary structures of proteins, enzymes, vitamins, Nucleic acids, bioinorganic chemistry	2	5	3,4
	Toxicity of heavy metals (Cu, Fe, As, Pb, Hg, Co, Cr, Cd, etc.),	2	5	3,4
	Tutorial 5	3	5	3,4
	Total Contact Hours	**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (15%)	CLA-3 (10%)	
Level 1	Remember	40%	60%	40%	60%	30%
	Understand					
Level 2	Apply	60%	40%	60%	40%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Peter Atkins, & Paula, J. de. Elements of Physical Chemistry 7th Ed., Oxford University Press (2014).
2. Concise Inorganic Chemistry: J.D. Lee (1999) 5th edition, Blackwell Science.
3. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.

Other Resources

1. -

Course Designers

1. Dr. Mahesh Kumar Ravva, Asst. Professor, Dept. of Chemistry, SRM University – AP.
2. Dr. Pardha Saradhi Maram, Assoc. Professor, Dept. of Chemistry, SRM University – AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Computer Science and Programming Using C

Course Code	CSC 108	**Course Category**	Core Course (CC)	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- Gain basic knowledge in C programming language.
- Acquire knowledge on Decision making and functions in C.
- Learn arrays, strings and pointers concept in C.
- Understand the basics concepts of Structures, Union and File handling techniques using C Programming.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe C structures, enumerators, keywords, header files and operators	2	75 %	70%
Outcome 2	Illustrate Decision-Making statements and Functions.	3	70 %	65%
Outcome 3	Interpret arrays, strings, and pointers programming in C	3	70 %	65%
Outcome 4	Apply Structures, unions, File handling operations on different scenarios	3	70 %	65%
Outcome 5	Solve given projects based on C concepts	4	70 %	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	1									2	2	3
Outcome 2	3	3	2	1									3	2	3
Outcome 3	3	3	2	2									3	2	3
Outcome 4	3	3	2	2									3	2	3
Outcome 5	3	3	2	2								2	3	2	2
Average	**3**	**3**	**2**	**2**								**2**	**3**	**2**	**3**

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**INTRODUCTION TO COMPUTER SCIENCE**	**9**	1	1
	Fundamentals of Computing, Historical perspective, Early computers	2	1	1,2
	Computing machine. Basic organization of a computer: ALU, input-output units, memory, program counter - variables and addresses - instructions: store, arithmetic, input and output	2	1	1,2
	Problem solving: Algorithm / Pseudo code, flowchart, program development steps	2	1	1,2
	Computer languages: Machine, symbolic and high-level langua Level languages	1	1	1,2
	Creating and Running Programs: Writing, editing (any editor), compiling (gcc)	1	1	1,2
	linking, and executing in Linux environment	1	1	1,2
Unit 2	**C PROGRAMMING BASICS**	**9**		
	Structure of a C program, identifiers Basic data types and sizes. Constan Variables	1	1	1,2
	Arithmetic, relational and logical operators, increment and decrement operator's	1	1	1,2
	Conditional operator, assignment operator, expressions Type conversion	1	1	1,2
	Conditional Expressions Precedence and order of evaluation, Sample Programs.	1	1	1,2
	SELECTION & DECISION MAKING: if-else, null else, nested if, examp multi-way selection: switch, else-if, examples.	2	1	1,2
	ITERATION: Loops - while, do-while and for, break, continue,	1	1	1,2
	initialization and updating, event and counter controlled loops and examples.	2	1,2	1,2
Unit 3	**FUNCTIONS AND ARRAYS**	**10**		
	User defined functions, standard library functions	1	2,3	1,2
	Passing 1-D arrays, 2-D arrays to functions.	1	2,3	1,2
	Recursive functions - Recursive solutions for Fibonacci series, towers of Hanoi.	2	2,3	1,2
	C Pre-processor and header files	1	2,3	1,2
	Concepts, declaration, definition, storing and accessing elements	1	2,3	1,2
	one dimensional, two dimensional and multidimensional arrays	2	2,3	1,2
	array operations and examples, Character arrays and string manipulations	2	2,3	1,2
Unit 4	**POINTERS**	**10**		
	Concepts, initialization of pointer variables	1	3,4	1,2
	pointers as function arguments, passing by address, dangling memory, address arithmetic	2	3,4	1,2
	character pointers and functions, pointers to pointers	2	3,4	1,2
	pointers and multi-dimensional arrays, dynamic memory management functions	2	3,4	1,2
	command line arguments	1	3,4	1,2
Unit 5	**ENUMERATED, STRUCTURE AND UNION TYPES**	**7**		
	Structures - Declaration, definition, and initialization of structures, accessing structures	1	5	2, 3, 4
	nested structures, arrays of structures, structures and functions, pointers to structures,	1	5	2, 3, 4
	self-referential structures. Unions, typedef, bit-fields, program applications	2	5	2, 3, 4
	Bit-wise operators: logical, shift, rotation, masks.	1	5	2, 3, 4
	FILE HANDLING: Concept of a file, text files and binary files, formatted I/O, file I/O operations and example programs.	2	5	2, 3, 4
	Total Contact Hours	**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 50%
		CLA-1 10%	Mid-1 20%	CLA-2 10%	CLA-3 10%	
Level 1	Remember	70%	60%	50%	40%	30%
	Understand					
Level 2	Apply	30%	40%	50%	60%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. The C programming Language by Brian Kernighan and Dennis Richie.
2. Programming in C, Pradip Dey and Manas Ghosh, Second Edition, OXFORD Higher Education, 2011.
3. Problem Solving and Program Design in C, Hanly, Koffman, 7th edition, PEARSON 2013.
4. Programming with C by R S Bichkar, Universities Press, 2012.

Other Resources

1. "Programming with C", Byron Gottfried, Mcgraw hill Education, Fourteenth reprint,2016

Course Designers

1. -

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Computer Science and Programming using C Lab

Course Code	CSE 108 L	Course Category	Core Course (CC)	L	T	P	C
				0	0	2	1
Pre-Requisite Course(s)		Co-Requisite Course(s)	CSC 108	Progressive Course(s)			
Course Offering Department	CSE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Learn and understand C programming basics and paradigm.
- Acquire knowledge on decision making and functions in C.
- Acquire knowledge on decision making, loop concept, control statements, arrays, string and functions using C.
- Learn basics of Structures, Union, and File handling concepts in C.

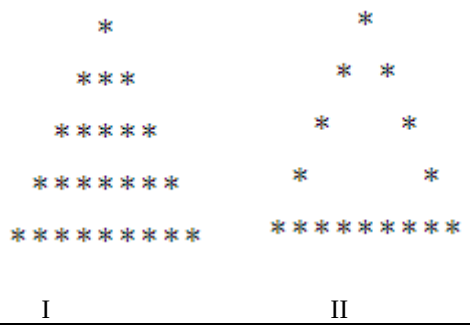
Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe fundamentals in C, enumerators, datatypes, vakeywords, header files and operators	2	75 %	70%
Outcome 2	Illustrate Decision-Making statements and Functions.	3	70 %	65%
Outcome 3	Interpret arrays, strings, and pointers programming in C	3	70 %	65%
Outcome 4	Apply Structures, unions, File handling operations on different scenarios	3	70 %	65%
Outcome 5	Solve given projects based on C concepts	4	70 %	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	3	2				2				3	2	
Outcome 2	2	2	3	3	2				2				2	2	
Outcome 3	2	3	3	2	2				2				2	2	
Outcome 4	3	3	3	3	2				3				2	3	
Outcome 5	2	3	3	3	3				3				2	2	
Average	**2**	**3**	**3**	**3**	**2**				**2**				**2**	**2**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**INTRODUCTION TO COMPUTER SCIENCE**	**4**		
	Lab Experiment 1: GCC Compiler using Linux, various Linux commands used to edit, compile and executing	2	1	1,2
	Lab Experiment 2: a) Calculation of the area of the triangle. b) Swap two numbers without using a temporary variable. c) Find the roots of a quadratic equation	2	1	1,2
Unit 2	**C PROGRAMMING BASICS**	**6**		
	Lab Experiment 3: a) Find the sum of individual digits of a positive integer and find the reverse of the given number. b) Generate the first n terms of Fibonacci sequence. c) Generate all the prime numbers between 1 and n, where n is a value supplied by the user.	2	1,2	1,2
	Lab Experiment 4: a) Print the multiplication table of a given number n up to a given value, where n is entered by the user. b) Decimal number to binary conversion. c) Check whether a given number is the Armstrong number or not.	2	1,2	1,2
	Lab Experiment 5: Triangle star patterns  I II	2	1,2	1,2
Unit 3	**FUNCTIONS AND ARRAYS**	**9**		
	Lab Experiment 6: **a)** (nCr) and (nPr) of the given numbers $1+x+x^2\2+x^3\3!+x^4\4!+\ldots\ldots\ldots X^n\n!$	2	2,3	1,2
	Lab Experiment 7: a) Interchange the largest and smallest numbers in the array. b. Searching an element in an array b. Sorting array elements.	2	2,3	1,2
	Lab Experiment 8: a. Transpose of a matrix. b.Addition and multiplication of 2 matrices.	2	2,3	1,2
	Lab Experiment 9: a. Function to find both the largest and smallest number of an array of integers. b. Liner search. c. Replace a character of string either from beginning or ending or at a specified location.	2	2,3	1,2
	Lab Experiment 10: Pre-processor directives a. If Def b. Undef c. Pragma	1	2,3	1,2

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 4	**POINTERS**	**6**		
	Lab Experiment 10: a. Illustrate call by value and call by reference. b. Reverse a string using pointers Compare two arrays using pointers	2	3, 4	1,2,3
	Lab Experiment 11: a. Array of Int and Char Pointers. Array with Malloc(), calloc() and realloc().	2	3, 4	1,2,3
	Lab Experiment 12: a. To find the factorial of a given integer. b. To find the GCD (greatest common divisor) of two given integers. c. Towers of Hanoi	2	3, 4	1,2,3
Unit 5	**ENUMERATED, STRUCTURE AND UNION TYPES**	**4**		
	Lab Experiment 13: a. Reading a complex number b. Writing a complex number. c. Addition of two complex numbers Multiplication of two complex numbers	2	5	2, 3, 4
	Lab Experiment 14: a. File copy b. Word, line and character count in a file.	2	5	2, 3, 4
Total Hours		**29**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)		End Semester Exam (50%)	
		Lab Record (20%)	Projects Presentations (30%)	Lab Record (20%)	Projects Presentations (30%)
Level 1	Remember	70%	60%	30%	40%
	Understand				
Level 2	Apply	30%	40%	70%	60%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. The C programming Language by Brian Kernighan and Dennis Richie.
2. Programming in C, Pradip Dey and Manas Ghosh, Second Edition, OXFORD Higher Education, 2011.
3. Problem Solving and Program Design in C, Hanly, Koffman, 7th edition, PEARSON 2013.
4. Programming with C by R S Bichkar, Universities Press, 2012.

Other Resources

1. Programming with C", Byron Gottfried, Mcgraw hill Education, Fourteenth reprint,2016

Course Designers

1. -

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Industry Standard Employability Skills – I

Course Code	ISES 101	**Course Category**	Ability Enhancement Course (AEC)	**L**	**T**	**P**	**C**
				0	0	1	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CDC	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- Gain the ability to work in a team and learn leadership skills.
- Gain the ability to be a leader who can cope up with the challenges, risks, and change management.
- Gain the ability to understand and be professionals with idealistic practical and moral values.
- Gain ability to acquire decision making skills in different situations.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Recognise the leadership skills for teamwork.	1	70%	60%
Outcome 2	Demonstrate the ability to cope up with changes and challenges.	3	80%	70%
Outcome 3	Manage stress and control emotions.	3	70%	60%
Outcome 4	Apply decision making and problem-solving skills to given scenarios.	3	90%	80%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1								1			2				
Outcome 2	2					1							2		
Outcome 3					2		2								
Outcome 4	2		1					2		1			2		1
Average	2.0		1.0		2.0	1.0	2.0	1.5		1.0	2.0		2.0		1.0

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	COs Addressed	References Used
Unit No. 1	**Interpersonal skills**	**9**		
	Understanding the relationship between Leadership Networking and Teamwork, Realizing Ones Skills in Leadership	3	1,2	1,2
	Networking & Teamwork and Assessing Interpersonal Skills Situation description of Interpersonal Skill.	3	1,4	1,3
	Teamwork Necessity of Team Work Personally, Socially and Educationally.	3	1,4	1,3
Unit No. 2	**Leadership**	**9**		
	Skills for a good Leader, Assessment of Leadership Skills	3	1,2	1,2
	Change Management, Exploring Challenges	3	1,3	1,2
	Risking Comfort Zone, Managing Change	3	1,3	1,3
Unit No. 3	**Stress management**	**9**		
	Causes of Stress and its impact, how to manage & distress, Understanding the circle of control, Stress Busters.	3	2,3	3,4
	Emotional Intelligence What is Emotional Intelligence, emotional quotient	3	2,3	3,4
	why Emotional Intelligence matters, Emotion Scales. Managing Emotions.	3	2,3	3,4
Unit No. 4	**Conflict resolution**	**9**		
	Conflicts in Human Relations	3	1,4	2,3
	Reasons Case Studies	3	4	2,3
	Approaches to conflict resolution	3	1,4	2,3
Unit No. 5	**Decision making**	**9**		
	Importance and necessity of Decision Making	3	1,4	1,4
	process of Decision Making	3	1,4	1,4
	Practical way of Decision Making, Weighing Positives & Negatives.	3	2,4	1,4
Total Contact Hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50 %)								End Semester Exam (50 %)	
		CLA-1 (15 %)		CLA-2 (15 %)		CLA-3 (__%)		Mid Term (20 %)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	60%		40%				40%		30%	
	Understand										
Level 2	Apply	40%		60%				60%		70%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**				**100%**		**100%**	

Recommended Resources

1. Covey Sean, Seven Habit of Highly Effective Teens, New York, Fireside Publishers, 1998.
2. Carnegie Dale, How to Win Friends and Influence People, New York: Simon& Schuster, 1998.
3. Thomas A Harris, I am ok, you are ok, New York-Harper and Row, 1972
4. Daniel Coleman, Emotional Intelligence, Bantam Book, 2006.

Other Resources

1.

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Mathematics

Course Code	MAT 104	**Course Category**	Core	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Mathematics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To firm up the language of mathematics, primarily the notion of sets, functions, sequences.
2. To understand polynomials, solving simultaneous linear equations, exponential and logarithmic functions.
3. To learn to count the outcomes of permutations and combinations, appreciate the importance of mathematical modelling and data analysis.
4. To understand spatial representation, the connection between geometry and algebra, notions such as symmetry.
5. To learn the basics of calculus.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Write mathematical arguments logically and use the symbol system that is in use universally	3	90%	75%
Outcome 2	Solve problems involving a system of simultaneous linear equations, quadratic polynomials, and other simple algebraic equations algebraically and graphically	3	75%	65%
Outcome 3	Compute the permutations and combinations, sort and arrange data and do elementary data analysis	3	75%	65%
Outcome 4	Differentiate and integrate simple functions and apply their knowledge	3	75%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	2	1	2	-	-	-	-	-	-	2	2	2
Outcome 2	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 3	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 4	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Average	**3**	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Numbers Sets and Number Systems**	**14**		
	A brief history of numbers and numeration systems, number base, place value notation, zero as a number	2	1	1,2
	Base 10 and algorithmizablility of the four basic operations, counting and counting numbers, measurement, ratio-proportions and fractions, commensurability, and irrationality	2	1	1,2
	The language of sets- notation, subsets, union, intersection, complementation, powerset of a set, finite and infinite sets	2	1	1,2
	Functions- one-one, onto, one-to-one correspondence, inverse of a function, operations on functions	2	1	1,2
	Natural numbers, integers, rational, real, and complex number systems, representation on the number line, complex plane	2	1	1,2
	Number patterns, Arithmetic, and geometric progressions	2	1	1,2
	Sequences including Fibonacci and series, summability	2	1	1,2
Unit 2	**Algebraic Thinking**	**12**		
	Representing unknowns and variables, arithmetic on symbols, turning sentences into algebraic expressions	2	2	1,2
	Polynomial expressions, degree of a polynomial, polynomial equations, factorizing polynomials,	2	2	1,2,
	Algebraic equations, identities, inequalities, graphical representation of polynomials, roots of a polynomial, solving quadratic equations in one variable	3	2	1,2
	solving linear equations in 2 or 3 variables,	2	2	1,2,
	Factor and remainder theorem, Some fascinating examples from history. Polynomial, exponential, logarithmic, and rational functions.	3	2	1,2
Unit3	**Spatial Understanding**	**12**		
	A brief look at Euclidean and other geometries, Descartes and the Cartesian coordinate system,	2	2	1,2
	coordinate geometry and algebraic representation of some familiar geometrical objects;	2	2	1,2
	solving polynomial equations- a geometric perspective,	3	2	1,2
	Trigonometry, and trigonometric functions	3	2	1,2
	Symmetries of polygons	2	2	1,2
Unit4	**Mathematical Modelling and Data Analysis**	**14**		
	Permutations and Combinations	4	3	1,2
	Elementary graph theory and some famous problems,	2	3	1,2
	Data, Sorting and representing data as tables and pictograms,	2	3	1,2
	Measures of central tendency: Mean, median, mode, Variations and standard deviation,	4	3	1,2
	Mathematical Models and Constructing mathematical models	2	3	1,2
Unit5	**Calculus: An Introduction**	**8**		
	Derivative of polynomial, exponential and trigonometric functions	2	4	1,2
	Applications of derivative, ,	2	4	1,2
	Integration of a function	2	4	1,2
	Applications of integration	2	4	1,2
Total Contact Hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 20%	Mid-1 15%	CLA-2 10%	CLA-3 15%	
Level 1	Remember	70%	50%	70%	70%	30%
	Understand					
Level 2	Apply	30%	50%	30%	30%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. An Introduction to Mathematics by A. N. Whitehead, Williams and Norgate Henry Holt and Co., New York.
2. Introduction to The Foundations of Mathematics, By Raymond L. Wilder, Dover
3. Publications, Inc. Mineola, New York.

Other Resources

1. -

Course Designers

1. Sazzad Ali Biswasand Jayasree Subramanian

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Physics Lab

Course Code	PHY 103L	**Course Category**	Core Course (CC)	**L**	**T**	**P**	**C**
				0	0	2	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**	PHY 103	**Progressive Course(s)**			
Course Offering Department	Physics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- Operate physics equipment and measurement tools.
- Determine physical constants and fundamental materials properties in mechanics, electromagnetism, and optics.
- To collect experimental data, analyse and graph plot.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand basic equipment operation and analysis	2	70%	65%
Outcome 2	Compute time period, acceleration due to gravity, viscosity and spring constant	2	70%	65%
Outcome 3	Explain working principle of compound pendulum, spring and thermodynamic laws	3	70%	65%
Outcome 4	Verify basic laws of electromagnetism and optics using experimental results	3	70%	65%
Outcome 5	Plot graphs and analyse the experimental results	3	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	2	1	2	-	-	-	-	-	-	2	2	2
Outcome 2	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 3	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 4	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 5	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Average	**3**	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**

Course Unitization Plan

Exp. No.	Description of Experiment	Required Contact Hours	CLOs Addressed	References Used
1	Compound Pendulum: Acceleration due to gravity and radius of gyration of the given pendulum	4	2	4, 5
2	Hooke's law and determination of spring constant for a given spring	2	2	4, 5
3	Biot-savart law: Dependence of magnetic field on the current and magnetic field variation along the axis of a current carrying circular loop	4	2	4, 5
4	Faraday law & Induced E.M.F: Measurement of the induced voltage and calculation of the magnetic flux induced by a falling magnet	2		
5	Verification of Stefan's Law of blackbody radiation	2	3	4, 5
6	Measurement of dielectric constant of air and a given object using parallel plate capacitor	4	3	4, 5
7	Photoelectric effect and Planck's Constant determination	4	4	4, 5
8	Spectral lines from Hydrogen discharge lamp: Balmer Series and Rydberg constant	4	4	4, 5
9	Powder X-Ray diffraction patterns of NaCl and KCl	4	5	4, 5
	Total contact hours	**30 Hours**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (15%)		Mid-1 (20%)		CLA-2 (15%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember		40%		40%		60%				50%
	Understand										
Level 2	Apply		60%		60%		40%				50%
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**				**100%**	

Recommended Resources

1. Laboratory manuals, SRM University – AP
2. R.K. Shukla and Anchal Srivastava, "Practical Physics" New Age international (P) limited Publishers, 2006 [ISBN(13) – 978-81-224-2482-9]

Other Resources

1. Physics for Scientist and Engineers - Raymond A. Serway, John W. Jewett, XIX Edition (2017), Publisher - Cengage India Private Limited
2. Concept of Modern Physics - Arthur Beiser, Shobhit Mahajan, S Rai, 2017 Edition, Publisher - Tata McGraw Hill

Course Designers

1. Dr Sabyasachi Mukhopadhyay, Assistant Professor, Dept. of Physics, SRM University - AP
2. Dr. Pranab Mandal, Assistant Professor, Dept. of Physics, SRM University - AP
3. Prof. Ranjit Thapa, Professor. Dept. of Physics. SRM University - AP
4. Prof. M. S. Ramachandra Rao, Professor, Department of Physics, Indian Institute of Technology, Madras
5. Prof. D. Narayana Rao, Raja Ramanna Fellow, University of Hyderabad

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Introduction to Physics

Course Code	PHY 103	**Course Category**	Core Course (CC)	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Physics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- Knowledge on great scientific discoveries in modern physics.
- To understand fundamental concepts of classical mechanics with practical pplications.
- To understand fundamental concepts of electricity and magnetism with practical applications.
- To understand fundamental concepts crystal physics with X-ray/electron diffraction methods.
- To understand types of solids based on energy band diagram

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Great discoveries in Physics 19 Century	2	70%	65%
Outcome 2	Explain and apply conservation of linear momentum and conservation of mechanical energy	2	70%	65%
Outcome 3	Understand and explain concepts magnetic ekectric field and electromagnetic field	3	70%	65%
Outcome 4	Explain concept of wave particle duality, Quantum Mechanics	3	70%	65%
Outcome 5	Explain basic concept of lattice and X-ray diffraction of crystalline materials	3	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	2	1	2	-	-	-	-	-	-	2	2	2
Outcome 2	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 3	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 4	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 5	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Average	**3**	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Great Discoveries in Physics**	**9**		
	Bremsstrahlung: Braking radiation	1	1	1,2
	Radioactivity	1	1	1,2
	Various models of atoms	1	1	1,2
	Light: Particle or Wave?	1	1	
	Radio waves and long-distance communication	1	1	1,2
	Raman effect and applications	1	1	1,2
	Concept of Ether: Michelson-Morley experiment	1	1	1,2
	Gravitational Waves	1	1	1,2
	Zero resistance and superconductivity	1	1	1,2
Unit 2	**Mechanics**	**9**		
	Scalars and vectors, their various products	1	1,2	1,2
	Newton's Laws of motion and kinematics	1	1,2	1,2
	Free body force diagrams and applications on Inclined plane motion	1	1,2	1,2
	Simple Pulley	1	1,2	1,2
	Problem solving, quiz and Group activities on kinematics	1	1,2	1,2
	Impulse and Average force	1	1,2	1,2
	Conservation of linear momentum	1	1,2	1,2
	Work Energy conservation, and application in bullet's motion	1	1,2	1,2
	Conservation of mechanical energy: Pendulum systems	1	1,2	1,2
Unit 3	**Electricity and magnetism**	**9**		
	Atoms, types of charge carriers and quantization	1	1,2,3	1,2
	Force between charges, electric field and electric lines of force	1	1,2,3	1,2
	Concept of electric potential and potential difference	1	1,2,3	1,2
	Current through a conductor and Ohm's law	1	1,2,3	1,2
	Force between two current carrying conductors	1	1,2,3	1,2
	Magnetic field and magnetic lines of forces and types of magnets	1	1,2,3	1,2
	Force on a charge due to electric and magnetic field	1	1,2,3	1,2
	Cyclotron motion	1	1,2,3	1,2
	Accelerated charged particles and electromagnetic wave (concept)	1	1,2,3	1,2
Unit 4	**Modern Physics**	**9**		
	Longitudinal and transverse waves, travelling wave	1	4	1, 2
	Electromagnetic waves and EM spectrum	1	4	1, 2
	Blackbody radiation, classical interpretation and Planck's hypothesis	1	4	1, 2
	Photoelectric effect and particle nature of wave	1	4	1, 2
	Wave properties of particles and de-Broglie hypothesis	1	4	1, 2
	Concept of Wave function	1	2,4	1, 2
	Probability, physical significance of wavefunction	1	1,2,4	1, 2
	Wavefunction, probability and energy of particle in a box with infinite potential (concept only)	1	1,2,4	1, 2
	Heisenberg's uncertainty principle	1	1,2,4	1, 2
Unit 5	**Crystal Physics**	**9**		
	Crystalline, amorphous and glassy phases	1	3,5	2, 3
	Concept of lattice and basis	1	3,5	2, 3
	Primitive unit cell, Bravais lattice, Symmetry elements and operations: rotation, reflection, inversion	1	3,5	2, 3
	in simple, face centered and body centered cubic lattices	1	3,5	2, 3
	Lattice planes and Miller indices	1	3,5	2, 3
	Bragg's law of X-Ray diffraction in crystal	1	3,5	2, 3
	Group activities on X-Ray diffraction methods	1	3,5	2, 3
	Energy band diagrams in metals, insulators and semiconductors	1	3,5	2, 3
	X-ray and Electron diffraction, their applications in solid state physics.	1	3,5	2, 3
Total Contact hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50 %)								End Semester Exam (50 %)	
		CLA-1 (15 %)		Mid-1 (20 %)		CLA-2 %		CLA-3 %			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%	40%	60%	40%	40%	60%			30%	50%
	Understand										
Level 2	Apply	60%	60%	40%	60%	60%	40%			70%	50%
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**	**100%**	**100%**	**100%**	**100%**	**100%**			**100%**	**100%**

Recommended Resources

1. Physics for Scientist and Engineers - Raymond A. Serway, John W. Jewett, XIX Edition (2017), Publisher - Cengage India Private Limited
2. Concept of Modern Physics - Arthur Beiser, Shobhit Mahajan, S Rai, 2017 Edition, Publisher - Tata McGraw Hill

Other Resources

1. Introduction to Solid State Physics, 8th Edition Charles Kittel 8th edition Wiley India Pvt Ltd
2. K.G. Mazumdar and B. Ghosh, "Advanced Practical Physics" Sreedhar Publishers, Revised edition Jan 2004
3. R.K. Shukla and Anchal Srivastava, "Practical Physics" New Age international (P) limited Publishers, 2006 [ISBN(13) – 978-81-224-2482-9]

Course Designers

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Introduction to Communicative English

Course Code	EGL 100	**Course Category**	FIC	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	English	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To know the fundamentals of producing a spoken and written language.
2. To understand language Production skills while learning its importance in communication using written and spoken form.
3. To gain knowledge of the Persuasive Communication Principles in both academic and non-academic contexts focusing/preparing for the audience at hand.
4. To use Persuasive skills while presenting Scientific Data in written form with attention to various modes of presentation.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Apply fundamental knowledge critically while writing to persuade	3	75%	75%
Outcome 2	Demonstrate communication skills using Writing as a skill for communication.	3	75%	75%
Outcome 3	Analyse the role and use of writing in context suitable for academic and informative use.	2	75%	75%
Outcome 4	Utilize persuasion skills to study the art of comparing and contrasting.	3	75%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	-	3	3	3	2	3	-	3	3	3	1	3	-	-	-
Outcome 2	-	3	3	3	2	3	-	3	3	3	1	3	-	-	-
Outcome 3	-	3	3	3	2	3	-	3	3	3	1	3	-	-	-
Outcome 4	-	3	3	3	2	3	-	3	3	3	1	3	-	-	-
Average	-	**3**	**3**	**3**	**2**	**3**	-	**3**	**3**	**3**	**1**	**3**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**HORIZONTAL AND VERTICAL WRITING**	**6**		
	Fundamentals of Vertical and Horizontal Writing	2	1,4	1
	Reading and Illustrating best writing	2	1,4	1,2
	Expressing Ideas using Critical thought	2	1,4	1
Unit 2	**BASIC ENGLISH CONCEPTS AND INTRODUCTION TO LINGUISTICS**	**8**		
	Reading Skills – Introduction, Skill & Process	2	2	1
	Writing Skills – Introduction, Skill & Production	2	2	1,2
	Production Concepts- Reading, Writing Process & production of Language	4	2	1
Unit 3	**CREATIVE WRITING**	**12**		
	Introduction to Persuasive clarity	3	3	1
	Examine Reading: Comprehension and Creative Clarity	3	3	1
	Examine Writing: Expressive clarity using Rhetoric	3	3	1,2,3
	Production of Creative and Expressive clarity	3	3,4	1,2,3
Unit 4	**RESEARCH WRITING**	**12**		
	Fundamentals of Research Paper Writing	4	3,4	2, 3
	Understanding the role of Bibliography and Referencing	4	3,4	3
	Constructing a Write up using Fundamentals of Writing	4	3,4	2, 3
Unit 5	**Persuasion, ideology and media bias**	**7**		
	Identifying: combining and synthesizing information	2	4	3
	Processing: Clarity to Inform and persuade in written form	2	4	2,3
	Applying the skill within small and large group	3	4	1,3
Total Contact Hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 50%
		CLA-1 10%	Mid-1 15%	CLA-2 10%	Mid-2 15%	
Level 1	Remember	30%	50%	30%	50%	30%
	Understand					
Level 2	Apply	70%	50%	70%	50%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Beebe, Beebe and Ivy (2016). Communication: Principles for a Lifetime. (6th Edition). Pearson Publishing.
2. Taylor and Lindof (2011). Qualitative Communication Research Methods. (3rd Edition). Sage Publication.
3. Myers and Anderson (2008). The Fundamentals of Small Group Communication. Sage Publication

Other Resources

Course Designers

1. Dr. G. Priyank Varma, Asst. Prof Dept. of English, SRM University – AP.
2. Prof. Rajesh Kumar, Professor, IIT Madras.
3. Dr. Md. Mojibur Rahman, Associate Professor, IIT Dhanbad

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Introduction to Environmental Science

Course Code	ENV 100	**Course Category**	FC	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Environmental Science	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- To study the scope of Environmental Science and the idea of sustainability.
- To acquire basic knowledge of environmental ethics, critical environmental laws, and policies.
- To explore various sources and challenges in the renewable energy sector in replacing conventional energy.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Recognise the scope and purview of Environmental Science, the Idea of sustainability, environmental ethics, and global efforts to overcome the hindrance for sustainability.	2	80%	70%
Outcome 2	Interpret the environmental laws and policies.	3	80%	70%
Outcome 3	Investigate climate change, the way it affects life at different scales (global, regional, and local scales), and various mitigation strategies.	2	70%	60%
Outcome 4	Analyse the extent of environmental pollution and pollution reduction strategies through and resource optimization, renewable energy, and waste management.	3	70%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	-	-	-	1	-	3	1	1	-	1	1			
Outcome 2	1	-	1	-	1	-	3	-	1	-	1	1			
Outcome 3	1	-	-	-	1	-	3	-	1	-	1	1			
Outcome 4	1	-	-	-	1	-	3	-	1	-	1	1			
Average	**1**	**-**	**1**	**-**	**1**	**-**	**3**	**1**	**1**	**-**	**1**	**1**			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Fundamental Concepts in Environmental Science**	**12**	1	1, 2, 3, 4, 5, 6, 7, 8, 10
	Human population and environment	1		
	Environmental education and awareness, Environmental ethics Evolution of Environmental ethics – Leopold's land ethics, Silent Spring	2		
	Population growth, Ecological overshoot, and Ecological Footprint	2		
	Defining global sustainability, Garret Hardin's "Tragedy of the Commons', Brundtland commission report, Principles of sustainable development, Sustainable Development Goals (SDGs), Triple bottom line of sustainable development	2		
	Technology and Society: Information Technology - Human health & Environmental health, Environmental misconception	2		
	Sustainable ethics: Overcoming the obstacles of sustainability Individualizing Responsibility for a sustainable future - Consumption and its impact on sustainable development	3		
Unit 2	**Social issues and Environment**	**10**	4	1, 3, 9
	Fronterism, Biological Imperialism, and Natural rights, Significance of Human rights; Human rights and environment	3		
	Wastewater reclamation, Water conservation, Rainwater harvesting, Watershed management, Urban problems related to energy, Nuclear accidents	3		
	Global Environmental Policy, Environmental acts and laws, Water Act 1974, Environmental Protection Act 1986	4		
Unit 3	**Global Climate Change**	**14**	3	10, 3
	Differentiating Climate and Weather, Interconnection of Earth systems (Hydrosphere, Geosphere, Cryosphere, Atmosphere, and Biosphere)	2		
	Climate change through data (global temperature, and CO_2 – Mauna Lao Earth observatory)	3		
	Climate change: Impacts - Extreme weather events, Sea-level rise, Food and water security, and Human health & well-being, Biodiversity loss	4		
	Climate change: Adaptation – local to global scales, Synthesis	2		
	Disaster management – landslides, Tsunamis floods, earthquakes, anthropogenic disasters, Bhopal tragedy	2		
	Communicating climate change	1		
Unit 4	**Energy and Environment**	**8**	4	3, 4
	Renewable Energy: Global Status and trends	2		
	Global Renewable Energy Applications	2		
	Technical Issues, Challenges & Opportunities Solar, tidal, hydropower, Bioenergy, nuclear	2		
	Renewable Energy Markets	2		
Unit 5	**Environmental Pollution and Management**	**16**	2, 4	3, 11
	Pollution: Air pollution, Noise pollution, Water pollution, Soil pollution	4		
	Solid waste management: Collection, Handling, and solid waste management rules	4		
	E-waste and hazardous waste management, biomedical waste management	4		
	Wastewater treatment systems: Industrial and sewage treatment	4		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 50%
		CLA-1 10%	Mid-1 15%	CLA-2 (0%	Mid-2 15%	
Level 1	Remember	70%	70%	30%	30%	70%
	Understand					
Level 2	Apply	30%	30%	70%	70%	30%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Daniel D. Chiras (2012), Environmental Science 9th Edition. Jones & Barlet Publishers
2. Carson, R. (2002). Silent spring. Houghton Mifflin Harcourt.
3. Rajagopalan, R (2015). Environmental Science – from crisis to cure, 3rd Edition. Oxford Higher Education.
4. Walter K Dodds (2018). Humanity's Footprint: Momentum, Impact, and Our Global Environment. Columbia University Press
5. Hayley Stevenson (2018). Global Environmental Politics Problems, Policy and Practice. Cambridge University Press
6. Garette Hardin (1968). The Tragedy of the Commons. Science 162 (3859), 1243-1248. DOI: 10.1126/science.162.3859.1243
7. Brutland Commission Report, 1987. Oxford University Press
8. TRANSFORMING OUR WORLD: The 2030 Agenda for Sustainable Development
9. Shastri, S.C. (2015) Environmental Law by 5th edition, EBC Publications.
10. Intergovernmental Panel on Climate Change (IPCC) Synthesis Report, 2014.
11. C.S. Rao (2018) Environmental Pollution Control Engineering, New Age International Publishers.

Other Resources

1. W. Cunningham, M. Cunningham (2016). Principles of Environmental Science (8th Edition), McGraw-Hill
2. Divan Shyam (2002). Environmental Law and Policy in India, OUP India
3. Jonathan Cowie, (2002). Climate change: Biological and Human Aspects, 2nd Edition. Cambridge University Press
4. Hanjalic, Kemo, Roel Van de Krol, and Alija Lekic, eds. (2017). Sustainable energy technologies: options and prospects. Springer Science & Business Media

Course Designers

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INDUSTRY SPECIFIC EMPLOYABILITY SKILLS - II

Course Code	ISES 102	**Course Category**	SEC	**L**	**T**	**P**	**C**
				0	0	1	1
Pre-Requisite Course(s)	ISES 101	**Co-Requisite Course(s)**		**Progressive Course(s)**	**ISES 201**		
Course Offering Department	CDC	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To develop aptitude skills.
2. Develop the ability to solve logical problems.
3. To develop self-awareness and understand his emotions.
4. Build vocabulary through methodical approaches and nurture passion for learning new words.
5. Develop an ability to function on multidisciplinary teams.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Solve the basic mathematical problems.	3	90%	80%
Outcome 2	Demonstrate the ability in solving the logical reasoning problems.	3	70%	80%
Outcome 3	Use the images in solving the problems related to reasoning.	3	80%	70%
Outcome 4	Use emotional intelligence in developing interpersonal relations.	3	70%	60%
Outcome 5	Memorise grammatic rules for making flawless use of language.	1	80%	90%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Outcome 2	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-
Outcome 3	-	-	2	3	1	-	-	-	-	-	-	2	-	-	-
Outcome 4	-	-	-	-	-	-	-	2	3	2	-	2	-	-	-
Outcome 5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
Course Average	**-**	**3**	**1**	**3**	**-**	**-**	**-**	**1**	**2**	**3**	**-**	**2**	**-**	**-**	**-**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Quants**			
	Concept 1: Averages, Aligation or Mixture, Percentage	1	1	2,4
	Concept 2: Profit and loss, True discount	1	1	2,4
	Concept 3: Partnership, Height, and Distance	1	1	2,4
Unit 2	**Reasoning**			
	Concept 1: Logical deductions, Syllogism	1	2,3	1,3,4
	Concept 2: Image based problems, Coding and Decoding	1	2,3	1,3,4
	Concept 3: Cubes and Cuboids, Inequalities, Input output tracing	1	2,3	1,3,4
Unit 3	**Verbal**			
	Concept 1: Ordering of sentences, Comprehension, Verbal Analogies.	1	5	7
	Concept 2: Essential parts of a sentence, One-word substitutes.	1	5	7
	Concept 3: Cause and effect, Syllogism	1	5	7
Unit 4	**Communication skills**			
	Concept 1: Sentence formation (Practical)	1	6	5,6
	Concept 2: Word group categorization, Casual conversation (Practical)	1	6	5,6
	Concept 3: Formal conversation (interpersonal)	1	6	5,6

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%								End Semester Exam 50%	
		CLA-1 10%		Mid-1 15%		CLA-2 10%		Mid-2 15%			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		40%		40%		40%		40%	
	Understand										
Level 2	Apply	60%		60%		60%		60%		60%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. R.S. Agarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publication
2. How to prepare for Quantitative Aptitude for CAT – Arun Sharma
3. Meenakshi Upadhyay, Arun Sharma -Verbal Ability and Reading Comprehension
4. How to prepare for Logical reasoning and data interpretation for CAT – Arun Sharma.
5. Mastering Soft skills – Julian Vyner.
6. Soft skills – Key to success in workplace and life – Meenakshi Raman, Shalini Upadhyay.
7. English grammar and composition – S. C. Gupta.

Other Resources

Course Designers

1. Mr. Naresh Adapa, Quantitative Aptitude trainer, Department of CDC, SRM University AP.
2. Ghanshyam Pandey, Assistant Professor, Department of Economics, SRM University AP

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Research

Course Code	RM 100	**Course Category**	FIC	**L**	**T**	**P**	**C**
				1	0	0	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Chemistry	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To facilitate the students in understanding the basics of research
2. To educate the young researchers on methods of research
3. To prepare the students to apply research in scientific problems

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Illustrate the importance of research	2	85%	80%
Outcome 2	Demonstrate research acumen in the research process	3	80%	75%
Outcome 3	Apply the research method in given scenarios	5	80%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	2	1	-	1	2	3	3	2	-	3	1	2
Outcome 2	2	3	2	1	3	-	3	3	2	3	3	-	2	3	3
Outcome 3	1	3	1	3	2	-	2	1	2	2	1	-	1	2	1
Average	**2**	**3**	**2**	**2**	**2**	**-**	**2**	**2**	**2**	**3**	**2**	**-**	**2**	**2**	**2**

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Scientific Research**	**7**	**1**	**1,2**
	Importance of Research	2		
	Objectives of Research	2		
	Types of Research	3		
Unit 2	**Introduction to Research Articles**	**8**	**2**	**1,3**
	Literature survey	2		
	Tools to collect research articles	2		
	Identifying research problem	1		
	Understanding research articles	1		
	Different components in a research article	1		
	Review articles and book chapters, report writing	1		
Unit 3	**Scientific Conduct**	**8**	3	**1,2,3**
	Ethics with respect to science and research	2		
	Intellectual honesty and research integrity	2		
	Scientific misconducts: falsification, fabrication, and plagiarism	2		
	Redundant publications: duplicate and overlapping publications	2		
Unit 4	**Research Management and Collaboration**	**7**	3	**1**
	Google scholar, ResearchGate	3		
	Citations, h-index, i10 index	2		
	Bibliography, reference manager (Mendeley)	2		
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50 %								End Semester Exam 50 %	
		CLA-1 15 %		CLA-2 15 %		CLA-3 __%		Mid Term 20 %			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	60%		40%				40%		30%	
	Understand										
Level 2	Apply	40%		60%				60%		70%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**				**100%**		**100%**	

Recommended Resources

1. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008
2. Kothari C.K., Research Methodology- Methods and Techniques (New Age International, New Delhi), 2004
3. Catherine Dawson, Introduction to Research Methods, 2005

Other Resources

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Physical Chemistry – I

Course Code	CHE 113	**Course Category**	**Basic Sciences**	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Chemistry	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- To distinguish the types of matter in atoms in solution and also can predict the atomic structures with guiding principles.
- To learn the kinetic theory of gases. Also interpret the relations between various parameters associated with it.
- To gain in-depth knowledge on real gases and their deviations.
- To understand the phase behaviour in liquid states and various factors affecting their properties.
- To learn the formation of solid states with their applications

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	**Distinguish the types of matters in atom in solution and also can predict the atomic structures with guiding principles**	**2**	**70%**	**85%**
Outcome 2	**Interpret the kinetic theory of gases. Also interpret the relations between various parameters associated with it**	**2**	**70%**	**85%**
Outcome 3	**Discuss in-depth knowledge on real gases and their deviations**	**2**	**70%**	**85%**
Outcome 4	**Identify the phase behaviour in liquid states and various factors affecting their properties.**	**2**	**70%**	**85%**
Outcome 5	**The formation solid states with their applications.**	**3**	**70%**	**85%**

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective
Outcome 1	3	2	2	2	2	2			1	1		1	2	1	2
Outcome 2	3	2	2	2	2	2			1	1		1	2	1	2
Outcome 3	3	2	1	2	2	2			1	1		1	3	3	3
Outcome 4	3	2	2	2	2	2			1	1		1	3	3	3
Outcome 5	3	3	3	2	2	3			1	1		1	3	3	3
Average	3	2	2	2	2	2			1	1		1	3	2	3

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Atomic structures**	**13**		
	Recapitulation of Bohr's theory, its limitations, and the atomic spectrum of the heteroaromatic.	1	1	1, 2, 4
	Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle, and its significance.	2	1	1, 2, 4
	Schrödinger's wave equation, the significance of ψ and ψ2. Quantum numbers and their significance.	1	1	1, 2, 4
	Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom.	3	1	1, 2, 4
	Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Pauli's Exclusion Principle,	3	1	1, 2, 4
	Hund's rule of maximum multiplicity, Aufbau principle and its limitations. Electronic energy level diagram and electronic configurations of hydrogen-like and polyelectronic atoms and ions. Term symbols of atoms and ions for atomic numbers < 30.	3	1	1, 2, 4
Unit No. 2	**Kinetic Theory of Gas**	**11**		
	Concept of pressure and temperature.	1	2	1, 2, 4
	Nature of the distribution of velocities in one dimension (with derivation), extension to two and three dimensions (without derivation, expression by induction).	2	2	1, 2, 4
	Maxwell's distribution of speeds. Kinetic energy distribution in one, two, and three dimensions,	1	2	1, 2, 4
	calculations of average, root mean square and most probable values in each case; calculation of the number of molecules having energy ≥ ε	4	2	1, 2, 4
	Principle of the equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases. Collision of gas molecules; collision diameter; collision number and mean free path; frequency of binary collisions (similar and different molecules); wall collision and rate of effusion. Viscosity of gases from kinetic theory of gas.	3	2	1, 2, 4
Unit No. 3	**Real Gas**	**12**		
	Deviations from ideal gas behaviour,	1	3	2,4
	compressibility factor, Z, virial coefficient and its variation with pressure and temperature for different gases.	2	3	2,4
	Causes of deviation from ideal behaviour.	1	3	2,4

	van der Waals equation of state, its derivation and application in explaining real gas behaviour	**2**	**3**	**2,4**
	calculation of Boyle temperature.	**1**	**3**	**2,4**
	Isotherms of real gases and their comparison with van der Waals isotherms	**2**	**3**	**2,4**
	continuity of states, critical state,	**1**	**3**	**2,4**
	relation between critical constants and van der Waals constants, law of corresponding states.	**2**	**3**	**2,4**
Unit No. 4	**Liquid State**	**12**		
	Qualitative treatment of the structure of the liquid state; physical properties of liquids;	**3**	**4**	**1, 3, 5**
	vapour pressure, surface tension and coefficient of viscosity, and their determination.	**2**	**4**	**1, 3, 5**
	Effect of addition of various solutes on surface tension and viscosity	**2**	**4**	**1, 3, 5**
	Explanation of cleansing action of detergents.	**3**	**4**	**1, 3, 5**
	Temperature variation of viscosity of liquids and comparison with that of gases	**2**	**4**	**1, 3, 5**
Unit No. 5	**Solid State**	**12**		
	Nature and different types of the solids including covalent, non-covalent ionic and metallic solids and their bonding,	**3**	**5**	**1, 2, 4, 6**
	law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups,	**1**	**5**	**1, 2, 4, 6**
	seven crystal systems and fourteen Bravai's lattices.X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method.	**2**	**5**	**1, 2, 4, 6**
	Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.	**2**	**5**	**1, 2, 4, 6**
	Band theory: metals, insulators, and semiconductors. Band gaps, doping, and devices.	**2**	**5**	**1, 2, 4, 6**
	Magnetic properties, dielectric & optical properties, superconductivity, mechanical properties, thermal analysis, materials synthesis.	**2**	**5**	**1, 2, 4, 6**
Total Contact Hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (15%)		Mid-1 (15%)		CLA-2 (10%)		CLA-3 (10%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	60%		40%		60%		40%		30%	
	Understand										
Level 2	Apply	40%		60%		40%		60%		70%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Peter Atkins, & Paula, J. de. Elements of Physical Chemistry 7th Ed., Oxford University Press (2014).
2. Physical Chemistry: G.M. Barrow (2007) 5th edition, Tata McGraw Hills Publishing.
3. Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
4. Physical Chemistry: I.N. Levine (2010) 5th edition, Tata McGraw Hills Publishing.
5. Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004).
6. Solid State Chemistry: An Introduction: Lesley Smart and Elaine Moore 2nd edition, 2004, Indian Edition by VIVA books

Other Resources

1. Enter Data

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Inorganic Chemistry – I

Course Code	CHE 114	Course Category	Inorganic chemistry	L	T	P	C
				4	0	0	4
Pre-Requisite Course(s)	NIL	Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To address the periodicity of elements in the periodic table and trends.
- To explain different types of bonding in compounds.
- To gain knowledge on chemistry of radioactivity, transmutation, nuclear reactions, and the applications of isotopes.
- To impart knowledge on basic concepts of acid-bases and theories involved in it.
- To get expertise in the preparation of standard solutions, to understand basic principles and develop skill in titrimetric analysis.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain the periodic properties of elements	1 & 2	90%	90%
Outcome 2	Students will gain knowledge on the different types of chemical bonding and differentiate between ionic and covalent compounds	3	90%	90%
Outcome 3	Learners will understand in depth concepts of radioactivity and applications of isotopes	3	85%	85%
Outcome 4	Learners should be able to provide a clear explanation of the acidic/basic nature of any compound.	3	80%	80%
Outcome 5	Students will be able to Prepare standard solutions, demonstrate the principles of titrimetry,analyze titrimetric data systematically and estimate the amount of any analyte in a given solution.	3	80%	80%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective
Outcome 1	3	3	3	3	3	3	2	2	3	2	2	3	2	3	2
Outcome 2	3	3	3	3	3	3	2	2	3	2	2	3	3	2	2
Outcome 3	3	3	3	3	3	3	2	2	3	2	2	3	3	2	3
Outcome 4	3	3	3	3	3	3	2	2	3	2	2	3	2	3	2
Outcome 5	3	3	3	3	3	3	2	2	3	2	2	3	2	2	3
Average	3	3	3	3	3	3	2	2	3	2	2	3	2	2	2

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Periodicity of Elementss**	**10**		
	Periodic law and arrangement of elements in the periodic table, horizontal, vertical, and diagonal relationships.	2	1	1
	A brief discussion of the following properties of the elements and the trends shown: (a) Effective nuclear charge, variation of effective nuclear charge in the periodic table, inert-pair effect, shielding or screening effect, and Slater rules.	2	1	1
	(b) Atomic and ionic radii (c) Ionisation enthalpy, Successive ionisation enthalpies, factors affecting ionisation enthalpy, and trends in groups and periods. (d) Electrons gain enthalpy and trends in groups and periods.	3	1	1, 2
	(e) Electronegativity, Pauling's/ Allred Rochow's scales. Variation of electronegativity with bond order, partial charge, hybridisation, and group electronegativity.	3	1	1, 2
Unit No. 2	**Chemical Bonding – Ionic, Covalent and Metallic**	**10**		
	Ionic bond: General characteristics, types of ions, size effects, radius ratio rule, and limitations. Packing of ions in crystals.	1	2	1, 2
	Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle, and its application, Solvation energy.	1	2	1, 2
	Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridisation, equivalent and non-equivalent hybrid orbitals.	1	2	1, 2
	Bent's rule. Multiple bonding (ζ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarising power, and polarizability. Fajan's rules and consequences of polarisation.	1	2	1, 2, 3
	Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.	1	2	1, 2, 3
	VSEPR, shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H_2O, NH_3, PCl_3, PCl_5, SF_6, ClF_3, I_3^-, BrF_2^+, PCl_6^-, ICl_2^- ICl_4^- and SO_4^{2-}.	1	2	1, 2, 3
	Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl (the idea of s-p mixing and orbital interaction to be discussed).	1	2	1, 2, 3
	Noncovalent bonding: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction.	1	2	1, 2, 3
	Hydrogen bonding (theories of hydrogen bonding, valence bond treatment). Effects of weak chemical forces, melting and boiling points, solubility, and the energetics of the dissolution process.	1	2	1, 2, 3
	Metallic bond: Properties of Metallic compounds.	1	2	1, 2, 3
	Nuclear Chemistry – Introduction.	10		

Unit No. 3	**Nuclear stability and nuclear binding energy. Nuclear forces: meson exchange theory.**	**2**	**3**	**1, 7**
	Nuclear models (elementary idea): Concept of nuclear quantum number, magic numbers.	**2**	**3**	**1, 7**
	Nuclear Reactions: Artificial radioactivity, transmutation of elements, fission, fusion, and spallation.	**2**	**3**	**1, 7**
	Nuclear energy and power generation. Separation and uses of isotopes in tracer techniques.	**2**	**3**	**1, 7**
	Radiochemical methods: Determination of the age of rocks and minerals, radiocarbon dating, hazards of radiation, and safety measures.	**2**	**3**	**1, 7**
Unit No. 4	**Acid-Base Concept.**	**8**		
	Arrhenius's concept, theory of solvent system (in H2O, NH3, SO2, and HF), Bronsted-Lowry's concept, the relative strength of acids.	**2**	**4**	**1, 2, 6**
	Amphoteric, Lux-Flood concept, Lewis concept. Superacids, HSAB principle. Acid-base equilibria in aqueous solution and pH.	**3**	**4**	**1, 2, 6**
	Acid-base neutralisation curves; indicator, choice of indicators. Buffer solution, composition, buffer capacity.	**3**	**4**	**1, 2, 6**
Unit No. 5	**Noble Gases.**	**7**		
	Rationalization of the inertness of noble gasses, clathrates, preparation.	**2**	**4**	**1, 2, 6**
	Properties of XeF2, XeF4, and XeF6, bonding in these compounds using VBT.	**2**	**4**	**1, 2, 6**
	Shapes of noble gas compounds using VSEPR Theory.	**3**	**4**	**1, 2, 6**
	Total Contact Hours	**45 Hours**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (__%)								End Semester Exam (__%)	
		CLA-1 (__%)		CLA-2 (__%)		CLA-3 (__%)		Mid Term (__%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	50%	40%	50%	30%	50%	50%	50%		50%	50%
	Understand										
Level 2	Apply	50%	60%	50%	70%	50%	50%	50%		50%	50%
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100 %**	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**		**100%**	**100%**

Recommended Resources

1. Concise Inorganic Chemistry: J.D. Lee (1999) 5th edition, Blackwell Science.
2. Inorganic Chemistry: Mark Weller, Tina Overton, Jonathan Rourke, and Fraser Armstrong, 6th edition, Oxford University Press, 2014.
3. Concepts and Models of Inorganic Chemistry: B. Douglous, D. McDaniel and J. Alexander (2006) 3rd edition (student edition), Wiley-India.
4. Inorganic chemistry, R. Gopalan, University Press, 2009
5. Basic Inorganic Chemistry, Cotton Wilkinson and Paul L Gaus, 1994
6. Inorganic Chemistry: J.E. Huheey, E.A. Keiter and R.L. Keiter (2007) 4th edition, Pearson Education.
7. Essentials of Nuclear Chemistry by H.J. Arnikar, New Age International.
8. Vogel's Quantitative Chemical Analysis 6th Edition, 2009, Pearson Education.

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (__%)								End Semester Exam (__%)	
		CLA-1 (__%)		CLA-2 (__%)		CLA-3 (__%)		Mid Term (__%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	50%	40%	50%	30%	50%	50%	50%		50%	50%
	Understand										
Level 2	Apply	50%	60%	50%	70%	50%	50%	50%		50%	50%
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100 %**	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**		**100%**	**100%**

Recommended Resources

9. Concise Inorganic Chemistry: J.D. Lee (1999) 5th edition, Blackwell Science.
10. Inorganic Chemistry: Mark Weller, Tina Overton, Jonathan Rourke, and Fraser Armstrong, 6th edition, Oxford University Press, 2014.
11. Concepts and Models of Inorganic Chemistry: B. Douglous, D. McDaniel and J. Alexander (2006) 3rd edition (student edition), Wiley-India.
12. Inorganic chemistry, R. Gopalan, University Press, 2009
13. Basic Inorganic Chemistry, Cotton Wilkinson and Paul L Gaus, 1994
14. Inorganic Chemistry: J.E. Huheey, E.A. Keiter and R.L. Keiter (2007) 4th edition, Pearson Education.
15. Essentials of Nuclear Chemistry by H.J. Arnikar, New Age International.
16. Vogel's Quantitative Chemical Analysis 6th Edition, 2009, Pearson Education.

Other Resources

2. Enter Data

Course Designers

2. Enter Data

Biomolecules

Course Code	BIO 215	**Course Category**	DC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- Equip students with a foundational understanding of bioenergetic principles and the structure-function relationships of key biomolecules. This knowledge is crucial for understanding metabolic pathways, cellular processes, and the molecular basis of life, forming a cornerstone for advanced studies in biological sciences.
- Develop the ability to integrate knowledge of biomolecules such as carbohydrates, lipids, proteins, and nucleic acids into the context of cellular function and organismal biology. This integration is essential for comprehending complex biological systems and for pursuing specialized fields such as molecular biology, biochemistry, and physiology within a Biological Science BSc program.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe knowledge of biomolecules and bioenergetic principles.	1	80%	75%
Outcome 2	Classify carbohydrates, lipids, amino acids, and proteins with structure-function correlation.	2	75%	70%
Outcome 3	Describe the structure and functions of nucleic acids (DNA, RNA) and their different forms.	1	80%	75%
Outcome 4	Relate acquired knowledge to solve biochemical problems, critically analyze data, and communicate effectively in both written and oral formats.	3	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	1	2	1	1		1	2	3		2	2	1	3
Outcome 2	3	3	2	3	2	2		1	2	3		2	3	2	3
Outcome 3	3	2	2	2	2	3	2	2	2	3		2	2	3	3
Outcome 4	3	3	3	3	3	3	2	1	3	3		3	3	3	3
Course Average	**3**	**2.5**	**2**	**2.5**	**2**	**2.3**	**2**	**1.3**	**2.3**	**3**		**2.3**	**2.5**	**2.3**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
1	UNIT I: Bioenergetics	**9**		
	Biomolecules: water- structure and properties, buffers, and their biological importance	3	1,4	**1,2,3**
	Principles of bioenergetics- laws of thermodynamics, entropy and enthalpy, standard free energy changes,	3	1,4	**1,2,3**
	standard reduction potentials,	2	1,4	**1,2,3**
	thermodynamics of coupled reactions.	1	1,4	**1,2,3**
2	UNIT II: Carbohydrates	**9**		
	Carbohydrates: definition and functions,	3	2,4	**1,2,3**
	classification, properties, monosaccharides,	3	2,4	**1,2,3**
	disaccharides, oligosaccharides,	2	2,4	**1,2,3**
	polysaccharides- homo- and hetero-polysaccharides.	1	2,4	**1,2,3**
3	UNIT III: Lipids	**9**		
	Lipids: Classification,	2	2,4	**1,2,3**
	structure and properties,	2	2,4	**1,2,3**
	phospholipids,	1	2,4	**1,2,3**
	glycolipids,	1	2,4	**1,2,3**
	sphingolipids,	1	2,4	**1,2,3**
	cholesterol,	1	2,4	**1,2,3**
	fatty acids- saturated and unsaturated fatty acids.	1	2,4	**1,2,3**
4	UNIT IV: Amino acids and Proteins	**9**		
	Amino Acids: Classification and properties,	2	2,4	**1,2,3**
	structure and properties of amino acids,	2	2,4	**1,2,3**
	essential and nonessential amino acids,	2	2,4	**1,2,3**
	proteins-classification and functions,	1	2,4	**1,2,3**
	levels of protein structure,	1	2,4	**1,2,3**
	haemoglobin,and myoglobin.	1	2,4	**1,2,3**
5	UNIT V: Nucleic Acids	**9**	3,4	
	Nucleic acids: Structure,	3	3,4	**1,2,3**
	purine and pyrimidine bases structure,	2	3,4	**1,2,3**
	properties and functions of nucleic acids (DNA, RNA)	2	3,4	**1,2,3**
	Different forms of DNA and RNA.	2	3,4	**1,2,3**
	Total	**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	80%		70%		70%		60%		50%	
	Understand										
Level 2	Apply	20%		30%		30%		40%		50%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Harper's Illustrated Biochemistry, V. W. Rodwell, D. Bender, K.M. Botham, P.J. Kennelly and P.A. Weil (2018) 31st edition, McGraw Hill-Medical.
2. Lehninger Principles of Biochemistry, D. L. Nelson and M. M. Cox, (2017) 7th edition, W.H. Freeman & Company.
3. Biochemistry: D. Voet and J.G. Voet (2011), 4th edition, Wiley.

Other Resources

1. No data given

Course Designers

1. Prof. Jayaseelan Murugaiyan, Professor, Dept. Of Biological Sciences. SRM University – AP
2. Dr. Writoban Basu Ball, Dept. Of Biological Sciences. SRM University - AP
3. Dr. Sutharsan Govindrajan, Dept. Of Biological Sciences. SRM University - AP

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Digital Literacy

Course Code	SEC 102	Course Category	SEC	L	T	P	C
				1	1	0	2
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	ITKM	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Introduce basic digital skills that are needed in today's 21st century work environment.
- develop the skills that they need to effectively integrate technology into their respective professional practices.
- Learn practical-oriented and will have a lot of hands-on exercises.
- Understand basic and practical digital skills.
- learn and use software and hardware systems, including the basic troubleshooting.
- Learn issues pertaining to emerging technologies and creating digital identity in various platforms.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Discuss the importance of Digital Literacy	2	75%	80%
Outcome 2	Compare and Contrast collaborative features in digital platforms	3	70%	70%
Outcome 3	Create digital identity profile on LinkedIn	3	75%	75%
Outcome 4	Demonstrate best practices of digitally managed workspace on MS office 365 and G Suite	3	70%	75%
Outcome 5	Identify relevant information from authentic data sources	3	70%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1					3	3		1	2	3		3			
Outcome 2					3	3		1	2	3		3			
Outcome 3					3	3		1	2	3		3			
Outcome 4					3	3		1	2	3		3			
Average					3	3		1	2	3		3			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	COs Addressed	References Used
Unit No. 1	**Introduction - Digital Literacy**	**2**	**1**	1,2,3
	About Digital Literacy	0.5	1	1,2,3
	Importance of digital literacy	0.5	1	1,2,3
	Overview of Computing Systems and Platforms	0.5	1	1,2,3
	Digital Proficiency for Career prospects and Everyday living	0.5	1	1,2,3
Unit No. 2	**Know your computer**	**3**	**1**	1,2,3
	Types of computing	0.5	1	1,2,3
	Accessories & peripherals	0.5	1	1,2,3
	System upkeep & maintenance	0.5	1	1,2,3
	Basic Troubleshooting	0.5	1	1,2,3
	Operating Systems	1	1	1,2,3
Unit No. 3	**Microsoft Office Automation software**	**5**	4	1,2,3
	Word Processing	1	4	1,2,3
	Excel - Data Analysis	1	4	1,2,3
	PowerPoint Presentations	1	4	1,2,3
	Digital software tools	1	4	1,2,3
	Best practices	1	4	1,2,3
Unit No. 4	**Google Automation Software**	**3.5**	4	1,2,3
	Word Processing	1	4	1,2,3
	Spreadsheet	1	4	1,2,3
	Presentations	1	4	1,2,3
	Best practices	0.5	4	1,2,3
Unit 5	**Digital Communication tools**	**4**	2	1,2,3
	Emails Systems - Gmail, MS Outlook, Zimbra, etc	0.5	2	1,2,3
	Calendar Functionality	0.5	2	1,2,3
	Drive - Access Permissions - Best practices	1	2	1,2,3
	Chat functionality and Use	1	2	1,2,3
	Zoom, MS Teams, Google meet, Jiomeet,	1	2	1,2,3
Unit No. 6	**Network and Internet**	**3**	1	1,2,3
	Basics of Network	1	1	1,2,3
	Types of browsers, Safety measures, bookmarks	1	1	1,2,3
	Search engines	1	1	1,2,3
Unit No. 7	**Digital Identity for Professional Connect activities**	**5**	3	1,2,3
	Social media	1	3	1,2,3
	Dos and Don’ts handling Social Media Accounts	2	3	1,2,3
	Digital Profile	3	3	1,2,3
Unit No. 8	**Cybersecurity**	**1.5**	1	1,2,3
	Introduction to Cybersecurity	0.5	1	1,2,3
	Strategies to project the personal and professional data	0.5	1	1,2,3
	Awareness on various Cyber Attacks	0.5	1	1,2,3
	Security measures for Email, Personal computing systems		1	1,2,3
Unit No. 9	**Information and Data Literacy**	**4**	5	1,2,3
	Information & Data Mining Strategies	1	5	1,2,3
	Online resources	2	5	1,2,3
	Understanding on Plagiarism	1	5	1,2,3
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (60%)				End Semester Exam (40%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (15%)	
Level 1	Remember	70%	40%	30%	30%	30%
	Understand					
Level 2	Apply	30%	60%	70%	70%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Digital Literacy (20210401) Kindle Edition by Mandy Reininger (Author), Darrel Karbginsky (Author) Format: Kindle Edition
2. Digital Literacies: Concepts, Policies and Practices (New Literacies and Digital Epistemologies) New Edition by Colin Lankshear (Editor), Michele Knobel (Editor
3. Read the World: Rethinking Literacy for Empathy and Action in a Digital Age Illustrated Edition by Kristin Ziemke (Author), Katie Muhtaris (Author)

Other Resources

1.

Course Designers

1.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Fundamentals of Organic Chemistry

Course Code	CHE 201	**Course Category**	CORE	**L**	**T**	**P**	**C**
				3	**0**	**1**	**4**
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Dept. of Chemistry	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- **To learn the nomenclature of organic compounds, the identification of functional groups, and the principals involved in the structure and bonding of organic molecules.**
- **To learn the electronic effects of organic chemistry i.e. resonance, delocalization, hyperconjugation, inductive effects, and mesomeric effects on the formation, stability, and reactivity of reactive intermediates such as carbanions, carbocations, radicals, carbenes, and nitrenes.**
- **To learn the basic mechanistic principles involved in substitution, addition, elimination, elimination-addition, and addition-elimination reactions.**
- **To learn the isomerism of organic molecules such as optical, geometrical, and conformational isomerism.**

Course Outcomes / Course Learning Outcomes (CLOs)

CO's	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
1	Gain insights on the importance of organic chemistry in day-to-day life. Predict the structure and bonding in organic molecules and apply them to analyse the structure and properties of aromatic compounds.	2	80%	75%
2	Name organic molecules using IUPAC nomenclature and also be able to identify organic functional groups. Draw the organic reaction mechanisms using arrows. Apply the knowledge of the electronic effects on predicting the formation, stability, and reactivity of the organic molecules.	2	75%	70%
3	Evaluate the stability, formation, and reactivity of reactive intermediates, including carbanions, carbocations, radicals, carbenes, and nitrenes. Predict the mechanisms of substitution, addition-elimination, and elimination-addition reactions.	3	70%	65%
4	Gain insights in synthesis and reactivity of unsaturated aliphatic compounds such as Alkanes, Alkenes and Alkynes.	2	70%	65%
5	Identify and categorize different isomers of organic molecules. Distinguish and name the isomers based on the functional groups arrangement around the central carbon atom, they include both conformational and stereo isomers.	2	65%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking
Outcome 1	-	-	-	-	-	-	1	1	1	2	-	-	2	-	-
Outcome 2	-	1	-	-	-	-	-	-	1	2	-	-	2	-	-
Outcome 3	-	2	1	2	-	-	-	-	1	2	-	-	2	1	-
Outcome 4	-	2	1	1	-	-	-	-	1	2	-	-	2	1	-
Outcome 5	-	1	1	1	-	-	-	-	1	2	-	-	2	1	-
Course Average	-	1	1	1	-	-	1	1	1	2	-	-	2	1	-

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Structure, Bonding and Aromaticity	15		
	Organic chemistry in day-to-day life. Atomic Structure: Atom and Atomic Orbitals.	2	1	1,2
	Introduction to MO, MO - sp3, sp2 and sp.	2	1	1,2
	Bond length, Bond angle, Bond energies and Molecular geometry. Covalent and Ionic Bond.	1	1	1,2
	Structural Formulas Representation: Lewis's structure, Kekule structure, condensed structure and ball-and-stick model.	2	1	1,2
	Aromaticity - Benzenoids and Hückel's rule.	2	1	1,2
Unit No. 2	Functional group Identification	10		
	Nomenclature of Organic Compounds: Naming of alkyl substitutions, alkanes, alkenes and alkynes	3	2	1,2
	Identification of functional groups, Drawing of electron movements with arrows, homolytic and heterolytic bond breaking. Electronegativity concepts.	3	2	1,2
	dipole moment, bond polarization, inductive effect, electrometric effect, localized and delocalized chemical bonds, resonance, hyperconjugation, steric effect.	3	2	1,2
Unit No. 3	Reactive intermediates	10		
	Types of reactive intermediates – electrophile and nucleophiles. Stability, Structure, Generation and Fate of Carbocation, Carbanion, Free Radical, Carbene and Nitrene.	4	3	1,2,3
	Types of organic reactions - Addition - electrophilic, nucleophilic, and free radical. Substitution - electrophilic, nucleophilic, and free radical. Elimination Reaction.	3	3	1,2,3
	Acids and Bases - Brønsted theory, Hard and Soft Acids and Bases, effects of structure on the strengths of acids and bases.	2	3	1,2,3
Unit No. 4	Chemistry of Alkanes, Alkenes and Alkynes	10		
	Alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation - relative reactivity and selectivity.	2	4	1,2,3
	Alkenes: Degree of unsaturation. Stability of alkenes. Preparation: Elimination reactions: Dehydration of alcohols (Zaitsev's rule) and dehydrohalogenation of alkyl halides;	2	4	1,2,3
	Cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO4) and trans-addition (bromine).	2	4	1,2,3
	Addition of HX (Markownikoff's and anti-Markovnikov's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.	1	4	1,2,3
Unit No.5	Stereochemistry of Organic Molecules.	15		
	Conformational analysis of ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations.	3	5	1,2

	Stereoisomerism: Geometrical (cis-trans isomers) and optical isomerism. Molecular chirality (upto two chiral centres):	**2**	**5**	**1,2**
	Enantiomers, stereo genic centres, plane of symmetry, axis of chirality, optical activity, enantiomeric excess, diastereomers (erythro and threo).	**2**	**5**	**1,2**
	Nomenclature: R/S, +/-, D/L, and E/Z nomenclature. Stereogenic centres other than carbons: Chiral amines, phosphines and sulphur.	**2**	**5**	**1,2**
	Total Contact Hours	**60 Hours**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (__%)**								**End Semester Exam (__%)**	
		CLA-1 (__%)		**CLA-2 (__%)**		**CLA-3 (__%)**		**Mid Term (__%)**			
		Th	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**
Level 1	Remember	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Paula Y. Bruice Organic Chemistry, 7th Ed. Pearson Edition, 2014.
2. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press (2001).
3. Morrison, R. T. & Boyd, R. N. Organic Chemistry Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Vogel's Textbook of Practical Organic Chemistry by Furniss (Pearson Education).

Other Resources

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Inorganic Chemistry II: Chemistry of Elements

Course Code	CHE 202	**Course Category**	CORE	**L**	**T**	**P**	**C**
				3	**0**	**1**	**4**
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Dept. of Chemistry	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. **To describe general characteristics, chemical properties and in-depth knowledge on important compounds of s and p -block elements.**
2. **To understand the complex forming ability s-block elements and their structures.**
3. **Learners to gain basic properties of d and f-block elements. To impart knowledge on iodometric titrations and inorganic salt preparations**

Course Outcomes / Course Learning Outcomes (CLOs)

CO's	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
1	**Gain in-depth knowledge on classification between s, p, d, and f block elements**	**1 & 2**	**80%**	**75%**
2	**Know about the electronic and structural aspects of some important compounds of p block elements**	**3**	**75%**	**70%**
3	**Develop knowledge about the basic characterisitc features of d and f-block elements.**	**3**	**70%**	**65%**
4	**Learners should be able to attain knowledge on practical application of iodometric titrations**	**3**	**75%**	**70%**

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Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking
Outcome 1		1							2	1					
Outcome 2		1		1	1				2		1		1	1	
Outcome 3	1	2		1	1				1			1	1	1	
Outcome 4	2	2	2	2	1				1	2		1	2	2	
Course Average	2	2	2	2	1				2	2	1	1	2	2	

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Occurrence, abundance, and extraction. Physical properties - melting/boiling point and flame colour.	2	1	1
	Chemical properties - reaction with water, air, nitrogen, and oxygen. Solutions of alkali metals in liquid ammonia and their properties.	3	1	1
	Oxides of s-block elements, Complex forming tendency of s-block elements, a preliminary idea of crown ethers and cryptates.	3	1	1, 2
	Structures of basic beryllium acetate, salicylaldehyde/acetylacetonate complexes of s-block metals. Anomalous behavior of the first element in the groups Li and Be.	2	1	1, 2
Unit No. 2	Boron group: Occurrence and extraction; Physical properties, namely size metallic character/melting/boiling point variation.	2	1, 2	1, 2
	Compounds of boron - boron sesquioxide, borates, borax, boron hydrides-reaction with ammonia, the structure of diborane.	3	1, 2	1, 2
	Carbon group: Allotropy of carbon; carbides -classification. Oxides of silicon, ortho-, pyro-, cyclic-, chain-, sheet-.	3	1, 2	1, 2
	Three-dimensional silicates, their properties, and structures; silicates in technology -cement, ceramics, glass.	2	1, 2	1, 2
Unit No. 3	Nitrogen group: Occurrence, extraction, and uses of Nitrogen group elements. Oxides and oxoacids of nitrogen, phosphorus.	3	1, 2	1, 2
	Oxygen group: Abundance, extraction, and general properties. Ozone chemistry.	2	1, 2	1, 2
	Oxides: standard oxides, peroxides, suboxides, basic oxides, amphoteric oxides, acidic oxides, neutral oxides.	3	1, 2	1, 2
Unit No. 4	Occurrence and uses, rationalization of inertness of noble gases and general properties of Group 17 elements.	2	2	1, 2
	Interhalogen compounds, Halogen oxides.	3	2	1, 2
	Oxoacids of halogens, polyhalide ions, pseudohalogens.	3	2	1, 2
Unit No. 5	Trends in electronic configuration, oxidation states, ionization energies, atomic and ionic radii variation.	3	3	1, 2
	Colour, and magnetic properties of d and f-block elements.	3	3	1, 2
	Lanthanide contraction and comparison between Lanthanide and Actinides.	3	3	1, 2

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (40%)								End Semester Exam (30%)	
		CLA-1 (10%)		CLA-2 (10%)		CLA-3 (5%)		Mid Term (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	25%	20%	25%	15%	25%	25%	25%	25%	25%	25%
	Understand	25%	20%	25%	15%	25%	25%	25%	25%	25%	25%
Level 2	Apply	25%	30%	25%	35%	25%	25%	25%	25%	25%	25%
	Analyse	25%	30%	25%	35%	25%	25%	25%	25%	25%	25%
Level 3	Evaluate										
	Create										
Total		**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Concise Inorganic Chemistry: J.D. Lee, 2008, 5th edition, Blackwell Science.
2. Inorganic chemistry, Shriver & Atkins, Inorganic Chemistry, 5th edition, 2009, Oxford University Press.
3. Vogel's Quantitative Chemical Analysis, 6th edition, 2009, Pearson Education.

Other Resources

1. Enter Data

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Physical Chemistry II:

Chemical Thermodynamics and Chemical Kinetics

Course Code	**CHE 203**	**Course Category**	CORE		**L**	**T**	**P**	**C**
					3	**0**	**1**	**4**
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**				
Course Offering Department	Dept. of Chemistry	**Professional / Licensing Standards**						

Course Objectives / Course Learning Rationales (CLRs)

- To discuss basic terminology in thermodynamics and thermochemistry, and applications of the first law of thermodynamics.
- To elucidate the concepts of entropy, including residual and absolute entropies, and to critically examine the second and third laws of thermodynamics. Additionally, to apply Gibbs and Helmholtz free energy functions to characterize phase and chemical equilibria, and to estimate the equilibrium constants of chemical reactions
- Understand and explain basic chemical kinetics terminology, derive rate constant expressions for various reaction orders, discuss reaction rate theories, and illustrate complex reaction mechanisms with derivations for unimolecular and enzyme catalysis rate laws

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	**Explain basic terminology of thermodynamics and thermochemistry and apply the first law of thermodynamics for different thermodynamic processes.**	**2, 3**	**90%**	**80%**
Outcome 2	**Explain the concept of entropy and discuss applications of the second and third laws of thermodynamics.**	**2**	**80%**	**70%**
Outcome 3	**Apply Gibbs and Helmholtz free energy functions to characterize phase and chemical equilibria and calculate equilibrium constant**	**3**	**70%**	**60%**
Outcome 4	**Derive expressions of rate constant for reactions of zeroth, first and second order, and discuss collision theory and transition state theory.**	**2, 3**	**80%**	**70%**
Outcome 5	**Apply steady state approximation to derive expressions for rate laws of unimolecular and enzyme catalyzed reactions**	**3, 4**	**60%**	**50%**

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modem Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective Thinking
Outcome 1	3	3	2	2	2	1			1	1		1	2	2	2
Outcome 2	3	3	2	2	2	1			2	1		1	2	2	2
Outcome 3	3	3	3	2	2	3			3	1		2	3	1	2
Outcome 4	3	3	2	2	2	3			1	1		2	3	2	3
Outcome 5	3	3	3	2	2	1			3	1		2	3	2	2
Average	3	3	2	2	2	2			2	1		2	3	2	2

Course Unitization Plan

Unit no.	Syllabus topics	Required contact hours	Clos addressed	References used
Unit no. 1	**First law of thermodynamics and thermochemistry**	**12**		
	Basic terminology: concepts of heat (q) and work (w), open, closed and isolated systems, thermodynamic variables and thermodynamic equilibrium, zeroth law of thermodynamics, state and path functions, intensive and extensive properties.	**3**	**1**	**1, 2**
	First law: internal energy (u) and statement of first law, enthalpy (h), applications of first law for isothermal, adiabatic, isochoric and isobaric processes, work done in reversible and irreversible processes under isothermal and adiabatic conditions,	**3**	**1**	**1, 2**
	Effect of temperature (kirchhoff's equations) and pressure on enthalpy, concepts of heat capacity and specific heat capacity, relation between heat capacities at constant volume and constant pressure for an ideal gas.	**3**	**1**	**1, 2**
	Thermochemistry: exothermic and endothermic reactions, standard states; enthalpy of formation, enthalpy of combustion (and applications), enthalpy of neutralization, enthalpy of solution, enthalpy of phase transitions.	**3**	**1**	**1, 2**
Unit no. 2	**Second and third laws of thermodynamics**	**7**		
	Second law: carnot heat engine and its efficiency; concept of entropy; statements of second law of thermodynamics.	**3**	**2**	**1, 2**
	Molecular and statistical interpretation of entropy; calculation of entropy change for reversible and irreversible processes.	**2**	**2**	**1, 2**
	Third law: statement of third law, concept of residual entropy, calculations of absolute entropy of molecules.	**2**	**2**	**1, 2**
Unit no. 3	**Free energy functions and equilibria**	**11**		
	Free energy functions: gibbs (g) and helmholtz (a) free energies; free energy change and criteria of spontaneity; maxwell relations	**3**	**3**	**2, 3**
	Variation of g with temperature (gibbs-helmholtz equation) and pressure; molar gibbs free energy (chemical potential).	**2**	**3**	**2, 3**

	Phase equilibria: phase transitions in pure substances: phase equilibria and clausius-clapeyron equation	**2**	**3**	**2, 3**
	Thermodynamics of mixtures: partial molar quantities, variation of g with composition, gibbs-duhem equation.	**2**	**3**	**2, 3**
	Chemical equilibria: reaction gibbs energy, exergonic and endergonic reactions, reaction quotient, equilibrium constant and its relation to g, relation between kc and kp.	**2**	**3**	**2, 3**
Unit no. 4	**Introduction to Chemical Kinetics**	**7**		
	Basic terminology: rate of a reaction, law of mass action, rate law and rate constant, order and molecularity of a reaction	**1**	**4**	**1, 4**
	Rate constant and rate laws: integrated form of rate laws for zero, first and second order reactions, experimental methods for the determination of rate laws, temperature dependence of reaction rates	**3**	**4**	**1, 4**
	Theories of reaction rates: the Arrhenius equation and parameters, activation energy and effect of catalyst, introduction to transition state theory, the Eyring equation.	**3**	**4**	**1, 4**
Unit no. 5	**Reaction Mechanisms**	**7**		
	Complex reactions: opposing reactions, parallel reactions and consecutive reactions, steady-state approximation and rate-determining step.	**2**	**5**	**1, 4**
	Unimolecular reactions: Lindemann-Hinshelwood mechanism.	**3**	**5**	**1, 4**
	Enzyme catalysis: The Michaelis-Menten mechanism and the catalytic efficiency of enzymes.	**3**	**5**	**1, 4**

Course Unitization Plan – Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	Determination of heat capacity of calorimeter	4	1	5
2.	Determination of enthalpy of neutralization for reaction between strong acid and strong base by calorimeter	4	1	5
3.	Determination of enthalpy of ionization of acetic acid by calorimeter.	4	1	5
4.	Determination of the rate constant of the hydrolysis of ethyl acetate using an acid as a catalyst.	6	4	6
5.	Determination of the order of the acid-catalyzed hydrolysis of ethyl acetate by varying the concentration of HCl.	6	4	6
6.	Determination of the order of the acid-catalyzed hydrolysis of ethyl acetate by varying the concentration of ethyl acetate.	6	4	6
Total Contact Hours		**30 Hours**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (__%)								End Semester Exam (__%)	
		CLA-1 (__%)		CLA-2 (__%)		CLA-3 (__%)		Mid Term (__%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	50	30	40	90	30	50	30		40	50
	Understand										
Level 2	Apply	50	70	60	10	70	50	70		60	50
	Analyse										
Level 3	Evaluate	0	0	0	0	0	0	0		0	0
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Physical Chemistry: A Molecular Approach, D. A. McQuarrie and J. D. Simon, Viva Student Edition, Viva Books Private Limited (2019).
2. Peter Atkins & Julio De Paula, Physical Chemistry 10th Ed., Oxford University Press (2014).
3. McQuarrie, D. A. & Simon, J. D., Molecular Thermodynamics, Viva Books Pvt. Ltd.: New Delhi (2004).
4. K. J. Laidler, Chemical Kinetics, 3rd Edition, Pearson Education Inc. (2014).
5. S. P. Mohanty, S. Chauhan, Experiments in Thermochemistry, Campus Books, 2010.
6. D. A. McQuarrie, Statistical Mechanics, Viva Student Edition, Viva Books Pvt. Ltd.: New Delhi (2000)

Other Resources

Course Designer

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Leadership for Professionals

Course Code	SEC 106	**Course Category**		**L**	**T**	**P**	**C**
				2	**0**	**0**	**2**
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Management	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- To understand different leadership styles and their applications.
- To develop effective communication and interpersonal skills for leadership.
- To learn strategies for building and leading high-performing teams.
- To acquire techniques for problem-solving and decision-making in leadership roles.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Analyse and apply appropriate leadership styles in various contexts.	4	60%	80%
Outcome 2	Summarize and interpret effective communication strategies for team members and stakeholders	2	80%	70%
Outcome 3	Evaluate and devise strategies to lead teams in achieving goals and objectives efficiently	5	70%	50%
Outcome 4	Synthesize and implement problem-solving techniques to address challenges in leadership roles	5	80%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)													
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	1	2		1			3	3	2	2
Outcome 2	3	2	2	1		3	1	2	3	3	3	2	3	3
Outcome 3	3	2	3	2	2	3	3	3	1	2	3	3	3	3
Outcome 4	3	2	3	1	3		2	2	2	1	3	3	3	3
Average	3	2	3	2	2	3	3	2	2	2	3	3	3	3

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**The Evolution of Leadership**	**6**		
	Historical Perspectives on Leadership, Leadership during the industrial revolution, Contemporary Leadership Theories and Models	2	1,2	1, 2
	Trait theory: identifying key traits of effective leaders, Behavioural theory: exploring leadership behaviours and styles, Situational theory: adapting leadership styles to different situations,	2		
	Leadership in the Digital Age: Challenges and Opportunities, Leading virtual teams and remote workforces, Harnessing technology for effective leadership communication, Addressing ethical considerations in the digital era.	2		
Unit 2	**Emotional Intelligence and Leadership**	**6**		
	Understanding Emotional Intelligence (EQ), Definition and components of emotional intelligence, Importance of EQ in leadership effectiveness, Developing Self-Awareness and Empathy as a Leader	2	2,3	1,2
	Techniques for self-reflection and self-awareness, Practicing empathy and perspective-taking in leadership roles, Utilizing Emotional Intelligence to Enhance Team Performance	2		
	Building rapport and trust within teams, Managing emotions in challenging situations, Resolving conflicts through emotional intelligence.	2		
Unit 3	**Transformational Leadership**	**6**		
	Characteristics and Principles of Transformational Leadership, Inspiring vision and purpose, Intellectual stimulation and innovation, Individualized consideration and mentorship	2	2,3	1
	Inspiring and Motivating Teams Towards a Shared Vision, Communicating a compelling vision for the future, Empowering and motivating team members to achieve goals, Creating a Culture of Trust and Empowerment Within Organizations	2		
	Building trust through transparency and integrity, Delegating authority and fostering autonomy, Celebrating successes and learning from failures.	2		
Unit 4	**Leading with Purpose and Authenticity**	**6**		
	Discovering Personal Values and Aligning Them with Leadership Goals, Identifying core values and principles, Aligning personal values with organizational mission and vision	2	2,3,4	1
	Authentic Leadership: Being True to Oneself While Leading Others	2		
	Building Credibility and Trust Through Authentic Leadership Practices	1		1,2
	Leading by example and modelling desired behaviours	1		1,2
Unit 5	**Leading Through Adversity and Crisis**	**6**	3.4	
	Strategies for Leading During Times of Uncertainty and Crisis, Remaining calm and composed under pressure, Making tough decisions with limited information	2		1
	Crisis Communication and Decision-Making in Leadership Roles, Communicating effectively with stakeholders during crises, Implementing crisis management plans and protocols	2		1
	Building Resilience and Fostering Organizational Agility, Encouraging adaptability and flexibility within teams, Cultivating a culture of resilience and innovation.	2		
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Project	Th	Prac
Level 1	Remember	60%		60%		60%			100%	60%	
	Understand										
Level 2	Apply	40%		40%		40%				40%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**			**100%**	**100%**	

Recommended Resources

1.Yukl, G. (2020). Leadership in Organizations (9th ed.). Pearson Education, Inc

2.Maxwell, J. C. (2007). The 21 Irrefutable Laws of Leadership: Follow Them and People Will Follow You (10th Anniversary ed.). Thomas Nelson.

Other Resources

- Collins, J. (2001). Good to Great: Why Some Companies Make the Leap… and Others Don't. HarperBusiness.
- Sinek, S. (2009). Start with Why: How Great Leaders Inspire Everyone to Take Action. Portfolio.
- Sinek, S. (2014). Leaders Eat Last: Why Some Teams Pull Together and Others Don't. Portfolio.
- Sandberg, S. (2013). Lean In: Women, Work, and the Will to Lead. Knopf.
- Bennis, W. (2009). On Becoming a Leader (4th ed.). Basic Books.
- Tzu, S. (2002). The Art of War. Shambhala.
- Wooden, J., & Jamison, S. (2005). Wooden on Leadership: How to Create a Winning Organization. McGraw-Hill.
- Goleman, D., Boyatzis, R., & McKee, A. (2013). Primal Leadership: Unleashing the Power of Emotional Intelligence (10th Anniversary ed.). Harvard Business Review Press.
- Covey, S. R. (2004). The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change (25th Anniversary ed.). Free Press.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Basic Concepts in Analytical Chemistry

Course Code	**CHE 204**	**Course Category**	CORE		**L**	**T**	**P**	**C**
					3	**1**	**0**	**4**
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**				
Course Offering Department	Dept of Chemistry	**Professional / Licensing Standards**						

Course Objectives / Course Learning Rationales (CLRs)

- **To understand the principles and applications of gravimetric analysis, highlighting its significance in qualitative and quantitative chemical analysis.**
- **Describe the key components and principles of electrochemical methods in analytical chemistry, with a focus on oxidation-reduction titrations and their applications.**
- **Explain the working mechanism of UV-Visible absorption spectroscopy and elucidate the fundamental principles governing the interaction of radiation and matter in spectrochemical analysis. To understand good laboratory practice**

Course Outcomes / Course Learning Outcomes (CLOs)

COs	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
1	Explain the principles and applications of gravimetric analysis, titrations, and electrochemical methods.	**2**	**80%**	**70%**
2	Perform standardization and calibration procedures and execute acid-base titrations with accurate volumetric calculations	**3**	**70%**	**65%**
3	Analyse the interaction of radiation and matter in spectrochemical analysis and distinguish between different types of optical instruments	**4**	**70%**	**60%**
4	Examine the accuracy and precision of experimental results using statistical data treatment and assess the selectivity and linearity of analytical methods during validation	**4**	**70%**	**50%**

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modem Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective Thinking
Outcome 1	3	3	2	2	2		1	3	2	2			1	2	3
Outcome 2	3	3	2	2	2		1	2	1	2			3	3	3
Outcome 3	3	3	2	3	3		1	2	1	3			2	1	2
Outcome 4	3	3	2	3	3		3	3	2	3			3	2	1
Average	**3**	**3**	**2**	**3**	**3**		**2**	**3**	**2**	**3**			2	2	2

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Qualitative and quantitative analysis Role of analytical chemistry, terms associated with chemical analysis	3	1	1,2,3
	Statistical data treatment, sampling, standardization, calibration.	3	1	1,2,3
	Different types of errors	3	1	1,2,3
	Accuracy, precision, confidence limits, tests of significance	3	1	1,2,3
Unit No. 2	Classical methods and analysis Gravimetric analysis.	2	2	2,3
	Applications of gravimetric methods	4	2	2,3
	Titrations, volumetric calculations	3	2	4,5
	Indicators, neutralization titrations	2	2	4,5
	Acid-base equilibria, complexation, and precipitation reactions	1	2	4,5
Unit No. 3	Electrochemical methods Introduction to electrochemistry	1	3	4,5
	Electrochemical cells, standard electrode potentials	3	3	4,5
	Oxidation-reduction titrations, potentiometry	3	3	4,5
	Reference and indicator electrodes,	4	3	5,6,9
	Electrogravimetry, coulometry, voltammetry and its applications.	1	3	5,6,9
Unit No. 4	Spectrochemical analysis Interaction of radiation and instrument components	5	4	6,7,8
	Sources of radiation	2	4	6,7
	Types of Optical Instruments, signals, noise	2	4	7,8
	Principle of Fourier transform, UV-Visible absorption spectroscopy	3	4	7,8
	Principle of matter absorption of radiation, and spectrophotometers	2	4	8,9
Unit No. 5	Good laboratory practice Validation of analytical methods, validation process, selectivity, linearity, limit of detection	4	4	7,8,9,10

	laboratory safety, handling reagents, laboratory notebook, analytical balance, glassware	3	4	7,8,9
	preparation of solutions	3	4	7,8,9
Total Contact Hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (__%)**								**End Semester Exam (50%)**	
		CLA-1 (10%)		**CLA-2 (15%)**		**CLA-3 (15%)**		**Mid Term (15%)**			
		Th	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**
Level 1	Remember	40		40		40		40		40	
	Understand										
Level 2	Apply	40		40		40		40		40	
	Analyse										
Level 3	Evaluate	20		20		20		20		20	
	Create										
Total		**100**		**100**		**100**		**100**		**100**	

Recommended Resources

1. Douglas A. Skoog, Donald M. West, F. James Holler, and Stanley R. Crouch, Fundamentals of Analytical Chemistry, 10th edition, Cengage, 2022
2. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
3. Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company, Belmont, California, USA, 1988.
4. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
5. Harris, D.C.: Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.
6. Khopkar, S. M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.
7. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.

Other Resources

1. Douglas A. Skoog, Donald M. West, F. James Holler, and Stanley R. Crouch, Fundamentals of Analytical Chemistry, 10th Edition, Cengage, 2022
2. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
3. Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company, Belmont, California, USA, 1988.
4. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004
5. Harris, D.C.: Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016
6. Khopkar, S. M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.
7. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
8. Mikes, O. Laboratory Handbook of Chromatographic & Allied Methods, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
9. Ditts, R.V. Analytical Chemistry; Methods of separation, van Nostrand, 1974.
10. R. Gopalan and K.S. Viswanathan, Analytical Methods: Interpretation, Identification, Quantification (2018).

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Inorganic III: Transition Metal and Bioinorganic Chemistry

Course Code	CHE 205	Course Category	Inorganic Chemistry	L	T	P	C
				3	0	1	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Dept. of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. **To understand the theory, properties of coordination compounds.**
2. **To describe the structure and bonding in organometallic compounds and its applications as catalyst.**
3. **Learners to gain roles of metal ion in biology and its primary functions.**
4. **To impart knowledge on semi-micro analysis of mixtures of cations/anions and preparation coordination complexes.**

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Gain in-depth knowledge on coordination compounds.	1 & 2	80%	75%
Outcome 2	Know about the structure and bonding in different organometallic complexes.	3	75%	70%
Outcome 3	Develop knowledge about the inorganic aspects of metal ions in biological process.	3	70%	65%
Outcome 4	Learners should be able to attain knowledge on systematic semi-micro analysis of mixtures of cations/anions and metal complex preparations.	3	75%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective
Outcome 1	1	1		1	1	1				1			1		
Outcome 2	2	1		2	1	1			1	1	1		1	1	
Outcome 3	2	2		1	1	1						1	1	1	
Outcome 4	2	2	2	2	2		2		2	1		1	2	2	
Average	**2**	**2**	**2**	**2**	**2**	**1**	**2**		**2**	**1**	**1**	**1**	1	1	

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Werner's theory, and Valence bond theory (inner and outer orbital complexes). IUPAC nomenclature of coordination compounds, isomerism in coordination compounds.	2	1	1
	Stereochemistry of complexes with 4 and 6 coordination numbers. Structure and Bonding: EAN rule, VB theory limitations.	2	1	1
	Crystal field theory, measurement of 10 D_q (Δ_o), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 D_q (Δ_o, Δ_t). O_h vs. T_d coordination. Qualitative aspects of Ligand field and MO Theory.	4	1	1, 2
Unit No. 2	Application of crystal field (lattice energy, ionic radius, hydration energy, redox pot, spinel), Jahn-Teller distortion (static and dynamic). Magnetism and Spin only magnetic moment.	4	1, 2	1, 2
	Spectrochemical series of ligands. Nephelauxetic parameter charge transfer spectra, different types (an elementary idea with examples). Chemistry of some representative compounds: $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, $K_2[Ni(CN)_4]$, H_2PtCl_6, $Na_2[Fe(CN)_5NO]$ (d-d transitions).	4	1, 2	1, 2
Unit No. 3	Definition, nomenclature, and classification based on the nature of the metal-carbon bond. 16- and 18-electron rule. Metal carbonyls - Structure, preparation, and bonding in Mononuclear, polynuclear, bridging, and terminal carbonyls. Structure and bonding in transition metal alkyls, carbenes, and carbynes, and metallocenes.	6	1, 2	1, 2
	Hapticity(n) of organometallic ligands, examples of mono, tri, and penta-hapto cyclopentadienyl complexes. Simple examples of fluxional molecules.	2	1, 2	1, 2
	Metal-olefin complexes: Zeise's salt (preparation, structure, and bonding), Ferrocene (preparation, structure, and reactions).	2	1, 2	1, 2
	Homogeneous catalysis by organometallic compounds: hydrogenation, hydroformylation, and polymerization of alkenes. Ziegler-Natta catalyst, Wilkinson catalyst (No mechanism). Basic terminologies, kinetic factors affecting quantum yield, photochemistry of Co, Rh, Cr, and Ru.	4	2	1, 2
Unit No. 4	Elements of life: essential major, trace, and ultra-trace elements. Basic chemical reactions in the biological systems. The role of metal ions in biology (specially Na^+, K^+, Mg^{2+}, Ca^{2+}, Fe^{3+}/Fe^{2+}, Cu^{2+}/Cu^+, and Zn^{2+}). Metal ion transport across biological membrane Na^+-ion pump, ionophores	6	3	1, 2
	Alkali and alkaline earth metal ions in biological system-mechanism of transport across the cell membrane, biochemistry of magnesium and calcium.	3	3	1, 2

	Elementary ideas of structure and oxygen binding mechanism in metalloporphyrins with special reference to haemoglobin and myoglobin.	**2**	**3**	**1, 2**
Unit No. 5	**Fe-S proteins, redox behavior. Biological nitrogen fixation, Photosynthesis: Photosystem-I and Photosystem-II.**	**2**	**3**	**1, 2**
	Toxic metal ions and their effects, chelation therapy (examples only), Pt and Au complexes as drugs (examples only), metal-dependent diseases.	**2**	**3**	**1, 2**

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (40%)**								**End Semester Exam (30%)**	
		CLA-1 (10%)		**CLA-2 (15%)**		**CLA-3 (15%)**		**Mid Term (-- %)**			
		Th	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**
Level 1	Remember	50	40	50	30	50	50			50	
	Understand										
Level 2	Apply	50	60	50	70	50	50			50	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**	**100%**	**100%**	**100%**	**100%**	**100%**			**100%**	**100%**

Recommended Resources

1. Concise Inorganic Chemistry: J.D. Lee, 2008, 5th edition, Blackwell Science.
2. Basic Organometallic Chemistry: B.D. Gupta and A.J. Elias, 2nd edition, 2013, Universities Press (India)
3. Vogel's Qualitative Inorganic Analysis, Revised by G. Svehla. 2002, Pearson Educatio

Other Resources

1. Concise Inorganic Chemistry: J.D. Lee (1999) 5th Edition, Blackwell Science.
2. Inorganic chemistry, Shriver & Atkins' Inorganic Chemistry 5th edition, 2009.
3. Inorganic chemistry, Catherine E. Housecroft and Alan G. Sharpe, 2nd Edition, 2004, Pearson.
4. Inorganic Chemistry,: Principles of Structure and Reactivity, Fourth Edition, Pearson (2006)
5. Inorganic Chemistry, Miessler, G. L. & Donald, A. Tarr. (2011), 5thEd.(adapted).Pearson.
6. Basic Organometallic Chemistry: B.D. Gupta and A.J. Elias (2013) 2nd Edition, Universities Press (India)
7. Transition Metals in the Synthesis of Complex Organic Molecules: L. Hegedus and B. Soderberg (2009) 3rd Edition, University Science Books
8. Bioinorganic Chemistry: I. Bertini, H.B. Gray, J.S. Valentine and J. Lippard (2007) South Asian Edition, Viva Books Private Ltd
9. Practicals (30hr)
10. List of Experiments
11. Verification of spectrochemical series.
12. Please make octahedral complexes of Ni(II) with H2O, DMSO, pyridine, NH3, acetylacetonato, oxalate, ethylene diamine and measure the following spectral data. These complexes will be either in situ or isolated as the case may be.
13. FTIR spectra (in KBr);
14. UV-Vis absorption spectra in at least three (or more) different concentrations. (You can decide the concentrations based on the measured spectrum) (for eg., 0.01, 0.005 & 0.001 M or any other concentrations that you think are suitable.) Always starts from higher concentration and go to the lower ones simply by dilution.
15. Copper oxalate isolated as potassium salt and then measure both FTIR and UV-Vis absorption at least in three different concentrations (as explained above).
16. Bis(acetylacetonato) copper(II) complex and then measure both FTIR and UV-Vis absorption at least in three different concentrations (as explained above).
17. Tris(acetylacetonato) iron(III) complex and then measure both FTIR and UV-Vis absorption at least in three different concentrations (as explained above).
18. Bis(acetylacetonato)Ni(II) complex of octahedral type and then measure both FTIR and UV-Vis absorption at least in three different concentrations (as explained above).
19. References
20. Vogels Qualitative Inorganic Analysis, 7th Edn, Pearson Education, 2012.
21. Marr & Rockett Practical Inorganic Chemistry. John Wiley & Sons 1972.

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Chemistry of functional groups in organic molecules: structure and reactivity

Course Code	CHE 206	Course Category	CORE	L	T	P	C
				3	0	1	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Dept of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To learn the nomenclature of different organic functional groups and the reactivities of different organic functional groups.
2. To learn the fundamentals and concepts of oxidation and reduction reactions of organic compounds and the addition of nucleophiles to the various carbonyl compounds.
3. To learn the mechanism of important selective name reactions.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Recognize and naming of the organic compounds having different functional groups.	2	75%	70%
Outcome 2	Identify the reactivity of the different organic functional groups such as halogenated hydrocarbon, alcohol, phenol, ether, epoxides, carbonyl compounds, carboxylic acids, derivatives nitrogen containing functional groups.	2	80%	70%
Outcome 3	Execute oxidation and reduction reactions of organic compounds using various reagents.	3	75%	65%
Outcome 4	Interpret diverse nucleophilic addition reactions to carbonyl compounds, expanding their understanding of organic chemistry.	3	70%	60%
Outcome 5	Interpret the reaction mechanism of the important selective name reactions.	3	65%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective
Outcome 1	-	-	-	-	-	-	1	1	1	2	-	-	2	-	1
Outcome 2	-	1	-	-	-	-	-	-	1	2	-	-	2	-	1
Outcome 3	-	2	1	2	-	-	-	-	1	2	-	-	2	1	2
Outcome 4	-	2	1	1	-	-	-	-	1	2	-	-	2	1	2
Outcome 5	-	1	1	1	-	-	-	-	1	2	-	-	2	1	2
Average	**-**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**2**	**-**	**-**	**2**	**1**	**2**

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Chemistry of Halogenated Hydrocarbons Alkyl halides.	10		
	Nomenclature and methods of preparation; nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereo chemical aspects and effect of solvent etc. nucleophilic substitution vs. elimination.	3	1	1,2
	Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.	3	1	1,2,3
Unit No. 2	Alcohols, Phenols, Ethers, and Epoxides Alcohols.	15		
	Preparation of 1 °, 2°, 3° alcohols; Bouvaelt Blanc Reduction	3	2	2,3
	Reactions and properties of 1 °, 2°, 3° alcohols.	2	2	2,3
	preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement.	1	2	2,3
	Ethers and Epoxides: Preparation and reactions with Nucleophiles such as alcohols, ammonia derivatives and $LiAlH_4$.	3	2	2,3
	Carbonyl Compounds Structure, and reactivity	15		
Unit No. 3	Nomenclature and General reactivity of aldehyde and Ketones Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism.	2	3	1,2,3
	Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Perkin, Cannizzaro and Wittig reaction.	2	3	1,2,3
	Beckmann rearrangements, α haloform reaction and Baeyer Villiger oxidation, - substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH4, NaBH4, MPV.	3	3	1,2,3
	Addition reactions of unsaturated carbonyl compounds: Michael addition. Active methylene compounds.	3	3	1,2,3
	Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate. Reaction of Grignard reagent to carbonyl compounds.	2	3	1,2,3
Unit No. 4	Carboxylic Acids and their Derivatives.	10		
	Preparation, physical properties and reactions of monocarboxylic acids.	2	4	2,3
	Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic, lactic, malic, tartaric, citric, maleic and fumaric acids.	2	4	2,3
	Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic sustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters.	3	4	2,3
	Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.	3		
Unit No. 5	Nitrogen containing functional groups.	10		
	Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines:	2	5	3
	Effect of substituent and solvent on basicity; Preparation and properties.	2	5	3
	Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation.	2	5	3
	Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.	2	5	3
	Total Contact Hours	60 Hours		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (60%)								End Semester Exam (40%)	
		CLA-1 (15%)		CLA-2 (15%)		CLA-3 (15%)		Mid Term (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. 1. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University
2. 2. Sykes, Peter. A guidebook to mechanism in organic chemistry, Kiribati, Longman, 1986.
3. 3. B. S. Furniss.Vogel's Textbook of Practical Organic Chemistry 5th Edition, Pearson Education

Other Resources

1. Paula Y. Bruice Organic Chemistry, 7th Ed. Pearson Edition, 2014
2. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University
3. Press Jie Jack Li, Name Reactions: A Collection of Detailed Reaction Mechanisms, second Edition, Springer-Verlag Berlin Heidelberg, 2003
4. Boyd, R. N., Morrison, R. T. (2005). Organic Chemistry, United Kingdom: Prentice Hall
5. Sykes, Peter. A guidebook to mechanism in organic chemistry, Kiribati, Longman, 1986.
6. Laboratory (30 hrs)
7. List of experiments
8. Identification of Various Organic Functional group
9. Synthesis of alkyl halides from Alcohols
10. Synthesis of Pinacolone
11. Aldol condensation reaction by using conventional or general method
12. Generation of Grignard reagent and further reaction with aldehyde, ketone, ester
13. Synthesis of alkene via wittig reaction
14. Synthesis amine by reductive amination

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Physical Chemistry III: Chemistry of Solutions

Course Code	CHE 207	Course Category	CORE	L	T	P	C
				3	0	1	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Dept. of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To explain the basic principles of ionic equilibria and their applications in analyzing hydrolysis of salts, action of buffers, indicators, and pH-metric titrations. Outline the properties of dilute solutions and applications of colligative properties in determining the molar mass of solute.
2. To discuss basic concepts of electrolysis, different theories concerning conductance of weak and strong electrolytes, and applications of conductance measurements. To illustrate the concepts of electrode potential, electromotive force (emf), and working principles of different types of electrochemical cells and fuel cells.
3. To explore applications of electrochemical series, Nernst equation, and emf measurements. To discuss the concepts of physical adsorption, chemical adsorption, Freundlich and Langmuir adsorption isotherms.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain the basic principles of ionic equilibria and apply them in analysing salt hydrolysis and buffer action	2, 3	80%	70%
Outcome 2	Apply colligative properties in determining the molar mass of solute	3	80%	70%
Outcome 3	Explain theories about conductance of weak and strong electrolytes	2	90%	80%
Outcome 4	Explain working principles of different types of electrochemical cells and fuel cells	2	90%	80%
Outcome 5	Apply electrochemical series and Nernst equation in calculating cell emf and potentiometric titrations	3	80%	70%
Outcome 6	Discuss physical adsorption, chemical adsorption and adsorption isotherms, and principles of spectrophotometry measurements	2	90%	80%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective
Outcome 1	3	2	2	2	1	1			1	1		1	2	1	2
Outcome 2	3	2	2	2	1	1			1	1		1	2	1	2
Outcome 3	3	2	1	1	1	1			1	1		1	3	3	3
Outcome 4	3	2	2	2	2	1			1	1		1	3	3	3
Outcome 5	3	3	3	1	2	1			1	1		1	3	3	3
Outcome 6	2	1	1	1	2	1			1	1		1	3	1	3
Average	3	2	2	2	2	1			1	1		1	3	2	3

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Ionic Equilibria**	**9**		
	Theories of acids and bases: Bronsted-Lowry theory, Lewis theory, Arrhenius theory, acid and base dissociation constants, pH scale	2	1	1, 2
	Salt hydrolysis: calculation of hydrolysis constant, degree of hydrolysis and pH for different salts	2	1	1, 2
	Buffer solutions: derivation of Henderson equation and its applications, buffer capacity	2	1	1, 2
	Solubility product of sparingly soluble salts: applications of solubility product principle, ionic product, common ion effect	1	1	1, 2
	Indicators: Theories of acid–base indicators, selection of indicators and their limitations.	1	1	1, 2
	pH-metric titrations: Qualitative treatment of acid–base titration curves	1	1	1, 2
Unit No. 2	**Dilute Solutions and Colligative Properties**	**4**		
	Dilute Solutions: ideal and non-ideal solutions, concepts of activity and fugacity.	1	2	2
	Lowering of vapor pressure, Raoult's and Henry's Laws and their applications.	1	2	2
	(i) relative lowering of vapor pressure, (ii) elevation of boiling point, their applications in calculating molar masses of solute.	1	2	2
	(iii) depression of freezing point (iv) osmotic pressure, and amount of solute, their applications in calculating molar masses of solute.	1	2	2
Unit No. 3	**Theories of Electrolytic Conductance**	**10**		
	Basics: Resistance, conductance and cell constant, Arrhenius theory of electrolytic dissociation, strong and weak electrolytes, degree of ionization and factors affecting it, Faraday's laws of electrolysis, specific, molar and equivalent conductances.	2	3	1, 3
	Variation of equivalent conductance on dilution for weak electrolytes: Ostwald's dilution law.	2	3	1, 3
	Variation of equivalent conductance on dilution for strong electrolytes: Debye-Huckel-Onsagar equation, asymmetric and electrophoretic effects.	2	3	1, 3
	Applications of conductance measurements: conductometric titrations.	2	3	1, 3
	Ionic mobility and conductance: Kohlrausch's law and Kohlrausch's equation, transport number and its determination.	2	3	1, 3
Unit No. 4	**Electrochemical Cells**	**16**		
	Basics: Types of electrochemical cells and examples, electromotive force (emf) of a cell and its measurement.	2	4	1, 3
	Electrodes and electrode potentials: Standard electrode (reduction) potential and electrochemical series, different types of electrodes with examples,	2	5	1, 3
	Nernst equation, effect of complexation on reduction potential.	2	5	1, 3
	Applications of emf measurements: thermodynamics of cell reactions, potentiometric titrations (acid-base and redox), activity and activity coefficients of ions in solution, Debye-Hückel limiting law.	3	5	1, 3
	Concentration cells: with and without transference, liquid junction potential.	3	4	1, 3
	Batteries and Fuel cells: primary and secondary cells – Lechlanche cell and dry cell, lead acid battery	2	4	1, 3

	Lithium-ion battery, oxygen-hydrogen fuel cell	**2**	**4**	**1, 3**
Unit No. 5	**Surface Chemistry**	**4**		
	Adsorption: physical adsorption, chemisorption	**2**	**6**	**1**
	Freundlich and Langmuir adsorption isotherms	**2**	**6**	**1**
	Applications of adsorption in heterogeneous catalysis: The Langmuir-Hinshelwood mechanism	**2**	**6**	**1**

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (__%)								End Semester Exam (25%)	
		CLA-1 (15%)		CLA-2 (15%)		CLA-3 (15%)		Mid Term (__%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	50	30	40	90	30	40			40	50
	Understand										
Level 2	Apply	50	50	50	10	50	60			50	50
	Analyse										
Level 3	Evaluate	0	20	10	0	20	0			10	0
	Create										
Total		**100%**	**100%**	**100%**	**100%**	**100%**	**100%**			**100%**	**100%**

Recommended Resources

1. Peter Atkins & Julio De Paula, Physical Chemistry 10th Ed., Oxford University Press (2014).
2. D. A. McQuarrie and J. D. Simon, Molecular Thermodynamics, Viva Books Pvt. Ltd.: New Delhi (2004).
3. S. Glasstone, An Introduction to Electrochemistry, Affiliated East-West Press Pvt Ltd.: New Delhi (2017).
4. J. Mendham, R.C. Denney, J. D. Barnes, M. Thomas, B. Sivasankar, Vogel's Quantitative Chemical Analysis, 6th Ed., Pearson Education, 2009.

Other Resources

1. Peter Atkins & Julio De Paula, Physical Chemistry 10th Ed., Oxford University Press (2014).
2. McQuarrie, D. A. & Simon, J. D., Molecular Thermodynamics, Viva Books Pvt. Ltd.: New Delhi (2004).
3. S. Glasstone, An Introduction to Electrochemistry, Affiliated East-West Press Private Ltd.: New Delhi (2017).
4. Practicals (30 hrs)
5. List of Experiments
6. A. pH-metric titrations
7. 1. Strong acid vs. strong base
8. 2. Weak acid vs. strong base
9. B. Conductometric titrations
10. 3. Strong acid vs. strong base
11. 4. Weak acid vs. strong base
12. 5. Mixture of strong acid and weak acid vs. strong base
13. C. Potentiometric titrations
14. 6. Strong acid vs. strong base
15. 7. Weak acid vs. strong base
16. 8. Potassium dichromate vs. Mohr's salt
17. References
18. J. Mendham, R.C. Denney, J. D. Barnes, M. Thomas, B. Sivasankar, Vogel's Quantitative Chemical Analysis, 6th Ed., Pearson Education, 2009.

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Aromatic Compounds and Heterocycles

Course Code	CHE 301	Course Category	CORE	L	T	P	C
				3	0	1	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Department of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- **To understand and describe the Fundamentals of Aromatic Compounds.**
- **To analyse and apply Concepts of Electrophilic Aromatic Substitution Reactions.**
- **To synthesize and evaluate the Properties of Aromatic Compounds and Heterocycles.**

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain the significance of aromaticity in the stability of compounds	2	85%	75%
Outcome 2	Discuss and predict the electrophilic aromatic substitution reactions based on the reactivity of aromatic compounds.	3	85%	75%
Outcome 3	Describe the reactivity of the arenes with functional groups	2	85%	75%
Outcome 4	Discuss and apply synthetic methods for the preparation of heterocycles in the context of organic synthesis.	3	85%	75%
Outcome 5	Demonstrate the synthesis of aromatic compounds	2	90%	85%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective Thinking
Outcome 1	3	2	2	2	2				2		2	2	3	2	2
Outcome 2	3	2	2	2	2				2		2	2	3	2	2
Outcome 3	3	2	2	2	2				3		2	2	3	2	2
Outcome 4	3	2	2	3	2				3		3	2	3	2	2
Outcome 5	3	3	3	3	2				3		3	3	3	3	3
Average	3	2	2	2	2				2		2	2	3	2	2

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Aromaticity**			
	Introduction to aromatic compounds. Structure of benzene and its stability. Nomenclature of benzene derivatives. Polynuclear aromatic hydrocarbons: Naphthalene and anthracene. Aromatic Character: The Huckell's 4n+2 rule	8H		
Unit 2	**Electrophilic Aromatic Substitution (11 hrs)**			
	Mechanism of Electrophilic Aromatic Substitution (EAS) i. Friedel-Crafts alkylation and acylation ii. Nitration iii. Halogenation iv. Sulfonation Substituent effects on aromatic reactivity. Reactions of naphthalene and anthracene. Application of EAS in Organic Synthesis	11h		
Unit 3	**Benzene with Functional Groups (11 hrs)**			
	Phenols and its derivatives: Structure, preparation, and reactivity. Aryl halides: Structure, preparation, and reactivity. Aromatic carbonyl compounds: Structure, preparation, and reactivity. Nitrobenzene and Benzonitrile: Structure, preparation, and reactivity. Styrene and its derivatives: Structure, preparation, and reactivity	11h		
Unit 4	**Benzyne and Diazonium Salts**			
	Formation and Reactivity of Benzyne: Mechanism of benzyne formation. Applications in synthetic chemistry. Diazonium Salts: Methods of preparation. Substitution and coupling reactions of diazonium salts.			
Unit 5	**Synthesis and Properties of Heterocycles**			
	Classification and nomenclature Synthesis, properties, and mechanism of substitution reactions of Furan, Pyrrole, Thiophene and Pyridine Synthesis, properties and mechanism of substitution reactions of Indole, Quinoline and Isoquinoline			

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (__%)								End Semester Exam (__%)	
		CLA-1 (__%)		CLA-2 (__%)		CLA-3 (__%)		Mid Term (__%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	60%		40%	40%	60%		40%	40%	40%	40%
	Understand										
Level 2	Apply	40%		40%	60%	40%		40%	60%	40%	60%
	Analyse										
Level 3	Evaluate			20%				20%		20%	
	Create										
Total		**100%**		**100%**	**100%**	**100%**		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Organic Chemistry, Morrison, R. T. & Boyd, R. N. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Organic Chemistry, Paula Y. Bruice, 7th Ed. Pearson Edition, 2014
3. Heterocyclic Chemistry, Raj K. Bansal, New Age International, 2020
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)

Other Resources

1. Practicals (30 hrs)
2. List of Experiments
3. Bromination of any one of the following:
4. a. Acetanilide by conventional methods
5. B.Acetanilide using green approach (Bromate-bromide method)
6. Nitration of any one of the following:
7. a. Acetanilide/nitrobenzene by conventional method
8. b. Salicylic acid by green approach (using ceric ammonium nitrate).
9. Synthesis of Hantzsch ester
10. Fischer indole synthesis
11. Preparation of allyl phenyl ether from phenol
12. Preparation of benzonitrile from aniline
13. Detection of extra elements (N, X, S) in organic compounds by Lassaigne's test.
14. Textbooks
15. Organic Chemistry, Morrison, R. T. & Boyd, R. N. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
16. Organic Chemistry, Paula Y. Bruice, 7th Ed. Pearson Edition, 2014
17. Organic Chemistry, Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Oxford University
18. Heterocyclic Chemistry, Raj K. Bansal, New Age International, 2020
19. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
20. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5th Ed. Pearson (2012)
21. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Physical Chemistry IV:
Molecular Spectroscopy and Statistical Thermodynamics

Course Code	CHE 302	Course Category	CORE	L	T	P	C
				4	0	0	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Dept. of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- **To discuss basic principles of rotational spectroscopy and applications of rigid rotor models in understanding rotational spectra of molecules. Demonstrate usefulness of harmonic oscillator approximation and explain differences between IR and Raman spectra of molecules.**
- **To explain basic principles of electronic, NMR and ESR spectroscopies and their applications in predicting structures and properties of molecules.**
- **To discuss the central ideas of Maxwell-Boltzmann statistics and their applications in computing average values of macroscopic properties in a canonical ensemble. Explain the concept of partition function and illustrate its decomposition into nuclear and electronic components.**

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain principles of rotational spectroscopy and apply rigid rotor model in understanding rotational spectra of molecules	2, 3	90%	80%
Outcome 2	Apply harmonic oscillator model in interpreting IR and Raman spectra of molecules	3,4	90%	80%
Outcome 3	Explain basic principles of electronic, NMR and ESR spectroscopies and apply them in predicting structures and properties of molecules	2,3	70%	70%
Outcome 4	Explain central ideas of Maxwell-Boltzmann statistics and apply them in computing average values of macroscopic properties in a canonical ensemble.	2,3	70%	60%
Outcome 5	Derive expressions for different components of molecular partition functions	3,4	60%	50%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem	Critical and Reflective Thinking	Scientific Reasoning and Design	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturala nd Ethical	Individual and Teamwork Skills	Communicati onSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning	Critical and Reflective
Outcome 1	3	3	2	2	1				1	1		1	3	1	2
Outcome 2	3	3	2	2	1				1	1		1	3	1	2
Outcome 3	3	3	2	2	1				1	1		1	3	1	2
Outcome 4	3	3	2	2	1				1	1		1	3	1	1
Outcome 5	3	3	2	2	1				1	1		1	3	1	1
Average	3	3	2	2	1				1	1		1	3	1	2

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Basic Principles and Rotational Spectroscopy**	**11**		
	Basic principles: characteristics of electromagnetic radiation, the quantization of energy, the Born-Oppenheimer approximation, representation of spectra	3	1	1
	Width of spectral lines: collision broadening, Doppler broadening and uncertainty broadening	2	1	1
	Intensity of spectral lines: transition probability and transition dipole moment integral, population of states, path length of the sample and Beer-Lambert's law	2	1	1
	Rotational spectroscopy: rotational spectra of diatomic molecules, Moment of inertia, rigid rotor, energy levels and selection rules	2	1	1
	Calculation of bond length and isotopic masses, overview of rotational spectroscopy of polyatomic molecules	2	1	1
Unit No. 2	**Vibrational Spectroscopy**	**15**		
	Infrared spectroscopy: IR spectra of Diatomic molecules – harmonic oscillator approximation, selection rules, calculation of force constant	3	2	1
	IR spectra of polyatomic molecules – overtones, combination bands, and Fermi resonance, overview of anharmonic oscillator model.	4	2	1
	Raman Spectroscopy: classical and quantum mechanical explanations of Raman effect, Stokes and anti-Stoke's lines	4	2	1
	Pure rotational and vibrational Raman spectra, selection rules, mutual exclusion principle	4	2	1
Unit No. 3	**Electronic Spectroscopy and Basics of NMR and ESR Spectroscopies**	**18**		
	Electronic spectroscopy: Electronic spectra of diatomic molecules– vibrational coarse structure, intensity of vibronic spectra, Franck-Condon principle, rotational fine structure of vibronic transitions	3	3	1
	Electronic spectra of polyatomic molecules–different types of transitions in organic molecules	3	3	1
	Nuclear Magnetic Resonance (NMR) spectroscopy: basic principles, chemical shift and its measurement, factors influencing chemical shift, shielding and deshielding	3	3	1
	Diamagnetic and paramagnetic anisotropy, spin-spin coupling and factors influencing coupling constant *J*	3	3	1
	Electron Spin Resonance (ESR) spectroscopy: basic principles, zero field splitting, factors affecting the "g" value, hyperfine structure	3	3	1
	ESR spectra of simple radicals: deuterium and methyl free radicals.	3	3	1
Unit No. 4	**Introduction to Statistical Thermodynamics**	**12**		
	Basic ideas: concept of ensemble and ensemble averaging, canonical, grand canonical and microcanonical ensembles, overview of classical and quantum statistics.	3	4	2, 3
	The Canonical ensemble: Maxwell-Boltzmann statistics, Boltzmann factor and canonical partition function, calculation of average energy, heat capacity, entropy and average pressure,	3	4	2, 3
	Molecular partition function and its relation to canonical partition functions for systems of distinguishable and indistinguishable particles,	3	4	2, 3
	Decomposition of partition function into electronic and nuclear components, equipartition theorem.	3	4	2, 3
Unit No. 5	**Partition Functions of Ideal Gases**	**5**		
	Translational, electronic, vibrational and rotational partition functions of monoatomic and polyatomic ideal gases	3	5	3
	Statistical interpretation of entropy and Boltzmann's equation.	2	5	3

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (__%)								End Semester Exam (__%)	
		CLA-1 (__%)		CLA-2 (__%)		CLA-3 (__%)		Mid Term (__%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	50		40		30				40	
	Understand										
Level 2	Apply	50		50		50				50	
	Analyse										
Level 3	Evaluate	0		10		20				10	
	Create										
Total		**100%**		**100%**		**100%**				**100%**	

Recommended Resources

1. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Ed., McGraw Hill Education (India), Chennai (2017).
2. D.A. McQuarrie and J. D. Simon, Molecular Thermodynamics, Viva Student Edition, Viva Books Pvt. Ltd: New Delhi (2004).
3. D.A. McQuarrie, Statistical Mechanics, Viva Student Edition, Viva Books Pvt. Ltd: New Delhi (2000).

Other Resources

1. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Ed., McGraw Hill Education (India), Chennai (2017).
2. D.A. McQuarrie and J. D. Simon, Molecular Thermodynamics, Viva Student Edition, Viva Books Pvt. Ltd: New Delhi (2004).
3. D.A. McQuarrie, Statistical Mechanics, Viva Student Edition, Viva Books Pvt. Ltd: New Delhi (2000).

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Principles of Instrumental Analysis

Course Code	CHE 303	Course Category	Core	L	T	P	C
				4	0	0	4
Pre-Requisite Course(s)	CHE211, CHE 312	Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Dept. of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Understand the various types of instrumental methods and their components, including electrical components, circuits, signals, noise, and detectors.
- Learn how to select appropriate analytical methods based on the specific requirements of an analysis.
- Understand surface characterization techniques using spectroscopy and microscopy methods, such as electron spectroscopy, ion spectroscopic methods, electron-stimulated microanalysis, and scanning probe microscopy.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand the different types of instrumental methods, the components involved, electrical circuits, signals, noise, and detectors	2	80%	75%
Outcome 2	Compare methods such as precipitation, ion exchange, planar chromatography, capillary electrophoresis, high-performance liquid chromatography (HPLC), and gas chromatography to separate and analyse chemical components.	4	80%	75%
Outcome 3	Develop proficiency in optical atomic spectra, atomization methods, and diverse atomic spectrometry techniques such as absorption, fluorescence, emission, and mass spectrometry.	3	80%	70%
Outcome 4	Critically evaluate the performance and limitations of different instrumental techniques and their applications in analytical chemistry.	5	70%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective
Outcome 1	3	3	3	2	2		1	3	2	2			2	3	1
Outcome 2	3	2	2	2	2		1	2	1	2			3	2	3
Outcome 3	3	2	3	2	3		1	2	1	3			1	2	2
Outcome 4	3	3	3	3	3		3	3	2	3			2	1	3
Average	3	3	3	2	3		1	3	2	3			2	2	2

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Introduction to instrumental analysis**	**6**		
	Types of instrumental methods	3	1	1,2
	Components in instruments electrical components and circuits, signals	2	1	1,2
	Noise, and detectors, selecting an analytical method.	1	2	1,2,3
Unit No. 2	**Analytical separations**	**10**		
	Kinetics and separation	3	2	2,3
	Separation by precipitation, separating ions by ion exchange	2	2	1,2
	Planar chromatography, capillary electrophoresis	2	3	3,4
	Introduction to HPLC and gas chromatography	3	3	3,4
Unit No. 3	**Atomic spectrometry**	**10**		
	Optical atomic spectra, atomization methods	3	4	3,4,5
	Atomic absorption and atomic fluorescence spectrometry	4	4	4,5
	Atomic emission spectrometry, and atomic mass spectrometry.	3	4	4,5
Unit No. 4	**Surface characterisation by spectroscopy and microscopy**	**10**		
	Introduction to the study of surfaces, electron spectroscopy	5	4	4,5,6
	Ion spectroscopic methods	2	1	1,2
	Electron stimulated microanalysis methods and scanning probe microscopes.	3	1	1,2
Unit No. 5	**Miscellaneous methods**	**8**		
	Thermogravimetric analysis, differential thermal analysis	2	2	1,2,3
	Differential scanning calorimetry, isotope dilution method	3	2	2,3
	Microthermal analysis, and flow injection analysis	3	2	2,3
Total Contact Hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (__%)								End Semester Exam (__%)	
		CLA-1 (__%)		CLA-2 (__%)		CLA-3 (__%)		Mid Term (__%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		40%		40%		40%		40%	
	Understand										
Level 2	Apply	40%		40%		40%		40%		40%	
	Analyse										
Level 3	Evaluate	20%		20%		20%		20%		20%	
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Gunther, H., NMR Spectroscopy – An Introduction, John Wiley, 1980.
2. Brisdon, A. K., Inorganic Spectroscopic Methods, Oxford University Press, 2005.
3. Iggo, J. A., NMR Spectroscopy in Inorganic Chemistry, Oxford University Press, 2011.
4. Parrish, R. V., NMR, NQR, EPR and Mossbauer spectroscopy in Inorganic Chemistry, Ellis Horwood Limited, 1990.
5. Scott, R. A. and Lukehart, C. M., Applications of Physical Methods to Inorganic and Bioinorganic Chemistry, Wiley, 2007

Other Resources

1. Gunther, H.,NMR Spectroscopy – An Introduction, John Wiley, 1980.
2. Brisdon, A. K., Inorganic Spectroscopic Methods, Oxford University Press, 2005.
3. Iggo, J. A., NMR Spectroscopy in Inorganic Chemistry, Oxford University Press, 2011.
4. Parrish, R. V., NMR, NQR, EPR and Mossbauer spectroscopy in Inorganic Chemistry, Ellis Horwood Limited, 1990.
5. Scott, R. A. and Lukehart, C. M.,Applications of Physical Methods to Inorganic and Bioinorganic Chemistry, Wiley, 2007.
6. R. Gopalan and K.S. Viswanathan, Analytical Methods: Interpretation, Identification, Quantification (2018), Universities Press, India

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh

Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

The Quantum World:
An Introduction to Quantum Chemistry

Course Code	CHE 304	Course Category	Core	L	T	P	C
				4	0	0	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Dept. of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Facilitate students in cultivating a thorough comprehension of the fundamental principles of quantum mechanics in the context of exploring atomic and molecular structures.
- This includes the application of quantum postulates to solve problems involving particles in one, two, and three-dimensional boxes.
- Additionally, the course will introduce the concept of operators and elucidate their application in solving problems related to Hydrogen or Hydrogen-like atoms.
- Introduce approximation methods and their application in multi-electron systems.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand the foundational concepts and principles of quantum mechanics, including the inadequacies of classical mechanics and the motivation for quantum theory.	**2**	**85%**	**80%**
Outcome 2	Analyze and apply the fundamental postulates of quantum mechanics, including the significance of quantum mechanical operators and the concept of degeneracy.	**3**	**85%**	**80%**
Outcome 3	Apply quantum mechanics to solve problems related to vibrational and rotational motion, including the treatment of simple harmonic oscillators and rigid rotators.	**3**	**85%**	**80%**
Outcome 4	Analyze the qualitative treatment of quantum systems, including the hydrogen atom, hydrogen-like ions, and the Born-Oppenheimer approximation, and apply approximation methods to multi electron systems	**3**	**85%**	**80%**
Outcome 5	Compare and contrast different bonding models and evaluate their limitations in explaining the behavior of molecules.	**3**	**85%**	**80%**

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturalan d Ethical	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective
Outcome 1	3	2	2	3	3	3	1	2	2	2	2	3	2		
Outcome 2	3	2	2	3	3	3	1	2	2	2	2	3	2		
Outcome 3	3	2	2	3	3	3	1	2	2	2	2	3	2		
Outcome 4	3	2	2	3	3	3	1	2	2	2	2	3	2		
Outcome 5	3	2	2	3	3	3	1	2	2	2	2	3	2		
Average	3	2	2	3	3	3	1	2	2	2	2	3	2		

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1		2	1	1,2
	Inadequacy of classical mechanics, Introduction to quantum mechanics,			
	Black Body radiation, Planck's radiation law, Photoelectric effect,	2	1	1,2
	Bohr's Model, Compton effect, de-Broglie's hypothesis,	2	1	1,2
	Heisenberg's uncertainty principle, Mathematical background.	3	1	1,2
Unit No. 2		3	2	3,4
	Postulates of quantum mechanics, need for quantum mechanical operators, Introduction to degeneracy			
	Schrödinger equation and its application to free particle and exact solutions for a particle in a box;	3	2	3,4
	Quantisation of energy levels, zero-point energy, wavefunctions, probability distribution functions, nodal properties,	3	2	3,4
Unit No. 3		3	3	1,5
	Qualitative treatment of a simple harmonic oscillator model of vibrational motion: Vibrational energy of diatomic molecules and zero-point energy.			
	Schrödinger equation, transformation to spherical polar coordinates.	2	3	1,5
	Angular momentum: Commutation rules, quantisation of square of total angular momentum and the z-component.	1	3	1,5
	Rigid rotator model of rotation of diatomic molecules. Schrödinger equation, transformation to spherical polar coordinates	1	3	1,5
	Separation of variables. Spherical harmonics. Discussion of solution.	2	3	1,5
Unit No. 4		3	4	1,5
	Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantisation of energy (only final energy expression).			
	Average and most probable distances of electrons from nucleus. Born-Oppenheimer approximation and the concept of potential energy surface.	3	4	1,5
	Approximation methods: an overview of perturbation and variational methods and their application to multi-electron systems.	3	4	1,5
Unit No. 5		3	5	1,3
	Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches			
	LCAO-MO treatment of H_2^+. Bonding and antibonding orbitals.	3	5	1,3
	Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wavefunctions, detailed solution not required) and their limitations.	1	5	1,3
	Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH).	2	5	1,3

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (60%)			End Semester Exam (40%)
		CLA-1 (20%)	CLA-2 (20%)	CLA-3 (20%)	
Level 1	Remember	70	60	60	60
	Understand				
Level 2	Apply	30	40	40	40
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Peter Atkins & Julio De Paula, Physical Chemistry 10th Ed., Oxford University Press (2014).
2. Elements of physical chemistry, 5th Edition - Peter William Atkins, Julio De Paula, Oxford University Press, 2009
3. Modern Quantum Chemistry: Introduction to Advanced Electronic Structure Theory by Szabo and Ostlund, Dover Books on Chemistry.
4. Physical Chemistry: A Molecular Approach [1 ed.] - Donald A. McQuarrie, John D. Simon, University Science Books, 1997

Other Resources

1. Peter Atkins & Julio De Paula, Physical Chemistry 10th Ed., Oxford University Press (2014).
2. Elements of physical chemistry, 5th Edition - Peter William Atkins, Julio De Paula, Oxford University Press, 2009
3. Modern Quantum Chemistry: Introduction to Advanced Electronic Structure Theory by Szabo and Ostlund, Dover Books on Chemistry.
4. Physical Chemistry: A Molecular Approach [1 ed.] - Donald A. McQuarrie, John D. Simon, University Science Books, 1997

Course Designers

1. Enter Data

CO-CURRICULAR ACTIVITIES

Course Code	VAC 103	**Course Category**	VAC	**L**	**T**	**P**	**C**
				0	0	2	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	SA	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Develop essential skills, including leadership, communication, and teamwork, among students.
2. Offer opportunities for students to apply academic concepts in practical, real-world scenarios.
3. Promote self-exploration, confidence-building, and social responsibility.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	Demonstrate confidence in leading group activities, communicate clearly, and collaborate effectively with diverse teams.	2	80%	75%
Outcome 2	Apply theories to practical tasks by solving problems and adapting concepts to real-life situations through cocurricular activities	2	80%	70%
Outcome 3	Develop new experiences with an open approach through guided reflection to assess personal growth, skills, and learning for holistic development.	3	80%	70%

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments 100%**			
		CLA-1 25%	**CLA-2 25%**	**CLA-3 25%**	**CLA-4 25%**
Level 1	Remember				
	Understand				
Level 2	Apply	15%	15%	15%	15%
	Analyse				
Level 3	Evaluate	10%	10%	10%	10%
	Create				
Total		**25%**	**25%**	**25%**	**25%**

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

COMMUNITY SERVICE AND SOCIAL RESPONSIBILITY

Course Code	VAC 104	**Course Category**	VAC	**L**	**T**	**P**	**C**
				0	0	2	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CEL	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Encourage initiatives that address local needs, foster self-sufficiency, and promote environmental sustainability within the community.
2. Equip participants with a deeper understanding of social issues and a sense of responsibility towards marginalized communities.
3. Inspire active participation in community service programs and foster a culture of giving back among individuals and organizations.
4. Develop and implement programs that contribute to skill development, economic empowerment, and equal opportunities for underprivileged sections of society.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Develop effective strategies for identifying and addressing community needs.	3	80%	80%
Outcome 2	Demonstrate empathy and cultural sensitivity when engaging with diverse community groups.	4	80%	75%
Outcome 3	Implement sustainable solutions and evaluate their impact on social well-being.	5	90%	85%
Outcome 4	Collaborate effectively within teams to design and lead community service projects.	6	90%	80%

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 50%
		CLA-1 20%	Mid-1 20%	CLA-2 20%	CLA-3 20%	
Level 1	Remember	10%	10%			20%
	Understand					
Level 2	Apply		10%	10%		20%
	Analyse					
Level 3	Evaluate				10%	10%
	Create					
Total		**10%**	**20%**	**10%**	**10%**	**50%**

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to modern organic synthesis

Course Code	CHE 305	Course Category	Core	L	T	P	C
				3	1	0	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Dept. of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- The concepts of enolate formation and its reaction with different electrophiles and The concept and mechanism of important rearrangement reaction.
- The formation of C-C bonds by means of enolates and organometallic reagents.
- The concept of enantioselective synthesis and the differentiation between stereoselective and stereospecific synthesis.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain the enolate reactivity.	2	75%	70%
Outcome 2	Devise schemes for alkylation reaction of carbonyl compounds.	2	80%	70%
Outcome 3	Develop a synthetic scheme for C-C bond formation.	3	75%	65%
Outcome 4	Understand the concept of introducing chirality in a molecule.	3	70%	60%
Outcome 5	Evaluate the reactivity and synthetic potential of rearrangement reactions involving intermediates, such as carbocations, carbanions, carbenes, and nitrenes.	3	65%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective
Outcome 1							1	1	**1**	**2**			2		1
Outcome 2		1							**1**	**2**			2		1
Outcome 3		**2**	**1**	**2**					**1**	**2**			2	1	2
Outcome 4		2	**1**	**1**					**1**	**2**			2	1	2
Outcome 5		1	**1**	**1**					**1**	**2**			2	1	2
Average		**1**	**1**	**1**			**1**	**1**	**1**	**2**			2	1	2

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Formation of Carbon-Carbon Bond via enolates**	**15**		
	Tautomerism: formation enols by proton transfer, Evidence for the equilibration of Enolization catalysed by acids and bases, types of enol and enolate, Stability of enols, Consequences of enolization, reaction with enols or enolates as intermediates, Stable equivalents of enolate ions.	**5**	**1,3**	**1,2,3**
	some important considerations that affect alkylations, Choice of electrophile for alkylation, Lithium enolates of carbonyl compounds, Alkylations of lithium enolates.	**5**	**1,3**	**1,2,3**
	Using specific enol equivalents to alkylate aldehyde and ketones, Alkylation of β-dicarbonyl compounds, regioselectivity in Ketone alkylation, Alkylation reaction of enolates, using Michael acceptors as electrophiles.	**5**	**1,3**	**1,2,3**
Unit No. 2	**Formation of Carbon-Carbon Bond via Organometallic reagents**	**15**		
	Transition metals extend the range of organic reactions, The 18 electron rule, Bonding and reactions in transition metal complexes.	**5**	**2,3**	**2,3,4**
	Palladium homogeneous catalysis, Heck reaction, Cross-coupling of organometallics and halides, Palladium-catalysed amination of aromatic rings.	**5**	**2,3**	**2,3,4**
	Tsuji Trost reaction, Palladium catalysis in the total synthesis of natural products. An overview of some other transition metals.	**5**	**2,3**	**2,3,4**
Unit No. 3	**Stereospecific and Stereoselective synthesis**	**15**		
	Nature is asymmetric: The chiral pool, Resolution can be used to separate enantiomers, Chiral auxiliaries, Chiral reagents.	**5**	**4**	**1,2,3**
	Asymmetric catalysis, Asymmetric formation of carbon–carbon bonds, Asymmetric aldol reactions, Enzymes as catalysts.	**5**	**4**	**1,2,3**
	Stereochemical control in six-membered rings, Regiochemical control in cyclohexene epoxides, Reactions on small rings, Stereoselectivity in bicyclic compounds, Reactions with cyclic intermediates or cyclic transition states.	**5**	**4**	**1,2,3**
Unit No. 4	**Participation, rearrangement, and fragmentation**	**15**		
	Neighbouring groups effect, Carbocations rearrangement, The pinacol rearrangement, The dienone-phenol rearrangement, The benzilic acid rearrangement, The Favorskii rearrangement.	**5**	**3,5**	**2,3,5**
	Migration to oxygen: the Baeyer–Villiger reaction, The Beckmann rearrangement.	**5**	**3,5**	**2,3,5**
	Polarization of C–C bonds helps fragmentation, Ring expansion by fragmentation, The synthesis of nootkatone: fragmentation showcase.	**5**	**3,5**	**2,3,5**

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (60%)								End Semester Exam (40%)	
		CLA-1 (15%)		CLA-2 (15%)		CLA-3 (15%)		Mid Term (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. 1. Paula Y. Bruice Organic Chemistry, 7th Ed. Pearson Edition, 2014
2. 2. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University.
3. 3. Press Jie Jack Li, Name Reactions: A Collection of Detailed Reaction Mechanisms, second Edition, Springer-Verlag Berlin Heidelberg, 2003.

Other Resources

1. Paula Y. Bruice Organic Chemistry, 7th Ed. Pearson Edition, 2014
2. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University
3. Press Jie Jack Li, Name Reactions: A Collection of Detailed Reaction Mechanisms, second Edition, Springer-Verlag Berlin Heidelberg, 2003
4. J. D. Hepworth, D. R. Waring and M. J. Waring. "Aromatic Chemistry", RSC 2002, ISBN: 0-85404- 662-3.
5. J. McMurry. "Organic Chemistry", 9 th Edition, Cengage Learning, 2015

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Supervised Learning

Course Code	CHE 306	Course Category	CORE	L	T	P	C
				0	0	4	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Dept. of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Acquire ability to read literature papers, present on the literature reports.
- Understand research methodologies in different labs.
- Exposure to Diverse Research Techniques.
- Identification of research interests.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Mastering literature analysis, presentation, and debate skills through reading and discussing research papers.	3	80%	70%
Outcome 2	Students with hands-on experience in a variety of experimental techniques commonly used in chemistry research	3	70%	60%
Outcome 3	Students know the research methodologies employed in different chemistry subfields	2	70%	50%
Outcome 4	Students can identify their research interests within the chemistry department	2	70%	50%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modem Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective Thinking
Outcome 1	3	3	2	2	2	3	1		2	2		1	3	1	1
Outcome 2	3	3	2	2	2	2	1		1	2		2	1	3	2
Outcome 3	3	3	3	3	3	2	1		1	3		1	1	2	2
Outcome 4	3	3	3	3	3	3	3		2	3		1	2	1	3
Average	3	3	3	3	3	3	2		2	3		1	2	2	2

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Lab 1	25	1,2,3,4	1
Unit No. 2	Lab 2	25	1,2,3,4	1
Unit No. 3	Lab 3	25	1,2,3,4	1
Unit No. 4	Lab 4	25	1,2,3,4	1
Unit No. 5	Lab 5	20	1,2,3,4	1

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	Lab 1	25	1,2,3,4	1
2	Lab 2	25	1,2,3,4	1
3	Lab 3	25	1,2,3,4	1
4	Lab 4	25	1,2,3,4	1
5	Report writing	20	1,2,3,4	1
Total Contact Hours		**120**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			Final presentation and thesis (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember	10%	10%	10%	10%
	Understand				
Level 2	Apply	60%	60%	60%	60%
	Analyse				
Level 3	Evaluate	30%	30%	30%	30%
	Create				
Total		100%	100%	100%	100%

Recommended Resources

1. Research Methodology: A Step-By-Step Guide for Beginners, 5th Edition, Sage publications Ltd, 2019

Other Resources

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Polymer Materials

Course Code	CHE 331	Course Category	Core Elective	L	T	P	C
				4	0	0	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To understand the classification, nomenclature of polymer and distinguish various polymerization techniques. Learn the Concepts of Molar Mass and Distribution.
- To gain in-depth knowledge about the physical characteristics of polymers, commercial polymers and their applications.
- To understand the polymer rheology, polymer blends, liquid crystalline polymers, conducting polymers, and their applications

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Identify and categorize different types of polymers, including linear, branched, crosslinked, ladder, thermoplastic, thermosetting, fibres, elastomers, natural polymers, addition, and condensation polymers. Describe various polymerization techniques.	2	85%	70%
Outcome 2	Explain the concepts of number average, mass average, viscosity average, and their relationships in polymer systems. Understand the methods for determining molecular mass.	2	85%	70%
Outcome 3	Investigate the morphology and order in crystalline polymers. Examine the relationship between glass transition temperature (Tg) and melting temperature (Tm) in polymers	2	85%	70%
Outcome 4	Identify the synthesis and applications of commercial organic polymers.	2	85%	70%
Outcome 4	Analyse polymer rheology, liquid crystalline polymers. Evaluate the properties and applications of polymer blends, nanocomposites, and synthetic-natural fiber composites.	3	85%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and CT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Project Management and Finance	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	2	2	1	1			1	1		1	2	1	2
Outcome 2	3	2	2	2	1	1			1	1		1	2	1	2
Outcome 3	3	2	1	1	1	1			1	1		1	3	3	3
Outcome 4	3	2	2	2	2	1			1	1		1	3	3	3
Outcome 5	3	3	3	1	2	1			1	1		1	3	3	3
Average	2	1	1	1	2	1			1	1		1	3	3	3

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Introduction to polymers**	**15**		
	Nomenclature and classification of polymers	**2**	**1**	**1,2,4,5**
	Types of polymers- linear, branched, crosslinked, ladder, thermoplastic, thermosetting, fibres, elastomers, natural polymers, addition and condensation polymers.	**4**	**1**	**1,2,4,5**
	Stereoregular polymers- atactic, syndiotactic and isotactic	**3**	**1**	**1,2,4,5**
	Steppolymerization, Addition Polymers	**3**	**1**	**1,2,4,5**
	Radical, Cationic, Anionic Living polymerization, Block copolymers	**3**	**1**	**1,2,4,5**
Unit No. 2	**Molar mass and its determination**	**12**		
	Molecular mass and molar distribution.	**5**	**2**	**1,2,4,6**
	Number average, mass average, viscosity, average molecular mass and relation between them.	**2**	**2**	**1,2,4,6**
	Molecular mass distribution. Determination of molecular mass- Osmometry (membrane and vapour phase). Light scattering, gel permeation chromatography.	**3**	**2**	**1,2,4,6**
	Sedimentation and ultracentrifuge, viscosity method and end-group analysi	**2**	**2**	**1,2,4,6**
Unit No. 3	**Physical characteristics of polymers**	**15**		
	Morphology and order in crystalline polymers	**2**	**3**	**2,4**
	Configuration of polymer chains, crystal structure of polymers.	**2**	**3**	**2,4**
	Morphology of crystalline polymers, strain-induced morphology, crystallization and melting.	**3**	**3**	**2,4**
	The glass transition temperature (Tg), relationship between Tg and Tm, Effect of molecular weight, dilments, chemical structure, chain topology, branching and cross linking.	**4**	**3**	**2,4**
	Methods of determination of glass transition and crystallinity of polymers.	**2**	**3**	**2,4**
	Dendrimers, hyperbranched polymers, random branched polymers, branching density, influence of branching on the melt, viscosity, rheological and thermal properties of polymers.	**2**	**3**	**2,4**
Unit No. 4	**Commercial polymers**	**9**		
	Organic polymers: Commercial polymers	**1**	**4**	**1,3,7,8**
	synthesis and application of polyethylene, Cellulose Acetate, PMMA	**2**	**4**	**1,3,7,8**
	synthesis and application of polyamides, polyesters, Urea resins and epoxy resins	**3**	**4**	**1,3,7,8**
	Functional polymers: Fire retarding polymers Conducting polymers, biomedical polymers	**3**	**4**	**1,3,7,8**
Unit No. 5	**Polymer applications**	**9**		
	Polymer Rheology, Liquid crystalline polymers	**3**	**5**	**1,2,4**
	Ring opening polymerization, Physical and Reactive blends	**1**	**5**	**1,2,4**
	Nanocomposites and synthetic-natural fiber composites	**2**	**5**	**1,2,4**
	Concepts of conducting polymers and their applications in opto-electronics and sensors, one and 3D dimensional polymeric materials.	**3**	**5**	**1,2,4**

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	60%		40%		60%		40%		30%	
	Understand										
Level 2	Apply	40%		60%		40%		60%		70%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Ed., McGraw Hill Education (India), Chennai (2017).
2. P. Atkins & J. D. Paula, Physical Chemistry 10th Ed., Oxford University Press (2014).
3. D. A. McQuarrie, & J. D. Simon, Molecular Thermodynamics, Viva Books Pvt. Ltd.: New Delhi (2004).
4. D. A. McQuarrie, Statistical Mechanics, Viva Student Edition, Viva Books Pvt. Ltd.: New Delhi (2000).
5. Polymer Science-V. Govarikar
6. Principle of Polymer Chemistry-P. J. Flory
7. An Outline of Polymer Chemistry-James Q. Allen
8. Organic Polymer Chemistry-K. J. Saunders

Other Resources

1. Enter Data

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Structural Methods and Analysis

Course Code	CHE 332	Course Category	Analytical Chemistry	L	T	P	C
				4	0	0	4
Pre-Requisite Course(s)	CHE211, CHE312	Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Learn the fundamental principles and theoretical background of Nuclear Magnetic Resonance (NMR) Spectroscopy, Infrared (IR) and Raman Spectroscopy, Mass Spectroscopy, X-Ray Photoelectron Spectroscopy (XPS), and Electron Paramagnetic Resonance (EPR) Spectroscopy.
- Gain proficiency in the theory, instrumentation, and practical applications of IR, Raman spectroscopy, X-Ray Photoelectron Spectroscopy (XPS), Differential Scanning Calorimetry (DSC), Electron Paramagnetic Resonance (EPR) spectroscopy, and TGA.
- Learn to analyse and interpret complex spectroscopic data from NMR, IR, Raman, Mass, XPS, and EPR spectroscopy.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	**Understand the fundamental principles behind NMR, IR, Raman, Mass, XPS, and EPR spectroscopy.**	**2**	**80%**	**70%**
Outcome 2	**Describe the instrumentation and methodologies used in NMR, IR, Raman, Mass, XPS, and EPR spectroscopy.**	**2**	**70%**	**60%**
Outcome 3	**Distinguish between different types of spectra and understand the information they provide about molecular properties.**	**3**	**70%**	**50%**
Outcome 4	**Identify the quality of spectroscopic data, identifying potential errors and limitations**	**4**	**70%**	**50%**

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective Thinking
Outcome 1	3	2	2	2	2	2	1	3	2	2			3	2	3
Outcome 2	3	2	2	2	2	2	1	2	1	2			2	3	2
Outcome 3	3	2	3	3	3	3	1	2	1	3			1	3	2
Outcome 4	3	2	3	3	3	3	3	3	2	3			2	1	1
Average	3	2	3	3	3	3	2	3	2	3			2	2	2

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Nuclear Magnetic Resonance Spectroscopy Basics and Introduction to NMR spectra	5	1	1,3,4
	Applications to multinuclear various inorganic molecules	4	1	1,3
	Applications to multinuclear various organic molecules.	3	1	1,4
Unit No. 2	IR and Raman spectroscopy Theory of IR spectroscopy	2	3	1,2,3,4
	IR instrumentation	2	3	3,4
	IR sources and detectors, IR microscopy	3	3	2,3
	Theory of Raman spectroscopy, instrumentation,	3	3	3,4
	Different types of Raman spectroscopy,	2	3	3,4
	Applications of Raman spectroscopy	2	3	3,4
Unit No. 3	Mass Spectroscopy Basics and Introduction to Mass Spectroscopy.	4	3	3,4
	Mass Spectroscopy – Ionization sources	3	3	3,4
	Mass Spectroscopy – Mass analyzers	3	3	3,4
	Applications of Mass spectroscopy.	2	3	3,4
Unit No. 4	X-Ray Photoelectron spectroscopy Principles PES & Valence excitation spectroscopy	4	4	3,4,5
	Core level PES	3	4	3,4
	Valence-electron PES & Valence excitation spectroscopy	3	4	4,5
	Thermal methods of characterization: DSC and TGA.	2	4	4,5
Unit No. 5	Electron Paramagnetic Resonance Spectroscopy Introduction theory of EPR spectra, instrumentation	3	2	2,4,5
	Applications of EPR spectroscopy, spin labelling	3	2	2,4
	characterization of metal complexes, multiple resonance ENDOR and ELDOR effect.	4	2	4,5
Total Contact Hours		60		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (__%)	
		CLA-1 (10%)		CLA-2 (15%)		CLA-3 (10%)		Mid Term (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		50%		50%		50%		50%	
	Understand										
Level 2	Apply	50%		40%		40%		40%		40%	
	Analyse										
Level 3	Evaluate	10%		10%		10%		10%		10%	
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Gunther, H., NMR Spectroscopy – An Introduction, John Wiley, 1980.
2. Brisdon, A. K., Inorganic Spectroscopic Methods, Oxford University Press, 2005.
3. Iggo, J. A., NMR Spectroscopy in Inorganic Chemistry, Oxford University Press, 2011.
4. Parrish, R. V., NMR, NQR, EPR and Mossbauer spectroscopy in Inorganic Chemistry, Ellis Horwood Limited, 1990.
5. Scott, R. A. and Lukehart, C. M., Applications of Physical Methods to Inorganic and Bioinorganic Chemistry, Wiley, 2007

Other Resources

1. Principles of Spectroscopy, MIT OpenCourseWare
2. ChemLibreTexts, Spectroscopy
3. RSC Learn Chemistry – Spectroscopy resources

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Project II

Course Code	CHE 402	Course Category	Dissertation / Project (P)	L	T	P	C
				0	0	12	12
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Conceive and select a research problem based on personal interest and feasibility.
- Perform hands-on data collection using appropriate methodologies.
- Prepare and deliver an oral presentation of research findings, supported by a well-written report.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Construct a Research Design	3	75%	70%
Outcome 2	Apply a strategy for conducting a literature survey on the proposed concept	3	75%	70%
Outcome 3	Implement experimental procedures and techniques in the laboratory	4	75%	70%
Outcome 4	Create hands-on research experience in the field of chemistry	5	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective Thinking
Outcome 1	3														
Outcome 2	3														
Outcome 3	3														
Outcome 4	3														
Average	**3**														

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No.1	Research problem and project selection	50		
	Based on interest conceive an idea	25	1,4	1
	Do a feasibility check of the project	25	1,4	1
Unit No.2	Literature review and methodology refinement	50		
	Literature survey of the related works	25	2	3,4,5,7
	Write an abstract of the proposed idea	25	2	1
Unit No.3	Data collection and analysis	200		
	Hands-on data collection using chosen methodologies	150	3	1,2,3
	Ongoing meetings with faculty advisor to discuss progress	50	3	1,6,7
Unit No.4	Oral presentation, evaluation and publish results	60		
	Evaluation of written reports and oral presentation	30	3	1,7
	Initiation of the process for a possible publication	30	5	2,3,4,5,7

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			Final presentation and thesis (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember	10%	10%	10%	10%
	Understand				
Level 2	Apply	60%	60%	60%	60%
	Analyse				
Level 3	Evaluate	30%	30%	30%	30%
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. https://pubs.acs.org/
2. https://www.sciencedirect.com/
3. www.springer.com
4. https://onlinelibrary.wiley.com/
5. Research Methodology

Other Resources

1. Enter Data

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Selected Topics in Organic Synthesis

Course Code	CHE 433	Course Category	Core Elective	L	T	P	C
				4	0	0	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To establish a foundational understanding of pericyclic and photochemical reactions.
- To gain knowledge on oxidation and reduction reactions.
- To apply the spectroscopic techniques on elucidating the structure of simple organic molecules

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Discuss and predict the type of pericyclic reactions	2	80%	70%
Outcome 2	Discuss and predict the type of photochemical reactions	2	85%	80%
Outcome 3	Select appropriate oxidation and reducing agent for organic transformation reactions	3	85%	80%
Outcome 4	Elucidate the structure of simple organic compounds using different spectral data.	3	85%	80%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective
Outcome 1	-	-	-	-	-	-	1	1	1	2	-	-	2	-	1
Outcome 2	-	1	-	-	-	-	-	-	1	2	-	-	2	-	1
Outcome 3	-	2	1	2	-	-	-	-	1	2	-	-	2	1	2
Outcome 4	-	2	1	1	-	-	-	-	1	2	-	-	2	1	2
Average	-	1	1	1	-	-	1	1	1	2	-	-	2	1	2

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Pericyclic Reactions**	**10**		
	Mechanism and synthetic applications of cycloaddition, electrocyclic, sigmatropic and related pericyclic reactions.	**5**	**1**	**1**
	Explanation based on frontier orbital, correlation diagram and Huckel-Mobius approaches.	**4**	**1**	**1**
Unit No. 2	**Organic Photochemistry**	**12**		
	Photoreduction and photooxidation reactions	**4**	**2**	**1**
	Photoaddition reactions: Photoaddition of alkenes to carbonyl compounds (Paterno – Buchi). Photoaddition of alkenes and alkynes to aromatic compounds.	**5**	**2**	**1**
	Photochemical dimerization of alkenes, conjugated dienes, and aromatic compounds	**3**	**2**	**1**
Unit No. 3	**Oxidation and Reduction Reactions**	**12**		
	Oxidation of organic compounds with reagents based on peroxides, peracids, ozone, osmium, chromium, ruthenium, silver, dimethyl sulfoxide, iodine, and selenium dioxide.	**6**	**3**	**1,2**
	Reduction of organic compounds with reagents based on boron, aluminum, hydrogen, hydrazine, formic acid and dissolving metals.	**6**	**3**	**1,2**
Unit No. 4	**Spectroscopic Identification of Organic Compounds**	**26**		
	Basic principles of NMR spectroscopy, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant	**4**	**4**	**3**
	Anisotropic effects in alkene, alkyne, aldehydes and aromatics.	**2**	**4**	**3**
	13C NMR: Proton coupled, off–resonance decoupled, proton noise decoupled 13C NMR spectra. Regions of the 13C NMR spectrum**,** Different ways of describing chemical shift	**4**	**4**	**3**
	Interpretation of NMR spectra of simple compounds	**3**	**4**	**3**
	UV Spectroscopy: Basic principle, electronic transitions and application to structure elucidation.	**3**	**4**	**3**
	IR Spectroscopy: Basic principles, characteristic frequencies of common functional groups.	**3**	**4**	**3**
	Basic principles, ionization techniques, isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation.	**4**	**4**	**3**
	Structure elucidation problems using the above spectroscopic techniques	**3**	**4**	**3**

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (__%)								End Semester Exam (__%)	
		CLA-1 (__%)		CLA-2 (__%)		CLA-3 (__%)		Mid Term (__%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		40%		40%		40%		40%	
	Understand										
Level 2	Apply	60		60%		40%		40%		40%	
	Analyse										
Level 3	Evaluate					20%		20%		20%	
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Norman, R.O.C. (1993). Principles of Organic Synthesis (3rd ed.). Routledge.
2. Carruthers, Modern Methods in Organic Synthesis, Academic Press, 1989.
3. R.M. Silverstein and F. X. Webster, Spectrometric identification of organic compounds; John Wiley and Sons. Inc., Sixth edition (1997).

Other Resources

1. S. Sankararaman, Pericyclic Reactions: A Textbook: Reactions, Applications and Theory, Wiley-VCH, 2005
2. .William Kemp, Organic Spectroscopy, Third Edition , Macmillan (1994).
3. J.D. Coyle, Organic Photochemistry - Wiley, 1985.

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Chemistry on Computers: Molecular Modelling

Course Code	CHE 434	Course Category	Core Elective	L	T	P	C
				4	0	0	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Understand the principles and importance of molecular modelling in chemistry.
- To learn Familiarize with the theoretical background of computational techniques and selective application to various molecular systems.
- Learn the density functional theory-based calculation for modelling chemical reactions.
- Compare computational and experimental results and explain deviations.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	understand of the principles and significance of molecular modeling in the field of chemistry.	2	80%	85%
Outcome 2	utilize computational techniques such as quantum mechanics and molecular mechanics for molecular modeling.	2	85%	80%
Outcome 3	demonstrate the ability to conduct quantum chemical calculations using ab initio and density functional theory methods	3	80%	80%
Outcome 4	apply molecular modeling techniques to address real-world problems in chemistry, including drug design, material science, and other relevant areas	3	80%	85%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	2	2	2		2			2	1	1	2	2		
Outcome 2	2	2	2	2		2			2	2	1	2	2		
Outcome 3	2	2	2	2		2			2	2	2	2	2		
Outcome 4	2	2	2	2		2			2	2	2	2	2		
Average	2	2	2	2		2			2	2	2	2	2		

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Concepts in Molecular Structure.**	**9**		
	Overview of Classical and Quantum Mechanical Methods.	**3**	**1**	**1**
	Coordinate systems: Cartesian and Internal Coordinates, Bond lengths, bond angles and torsion angles.	**3**	**1**	**1**
	Writing Z -matrix (ex: water, methane, ethane, ethene, ethyne, H2O2).	**3**	**1**	**1**
Unit No. 2	**Potential Energy Surfaces and Energy Minimization Techniques**	**9**		
	Intrinsic Reaction Coordinates, Stationary points, Equilibrium points – Local and Global minima.	**1**	**1**	**1,2**
	Concept of transition state with examples: SN2 reactions, Diels-Alder Reactions.	**2**	**1&2**	**1,2**
	Applications of computational chemistry to determine reaction mechanisms.	**3**	**1&2**	**1,2**
	Geometry optimization, Methods of energy minimization: Multivariate Grid Search, Steepest Descent Method, Newton-Raphson method and Hessian matrix.	**3**	**1&2**	**1,2**
Unit No. 3	**Molecular Mechanics**	**12**		
	Introduction to Molecular Mechanics.	**3**	**3**	**1,2**
	Energy calculations, Bond stretching and bending, torsional term, Force Fields.	**3**	**3**	**1,2**
	Electrostatic interaction- van der Waals interactions.	**3**	**3**	**1,2**
Unit No. 4	**ab initio and DFT methods.**	**12**		
	Hückel MO theory with examples: ethane, propenyl, cyclopropenyl and benzene systems, Overview of Hartree-Fock theory, Properties calculated – energy, charges, dipole moments, bond order, electronic energies, resonance energies, Oxidation and reduction (cationic and anionic species of above systems).	**3**	**3**	**1,2**
	Advantages of ab initio calculations, Koopman's theorem.	**3**	**3**	**1,2**
	Brief idea of Density Functional Theory.	**3**	**3**	**1,2**
Unit No. 5	**Drug Design**	**9**		
	Physicochemical properties of drugs	**3**	**4**	**2,3**
	Introduction to drug design- Concept of receptor/target site- Lead identification and structure modification	**3**	**4**	**2,3**
	Concepts in molecular recognition, Drug like properties and associated empirical rules	**2**	**4**	**2,3**
	Structure based drug design Conformational search technique- Target structure-based Drug Design (Active site identification).	**1**	**4**	**2,3**

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (__%)						End Semester Exam (40%)	
		CLA-1 (20%)		CLA-2 (20%)		CLA-3 (20%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	60		55		55		60	
	Understand								
Level 2	Apply	40		45		45		40	
	Analyse								
Level 3	Evaluate								
	Create								
Total		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Enter Data

Other Resources

1. E- Resources
2. Problem sets

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Chemistry in Life and Medicine

Course Code	CHE 435	Course Category	Core Elective	L	T	P	C
				4	0	0	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Dept. of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To learn Understand the chemical structure and bonding of various biomolecules.
- To gain knowledge of the extraction, isolation, and structural elucidation of carbohydrates, α-amino acids, purines & nucleic acids, lipids, and steroids.
- To learn about important reactions of carbohydrates, α-amino acids & proteins, purines & nucleic acids, steroids, and lipids.
- To learn the interaction of bioactive molecules with various biomolecules.
- To learn and obtain a brief idea about drug discovery and various classes of drugs.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain the basics of biomolecule chemistry.	2	90%	85%
Outcome 2	Describe to explain the isolation and structural elucidation of carbohydrates, α-amino acids, purines & nucleic acids, lipids, and steroids.	2	90%	85%
Outcome 3	Illustrate the important reactions of carbohydrates,α-amino acids, purines & nucleic acids, lipids, and steroids.	3	85%	80%
Outcome 4	Discuss the interaction of bioactive molecules with various biomolecules	2	95%	90%
Outcome 5	Describe the process of drug discovery.	2	90%	85%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	CommunicationSkills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective
Outcome 1	3	2	3	3	1	1	1		2	1		2	3	1	1
Outcome 2	3	3	3	3	2	1	1		2	1		2	3	2	1
Outcome 3	3	2	3	3	2	1	1		3	2		2	3	2	2
Outcome 4	3	3	3	3	2	1	1		3	1		2	3	1	1
Outcome 5	3	3	3	3	1	1	1		3	1		2	3	1	1
Average	3	3	3	3	1	1	1		3	1		2	3	1	1

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Carbohydrates**	**9**		
	Definition, classification; Monosaccharides: Structure, configuration, conformation and reactions of glucose.	**3**	**1,2,3**	**1,3**
	Disaccharides: Structures and conformations of sucrose and maltose.	**3**	**1,2,3**	**1,3**
	Polysaccharides: Preliminary ideas of starch and cellulose.	**3**	**1,2,3**	**1,3**
Unit No. 2	**Amino acids and proteins**	**9**		
	Structure, classification, synthesis, physical and chemical properties of α-amino acids.	**2**	**1,2,3**	**1,3**
	Analysis of α-amino acids; Peptides: Structure and synthesis; Proteins: General nature and structure (primary and secondary).	**3**	**1,2,3**	**1,3**
	Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method).	**2**	**1,2,3**	**1,3**
	Determination of primary structure of C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme).	**2**	**1,2,3**	**1,3**
Unit No. 3	**Nucleotides and nucleic acids**	**8**		
	Introduction; structure and synthesis of important derivatives of purine bases like adenine and guanine.	**4**	**1,2,3**	**1,3**
	Structural elucidation of uric acid, nucleosides, nucleotides and nucleic acids; replication of DNA.	**4**	**1,2,3**	**1,3**
Unit No. 4	**Lipids and Steroids.**	**9**		
	Definition, general classification, glycolipids, phospholipids, fats and oils, saponification number.	**2**	**1,2,3**	**1,3**
	Iodine value; preliminary ideas of LDL and HDL. Definition, Diels' hydrocarbon, chemistry of cholesterol.	**3**	**1,2,3**	**1,3**
	Functional group, angular methyl group and ring size determination.	**2**	**1,2,3**	**1,3**
	Preliminary ideas of steroidal glycosides: cardiotonic glycosides, saponins.	**2**	**1,2,3**	**1,3**
Unit No. 5	**Drug Discovery and Pharmaceutical Compounds.**	**9**		
	Brief story regarding the drug discovery and how the drug interacts with different biomolecules.	**3**	**4,5**	**2**
	Structure and Importance Classification, structure and therapeutic uses of antipyretics.	**2**	**4,5**	**2**
	Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis).	**2**	**4,5**	**2**
	An elementary treatment of Antibiotics and detailed study of chloramphenicol.	**2**	**4,5**	**2**

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (__%)								End Semester Exam (__%)	
		CLA-1 (__%)		CLA-2 (__%)		CLA-3 (__%)		Mid Term (__%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	50%		60%		60%				50%	
	Understand										
Level 2	Apply	50%		40%		40%				50%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**				**100%**	

Recommended Resources

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VIth Edition. W.H. Freeman and Co.
2. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
3. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hi.
4. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
5. Arthur, I. V. Quantitative Organic Analysis, Pearson.
6. Arthur, I. Vogel, Elementary Practical Organic Chemistry, Part-1 Small scale preparations, Indian Edition, Pearson (2011).

Other Resources

1. Enter Data

Course Designers

1. Enter Data

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Research Project I

Course Code	CHE 401	Course Category	Analytical Chemistry	L	T	P	C
				0	0	5	5
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Dept. of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Conceive and select a research problem based on personal interest and feasibility.
- Perform hands-on data collection using appropriate methodologies.
- Prepare and deliver an oral presentation of research findings, supported by a well-written report

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand Research Design and Execution	2	75%	70%
Outcome 2	Apply a strategy for conducting a literature survey on the proposed concept	3	75%	70%
Outcome 3	Implement experimental procedures and techniques in the laboratory	4	75%	70%
Outcome 4	Create hands-on research experience in the field of chemistry	5	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	**3**	**3**	**3**	**3**				**3**			2	3	2	3
Outcome 2	3	3	**3**	**3**	**2**				**2**			3	3	3	3
Outcome 3	3	**3**	**3**	**3**	**2**				**3**			3	3	3	3
Outcome 4	3	3	**3**	**3**	**3**				**3**			3	3	3	3
Average	**3**	**3**	**3**	**3**	**2**				**3**			**3**	3	3	3

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Research problem and project selection**			
	Based on interest conceive an idea	**20**	**1,4**	**1**
	Do a feasibility check of the project	**10**	**1,4**	**1**
Unit No. 2	**Literature review and methodology refinement**			
	Literature survey of the related works	**15**	**2**	**3,4,5,7**
	Write an abstract of the proposed idea	**15**	**2**	**1**
Unit No. 3	**Data collection and analysis**			
	Hands-on data collection using chosen methodologies	**40**	**3**	**1,2,3**
	Ongoing meetings with a faculty advisor to discuss progress	**20**	**3**	**1,6,7**
Unit No. 4	**Oral presentation, evaluation, and publish results**			
	Evaluation of written reports and oral presentation	**20**	**3**	**1,7**
	Initiation of the process for a possible publication	**10**	**5**	**2,3,4,5,7**

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			Final presentation and thesis (50%)
		Experiments (20%)	Record/ Observation Note (10%)	Viva + Model (20%) Th Prac	
Level 1	Remember	10%	10%	10%	10%
	Understand				
Level 2	Apply	60%	60%	60%	60%
	Analyse				
Level 3	Evaluate	30%	30%	30%	30%
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. https://pubs.acs.org/
2. https://www.sciencedirect.com/
3. www.springer.com
4. https://onlinelibrary.wiley.com/
5. Research Methodology
6. Purdue Online Writing Lab

Other Resources

1. Enter Data

Course Designers

1. Enter Data