Department of Chemistry

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

(Applicable to the students admitted from AY: 2023 onwards)

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)		8	240
University AEC	4		
School AEC	4		
Value Added Courses (VAC)		8	240
University VAC	8		
School VAC	0		
Skill Enhancement Courses (SEC)		15	450
School SEC	7		
Department SEC	2		
SEC Elective	6		
Foundation / Interdisciplinary courses (FIC)		17	510
School FIC	17		
Department FIC	0		
Core + Core Elective including Specialization (CC)		80	2400
Core	60		
Core Elective (Inc Specialization)	20		
Minor (MC) + Open Elective (OE)	15	15	450
Research / Design / Internship/ Project (RDIP)		17	510
Internship / Design Project / Startup / NGO	5		
Internship / Research / Thesis	12		
	Total	**160**	**4800**

Semester wise Course Credit Distribution Under Various Categories										
Category	**Semester**									
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**	**%**
Ability Enhancement Courses - AEC	2	2	2	2	0	0	0	0	8	**5**
Value Added Courses - VAC	2	2	0	0	0	4	0	0	8	**5**
Skill Enhancement Courses - SEC	3	2	2	2	3	3	0	0	15	**9**
Foundation / Interdisciplinary Courses - FIC	11	6	0	0	0	0	0	0	17	**11**
CC / SE / CE / TE / DE / HSS	0	8	12	16	16	16	12	0	80	**50**
Minor / Open Elective - OE	0	0	3	3	3	3	3	0	15	**9**
(Research/ Design/ Industrial Practice/Project/Thesis/Internship) -RDIP	0	0	0	0	0	0	5	12	17	**11**
Grand Total	**18**	**20**	**19**	**23**	**22**	**26**	**20**	**12**	**160**	**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	AEC	U AEC	AEC 101	Art of Listening, Speaking, and Reading Skills	1	0	1	2
2	VAC	U VAC	VAC 101	Environmental Science	2	0	0	2
3	SEC	S SEC	SEC 101	Analytical Reasoning and Aptitude Skills	1	1	1	3
4	FIC	S FIC	FIC 111	Chemical Basis of Life	3	0	0	3
5	FIC	S FIC	FIC 112	Mathematics for the Physical World	2	1	0	3
6	FIC	S FIC	FIC 113	Fundamentals of Computing	2	0	1	3
7	FIC	S FIC	FIC 101	Emerging Technologies	2	0	0	2
				Semester Total	**13**	**2**	**3**	**18**

SEMESTER - II								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	AEC	U AEC	AEC 107	Effective Writing and Presentation Skills	1	0	1	2
2	VAC	U VAC	VAC 102	Universal Human Values and Ethics	2	0	0	2
3	SEC	S SEC	SEC 103	Entrepreneurial Mindset	0	0	2	2
4	FIC	S FIC	FIC 107	Principles of Management	3	0	0	3
5	FIC	S FIC	FIC 124	Psychology for Everyday Living	3	0	0	3
6	Core	CC	CHE 104	Concepts in Inorganic Chemistry	3	0	1	4
7	Core	CC	CHE 105	Atomic structure and states of matter	3	0	1	4
				Semester Total	**15**	**0**	**5**	**20**

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	S 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	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**15**	**0**	**4**	**19**

SEMESTER - IV								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	AEC	U AEC	AEC 104	Creativity and Critical thinking 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 106	Leadership for Professionals	2	0	0	2
5	Core	CC	CHE 204	Basic Concepts in Analytical Chemistry	3	1	0	4
6	Core	CC	CHE 205	Transition Metal and Bioinorganic Chemistry	3	0	1	4
7	Core	CC	CHE 206	Chemistry of Functional Groups in Organic Molecules: Structure and Reactivity	3	0	1	4
8	Core	CC	CHE 207	Chemistry of Solutions	3	0	1	4
9	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**18**	**1**	**4**	**23**

SEMESTER - V								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	UVAC	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-1	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	The Quantum World: 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	0	1	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**	**0**	**9**	**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	Chemistry on Computers: 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 242	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

E Skill Enhanced 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.

The Art of Listening, Speaking and Reading Skills

Course Code	AEC 101	Course Category		L	T	P	C
				1	0	1	2
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Literature and Languages	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To develop and enhance students' proficiency in listening, speaking, and reading skills,
- To help the participants understand the purpose and differentiate various types of audience.
- To prepare the students to produce Language in various contexts be it Oral or Written form.

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 advanced listening skills, to comprehend and respond to a wide range of spoken language varieties, accents, and contexts with increased accuracy and fluency.	2	90%	90%
Outcome 2	Articulate ideas and thoughts clearly and effectively in both informal and formal settings, utilizing appropriate vocabulary, grammar, and speech delivery techniques.	3	90%	90%
Outcome 3	Enhance their reading comprehension and critical analysis abilities, enabling them to understand complex texts, extract key information, and critically evaluate the content within various genres and subjects.	3	70%	70%
Outcome 4	Engage in effective and meaningful conversations, demonstrating improved listening skills, oral communication abilities, and comprehension of written texts, thereby enhancing their overall language proficiency and communication competence	2	60%	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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1					1	1		3	2	3		3			
Outcome 2					1	1			1	3		3			
Outcome 3					1	1			1	3		2			
Average					**1**	**1**			**1**	**3**	**3**	**3**			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Augmenting Listening skills**	**9**		
	Course introduction and objectives: Importance of LSRW	1	1	1 a
	Listening - Barriers to active listening and steps to Overcome	2	1	1 b
	Listening Comprehension How to take/ make notes (different ways)	2	1	1b, 2a, 2c
	Listening practice: Identifying main ideas, supporting details, and inferences and summarizing key points	2	1	1b, 2a, 2c
	Practice sessions: memory games, Chinese whisper	2	1	NA
Unit 2	**Developing Speaking Skills**	**9**		
	Strategies for good speech, Basics of grammatically correct speech	1	2	1a, 2 a, b, c
	Basics of phonetics and intonation	2	2	1a
	Oral presentations: do's and don'ts	1	2	1a
	Speaking Practice: Just a minute/ Impromptu, Story-telling/ Story starters Group discussions,	5	2	NA
Unit 3	**Communication and Persuasion**	**9**		
	Verbal Communication and Nonverbal Communication	2	2, 3	1a
	The art of persuasive communication (Ethos, pathos, Logos)	2	2, 3	1a
	Practice sessions (Convince the other Role plays, Self-introduction, Pitching, extempore, public speaking)	5	2, 3	NA
Unit 4	**Reading**	**9**		
	Reading strategies (Skimming and scanning, extensive and intensive)	2	2	1c
	Reading and analyzing various texts, including articles, essays, and academic papers	3	2	1c
	Reading Comprehension Practice	4	2	1c, 2a
Unit 5	**Integrated Skills and Real-World Application**	**9**		
	Engaging in discussions and debates on current issues	2	3	NA
	Real-world application of language skills (e.g., job interviews, social interactions)	2	3	NA
	Pitching Presentation	5	3	NA
	Total contact hours	45		
	Notional hours	15		
	Total Leaning Hours	**60**		

Learning Assessment

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

Recommended Resources

1a. Shoba, L. (2017). Communicative English: A Workbook. U.K: CambridgeUniversity Press.
1b. Leonardo, N. (2020) Active Listening Techniques: 30 Practical Tools to Hone Your Communication Skills. Rockridge Press
1c. Williams, A.J. (2014) Reading Comprehension: How To Drastically Improve Your Reading Comprehension and Speed Reading Fast! (Reading Skills, Speed Reading)

2a. https://learnenglishteens.britishcouncil.org/
2b. https://www.bbc.co.uk/learningenglish/
2c. https://www.ted.com/?geo=hi

Other Resources

1. -

Course Designers

1. -

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

Environmental Science

Course Code	VAC 101	Course Category	Value Added Course	L	T	P	C
				2	0	0	2
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Environmental Science and Engineering	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To describe the environmental concepts from ecology and earth science to address real-world problems.
- To interpret the complex interactions within and between environmental systems and to evaluate evolving environmental 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	Comprehend the environmental challenges that need attention.	1	80%	70%
Outcome 2	Summarize the types of environmental pollutions and possible effects to society	2	80%	70%
Outcome 3	Classify the natural environmental resources, present state, rate of depletion and future perspectives	2	80%	70%
Outcome 4	Articulate a project-based learning on existing local to global environmental issues	2	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	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	-	1	1	-	1	1	1	2	1	-	1	-	-	-
Outcome 2	1	-	1	1	-	1	2	1	2	1	-	1	-	-	-
Outcome 3	1	-	1	2	1	1	3	2	2	1	-	1	-	-	-
Outcome 4	1	-	1	2	2	1	3	3	2	2	1	1	-	-	-
Average	1	-	1	1.5	1.5	1	2.25	1.75	2	1.25	1	1	-	-	-

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1.	**Human, Environmental Issues, and Climate Change**	**6**	1	1,2,3
	The man-environment interaction	1	1	1,2,3
	Environmental issues and scales	1	1	1,2,3
	Land use and Land cover change	2	1	1,2,3
	Ozone layer depletion	1	1	1,2,3
	Understanding climate change and adaptation	1	1	1,2,3
Unit No. 2	**Environmental Pollution and Health**	**7**	2	1,2,3
	Understanding pollution; Definitions, sources, impacts on human health and ecosystem	2	2	1,2,3
	Air pollution	1	2	1,2,3
	Water pollution	1.5	2	1,2,3
	Soil pollution	1	2	1,2,3
	Solid waste	1.5	2	1,2,3
Unit No. 3	**Ecosystems, Biodiversity Conservation, and Sustainable Development**	**9**	3	1,2,3
	Ecosystems and ecosystem services	1	3	1,2,3
	Biodiversity and its distribution	1	3	1,2,3
	Threats to biodiversity and ecosystems	1	3	1,2,3
	Overview of natural resources	1	3	1,2,3
	Biotic resources	1	3	1,2,3
	Water resources; Soil and Energy resources	2	3	1,2,3
	Introduction to Sustainable Development Goals (SDGs)- targets and indicators	2	3	1,2,3
Unit No. 4	**Environmental Management, Treaties and Legislation**	**8**	4	1,2,3
	Introduction to environmental laws and regulation	2	4	1,2,3
	Environmental management system	2	4	1,2,3
	Pollution control and management	2	4	1,2,3
	Major International Environmental Agreements; Major Indian Environmental Legislations	2	4	1,2,3
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 / Understand	60%		40%				40%		30%	
Level 2	Apply / Analyse	40%		60%				60%		70%	
Level 3	Evaluate / Create										
Total		**100%**		**100%**				**100%**		**100%**	

Recommended Resources

1. Bharucha, E. (2004). Textbook for Environmental Studies for Undergraduate Courses. University Grant Commission, New Delhi.
2. R. Rajagopalan (2016). Environmental Studies (3rd edition), Oxford University Press

Other Resources

1. Sharma, P. D., Sharma, P. D. (2018) Ecology and environment. Rastogi Publications.
2. Lame, M., Marcantonio, R. (2022) Environmental Management: Concepts and Practical Skills. Cambridge University Press.
3. Kohli, K., Menon, M. (2021) Development of Environment Laws in India, Cambridge University Press.

Course Designers

1.

SRM University *AP*, Andhra Pradesh

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Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Analytical Reasoning and Aptitude Skills

Course Code	SEC 101	Course Category	SEC		L	T	P	C
					3	0	0	3
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 categorize, apply and use thought process to distinguish between concepts of quantitative methods.
2. To prepare and explain the fundamentals related to various possibilities.
3. To critically evaluate numerous possibilities related to puzzles.
4. Explore and apply key concepts in logical thinking to business 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	Use logical thinking and analytical abilities to solve quantitative aptitude questions from company specific and other competitive tests.	1	70%	60%
Outcome 2	Solve questions related to Time and Distance and Time and work from company specific and other competitive tests.	3	65%	70%
Outcome 3	Understand and solve puzzle questions from specific and other competitive tests	1	60%	60%
Outcome 4	Make sound arguments based on mathematical reasoning and careful analysis of data.	1	65%	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		3	2	2					2						
Outcome 2		3	2	2					1						
Outcome 3		3	2	1					2						
Outcome 4		3	1	2					2						
Average		3	2	2					2						

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Quantitative Aptitude**	**14**		
	Time, speed and distance	5	1,4	1,4
	Time and work, Pipes and cisterns	9	1,4	1,4
Unit II	Numbers, LCM and HCF.	2	1,4	1,4
	P and C	4	1,4	1,4
	Probability, progressions	4	1,4	1,4
Unit III	Geometry, Mensuration	5	1,2	2,3
	Clocks and calendars	4	1,3	1,4
Unit IV	Linear equation and special equations	5	1,2	1,2
	Quadratic equations	2	1,2	1,2
	Inequalities	2	2,3	2,3
	Sets and Venn diagrams	3	1,2	2,4
Total Contact Hours		**45**		

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%		Mid -2 15%			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		50%		40%		50%		50%	
	Understand										
Level 2	Apply	60%		50%		60%		50%		50%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Arun Sharma – How to prepare for Quantitative Aptitude, Tata Mcgraw Hill.
2. R.S. Agarwal – Reasoning. Reasoning for competitive exams – Agarwal.
3. Objective Quantitative Aptitude – Oswaal books.
4. Test of reasoning and numerical ability, quantitative aptitude book – Sahitya bhavan.
5. Radian's Quantitative Aptitude.
6. Quantitative Aptitude and Reasoning – Shyam Saraf / Abhilasha Swarup.
7. Fast track objective Arithmetic – Rajesh Verma.

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

Chemical Basis of Life

Course Code	FIC 111	**Course Category**	FIC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences/ Chemistry	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To learn the origin and composition of complex biomolecules and primitive cells, focusing on the chemical reactions that drive the force of life
2. To gain foundational knowledge in chemical thermodynamics, covering the basic principles of energy, work, and heat, and understanding the first and second laws of thermodynamics, entropy, spontaneity, reversibility, disorder, and the calculation of Gibbs free 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	List and describe biomolecules and cellular structures	2	70%	65%
Outcome 2	Compare different chemical bonding concepts	2	70%	65%
Outcome 3	Analyze and explain cellular processes and structures	4	50%	50%
Outcome 4	Apply thermodynamic principles to chemical systems	3	70%	65%
Outcome 5	Interpret and evaluate energy harvesting reactions in life	6	50%	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, 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	3	1	1				3		3	3	1	2
Outcome 2	3	3	3	3	1	1			1			3	3	3	2
Outcome 3	3	3	3	2	1	1			1			2	3	2	3
Outcome 4	3	2	3	3	1	1			1			3	3	3	3
Outcome 5	3	3	3	3	1	1			2	3		3	3	2	3
Average	**3**	**2.6**	**3**	**2.8**	**1**	**1**			**1.3**	**3**		**2.8**	**3**	**2.2**	**2.6**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Life: Origin, composition, and chemistry**	**9**		
	Origin of complex biomolecules and primitive cells	1.5	1	1, 2
	Chemical basis of life- Importance of carbon & water	1.5	1	1, 2
	Synthesis by polymerization; importance of self-assembly; Selectively permeable membranes	1.5	1	1, 2
	Concepts of acids, bases, and buffers	1.5	1	3
	Concepts and numerical problems on pH, K_a, K_b, K_w	1.5		2, 3
	Henderson-Hasselbalch equation	1.5	1	1, 2, 3
Unit 2	**Chemical bonding**	**9**		
	Definition and importance; Valence electrons and their role in bond formation	1.5	2	3
	Introduction of Lewis dot structure; Covalent bonds- single, double, and triple bonds	1.5		
	Electronegativity and polarity in covalent bonds; Ionic bonds- transfer of electrons, cations and anions	1.5	2	3
	An elementary idea of lattice structure	1.5		3
	Weak intermolecular associations. Coordinate bonds.	1.5	2	3
	Comparison of bond strengths of different bonds with special relation to biological systems.	1.5	2	3
Unit 3	**Life forms and processes**	**9**		
	Prokaryotes and eukaryotes (cell structures and organelles); Virus- lysogenic and lytic cycles	1.5	3	1, 2
	Bacteria- typical bacterial cells, bacterial gene transfer- conjugation, transformation, and transduction	1.5	3	1, 2
	Antibiotic resistance- an emerging threat; Microbiome; Cell cycle- mitosis and meiosis	1.5	3	1, 2
	Structure of DNA and organization of chromosomes	1.5	3	1, 2
	Central dogma- replication in prokaryotes	1.5	3	1, 2
	Central dogma- transcription, and translation in prokaryotes	1.5	3	1, 2
Unit 4	**Chemical thermodynamics**	**9**		
	Introduction to energy, work and heat in chemical systems; Differentiating between open, closed, and isolated systems	1.5	4	3
	First law of thermodynamics: conservation of energy, calculation of internal energy changes, concept of enthalpy	1.5	4	3
	Second law of thermodynamics: definition, concept of entropy, calculation and interpretation of entropy changes	1.5	4	3
	Spontaneity, reversibility, and disorder	1.5	4	3
	Gibbs free energy: calculation, predicting feasibility of reaction	1.5	4	2, 3
	Concept of chemical equilibrium	1.5	4	1, 2, 3
Unit 5	**Energy harvesting reactions by life forms**	**9**		
	Biological reactions: Enzymes	1.5	5	1, 2
	Equilibrium constants (K_{eq}) of enzymes	1.5	5	1, 2
	Metabolism: Glycolysis	1.5	5	1, 2
	Anaerobic respiration	1.5	5	1, 2
	Aerobic cellular respiration	1.5	5	1, 2
	Fate of food in cellular energy cycle.	1.5	5	1, 2
Total Contact Hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (30%)	
		CLA-1 (20%)		Mid-1		CLA-2 (25%)		CLA-3 (25%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%				40%		40%		30%	
	Understand										
Level 2	Apply	60%				40%		40%		45%	
	Analyse										
Level 3	Evaluate					20%		20%		25%	
	Create										
Total		**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. ISBN-13: 978-1292177694.
2. Life: The Science of Biology, 11th Edition (2017). David Sadava, David M. Hillis, H. Craig Heller, Sally D. Hacker. Sinauer Associates Inc. ISBN-13: 978-1319121078.
3. Chemistry, 12 the Edition (2015). Raymond Chang, Kenneth A. Goldsby. McGraw-Hill Education. ISBN-13: 978-0078021510.

Other Resources

1. -

Course Designers

1. Dr. Writoban Basu Ball, Dept. Of Biological Sciences. SRM University – AP

SRM University *AP*, Andhra Pradesh

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

Mathematics for Physical World

Course Code	FIC 112	Course Category	FIC	L	T	P	C
				2	1	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Mathematics	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To enable students from the very beginning of their undergraduate course to know what Mathematics is about.
- To consolidate and improve students' understanding of mathematics by studying core mathematical topics in more depth.
- To understand the usefulness, power, and beauty of mathematics

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	Interpret mathematical concepts of set theory to solve appropriate problems in both familiar and unfamiliar situations including those in real-life contexts.	2	80%	70%
Outcome 2	Demonstrate basic matrix operations and apply the concepts to real-world applications.	3	80%	70%
Outcome 3	Express derivative as a limit and apply these techniques to graph sketching and optimization problems.	3	70%	65%
Outcome 4	Illustrate the process of integration as anti-differentiation and utilize it to solve several real-world problems.	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	3	3	3					1			2	3	1	2
Outcome 2	3	3	3	2	1				2			2	3	2	2
Outcome 3	3	3	3	3	1				2			2	3	2	2
Outcome 4	3	3	3	3	3				3			2	3	2	2
Average	3	3	3	3	2				2			2	3	2	2

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact hours	CLOs Addressed	Reference Used
Unit No. 1	**High School Mathematics and its Applications**	**6**		
	Set Theory	1	1	1
	Tutorial-I	1	1	1
	Permutation	1	1	1
	Tutorial -II	1	1	1
	Combination	1	1	1
	Tutorial-III	1	1	1
Unit No. 2	**Matrices and System of Linear Equations**	**10**		
	Introduction to Matrices	1	2	3
	Matrix Operations and Algebraic Properties of Matrices	2	2	3
	Tutorial-I	1	2	3
	Determinant and inverse of matrices	2	2	3
	Tutorial-II	1	2	3
	System of Linear Equations and their solutions	2	2	3
	Tutorial-III	1	2	3
Unit No. 3	**Differential Calculus**	**9**	3	
	Functions and their graph	2	3	1,2
	Tutorial-I	1	3	1,2
	Limit and Continuity of a function	2	3	1,2
	Derivative of a function and various rules	2	3	1,2
	Increasing and Decreasing functions	1	3	1,2
	Tutorial-II	1	3	1,2
Unit No. 4	**Integral Calculus**	**8**		
	Indefinite Integrals	2	4	1,2
	Tutorial-I	1	4	1,2
	Definite Integrals	2	4	1,2
	Tutorial-II	1	4	1,2
	Fundamental Theorem of Calculus	1	4	1,2
	Tutorial-III	1	4	1,2
Unit No. 5	**Applications**	**12**		
	Applications of Permutations and Combinations: Formation of molecules	1	1	1,2
	Generation of ON/OFF signals in computing	1	1	
	Tutorial-I	1	1	1,2
	Applications of Matrices: Cryptography by Matrices	1	2	1,2
	Electrical circuit problem	1	2	1,2
	Tutorial-II	1	2	
	Applications of Differential Calculus: Work done and Electric field	1	3	1,2
	Energy behaviour of physical system and computation of Area and volume	1	3	1,2
	Tutorial-III	1	3	1,2
	Applications of Integral Calculus: Kinematics of one-dimensional system	1	4	1,2
	Concept of Slope and analysis of its real-life applications	1	4	1,2
	Blood flow and Cardiac Output	1	4	1,2
	Total Contact Hours	**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (ds60%)				End Semester Assessments (40%)
		CLA-1 (15%)	Mid-1 (25%)	CLA-2 (10%)	CLA-3 (10%)	
Level 1	Remember	30%	20%	25%	25%	20%
	Understand	20%	30%	30%	25%	30%
Level 2	Apply	25%	30%	25%	25%	25%
	Analyse	25%	20%	20%	25%	25%
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Rosen, K. H. (2012). Discrete Mathematics and Applications (7th ed.). New Delhi: Tata McGraw-Hill.
2. Hass, J. R., Heil, C. E., & Weir, M. D. (2018). Thomas' Calculus (14th ed.). Place of publication: Publisher Name.
3. Hill, D., & Kolman, B. (2019). Elementary Linear Algebra with Applications (9th ed.). Place of publication: Pearson.

Other Resources

1.

Course Designers

1.

SRM University *AP*, Andhra Pradesh

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

Fundamentals of Computing

Course Code	FIC 113	Course Category	Core Course	L	T	P	C
				2	0	1	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 Computer Science and problem solving.
- Gain basic knowledge in C programming language.
- Acquire knowledge on Decision making and functions in C.
- Learn arrays, strings and pointers concept in C.

Course Outcomes / Course Learning Outcomes (CLOs)

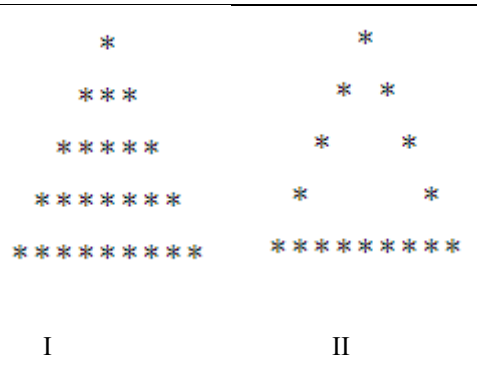
	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe basics of Computing and problem solving	2	75 %	70%
Outcome 2	Describe C structures, enumerators, keywords, header files and operators	3	70 %	65%
Outcome 3	Illustrate Decision-Making statements and Functions.	3	70 %	65%
Outcome 4	Interpret arrays, strings, and pointers programming in C	3	70 %	65%
Outcome 5	Apply Structures, unions, File handling operations on different scenarios	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 No. 1	**INTRODUCTION TO COMPUTING**	**10**	1	1
	Fundamentals of Computing, Historical perspective, Early computers	2	1	1,2
	Computing machine. Basic organization of a computer.	2	1	1,2
	ALU, input-output units, and addresses - instructions	2	1	1,2
	Computer Memory	2	1	1,2
	Program counter - variables	1	1	1,2
	Store, arithmetic, input and output	1	1	1,2
Unit No. 2	**INTRODUCTION TO PROBLEM SOLVING**	**10**		
	Problem solving: Algorithm / Pseudo code, flowchart, program development steps	2	1	1,2
	Computer languages: Machine, symbolic and high-level langua Level languages	2	1	1,2
	Creating and Running Programs: Writing, editing (any editor),	1	1	1,2
	linking, and executing in Linux environment	1	1	1,2
	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 No. 3	**C PROGRAMMING BASICS**	**15**		
	Structure of a C program, identifiers Basic data types and sizes. Constants, 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 conversi Type Conversions,	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, examples, 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
	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	2	1, 2	1,2

	 I II			
Unit No. 4	**FUNCTIONS AND ARRAYS**	**19**		
	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
	Lab Experiment 6: **a)** (nCr) and (nPr) of the given numbers b) $1+x+x^2\backslash 2+x^3\backslash 3!+x^4\backslash 4!+\ldots\ldots\ldots X^n\backslash n!$	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 c) 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. 5	**POINTERS**	**14**		
	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

	Lab Experiment 10: a. Illustrate call by value and call by reference. b. Reverse a string using pointers c. Compare two arrays using pointers	2	3, 4	1,2,3
	Lab Experiment 11: a. Array of Int and Char Pointers. b. 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
	Lab Experiment 14: a.File copy b. Word, line and character count in a file.	2	5	2, 3, 4
Total Hours		**68**		

Learning Assessment

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

Emerging Technologies

Course Code	FIC 101	Course Category	FIC	L	T	P	C
				2	0	0	2
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	ECE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. Foster a comprehensive grasp of diverse emerging technologies and their transformative impacts on society and industries.
2. Cultivate critical thinking skills to analyze challenges, opportunities, and applications within each technological domain.
3. Develop practical skills through hands-on experiences and assignments, translating theoretical concepts into real-world applications.
4. Raise awareness of ethical considerations, particularly in the context of Artificial Intelligence, and Machine Learning, IoT, Electric Vehicles, and Semiconductor Technology.

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	Exhibit a thorough understanding of quantum computing principles, including superposition, entanglement, and interference.	1	80%	90%
Outcome 2	Illustrate understanding by explaining the history, synthesis, and applications of nanomaterial and green hydrogen.	1	80%	90%
Outcome 3	Understand and classify 3D printing technologies.	2	75%	85%
Outcome 4	Demonstrate understanding of the evolution, classification, and applications of UAVs.	2	75%	85%
Outcome 5	Apply knowledge of Artificial Intelligence and Machine Learning, IoT, Electric Vehicles, and Semiconductor Technology.	2	75%	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	1	2	2	3	2	2	2	1	2	2	1	1	1	1
Outcome 2	2	1	1	2	3	1	2	2	2	2	2	1	1	1	1
Outcome 3	2	2	2	3	3	3	1	1	3	2	2	1	1	2	2
Outcome 4	2	2	2	2	3	3	2	2	3	2	2	1	2	2	1
Outcome 5	3	2	3	2	2	3	3	2	3	2	2	1	2	2	1
Average	2	2	2	2	3	2	2	2	2	2	2	1	2	2	1

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Quantum Computer and early ideas, classical and quantum computing approaches, superposition, entanglement, and interference in quantum computing.	1	1	1
	QUBITS and their types; representation of data in quantum mechanics.	1	1	1
	Shor's Algorithm, Grover's search algorithm.	1	1	1
	Quantum programming languages; Obstacles in building quantum computers.	1	1	1
	Applications of quantum computers; Opportunities in the field of quantum computing.	1	1	1
	Introduction of quantum communication pillers, quantum network, Heisenberg's uncertainty principle and QKD.	1	1	1
	Challenges in QKD, National Quantum Mission, Future perspectives.	1	1	1
Unit No. 2	Introduction to the nanometer scale. history of nanomaterials	1	2	2
	Synthesis of nanomaterials: Bottom-up and Top-down approach	1	2	2
	Tools & techniques to characterize nanomaterials. Applications of nanomaterials.	1	2	2
	Green Technology: Definition, types of Green Technologies, Green Hydrogen production.	1	2	2
	Challenges involved in the storage of Green Hydrogen produced from PEM based electrolysis.	1	2	2
	Applications of Green Hydrogen.	1	2	2
Unit No. 3	Introduction to 3D printing and additive manufacturing	1	3	3
	Capabilities of 3D printing	1	3	3
	Applications of 3D printing	1	3	3
	Classification based on ASTM	1	3	3
	Working principles of 3D printing technologies	1	3	3
Unit No. 4	Introduction to the evolution of drones	1	4	4
	Classification of drones	1	4	4
	Basic components of drones	1	4	4
	Principles of flight	1	4	4
	Applications of drones	1	4	4
	Drones rules in India, Challenges and future scope.	1	4	4
Unit No. 5	Introduction to Artificial Intelligence, Machine Learning, and Deep learning; applications	1	5	5
	Introduction to the Internet of Things (IoT)	1	5	6
	Applications of IoT	1	5	6
	Basic architecture of the Electric Vehicles (EVs)	1	5	7
	Trends and challenges in EVs	1	5	7
	Introduction to semiconductor mission and chip fabrication	1	5	8

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (100%)				
		CLA-1 20%	CLA-2 20%	CLA-3 20%	CLA-4 20%	CLA-5 20%
Level 1	Remember	90 %	90 %	80 %	75 %	85 %
	Understand					
Level 2	Apply	10 %	10 %	20 %	25 %	15 %
	Analyse					
Level 3	Evaluate	0%	0%	0%	0%	0%
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Quantum Computation and Quantum Information by Michael A. Nielsen, Isaac L. Chuang, 2010.
2. Nanotechnologies: Principles, Applications, Implications and Hands-on Activities – A compendium for educators by Luisa Filipponi and Duncan Sutherland, European Commission Research and Innovation, 2013.
3. Additive manufacturing: Principles, Technologies and applications by C.P. Paul and A.N. Jinoop, 2021.
4. Make: Getting Started with Drones - Build And Customize Your Own Quadcopter by Terry Kilby and Belinda Kilby, 2016.
5. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig, 2010.
6. Fundamentals of Internet of Things: For Students and Professionals by F. John Dian, 2022.
7. Electric Vehicle Engineering by Per Enge, Nick Enge, and Stephen Zoepf, 2021.
8. Fundamentals of Semiconductor Manufacturing and Process Control by Gary S. May and Costas J. Spanos, 2006.

Course Designers

1. Dr. Sunil Chinnadurai, Associate Professor, ECE Department.
2. Dr. Pardha Saradhi Maram, Associate Professor, Chemistry Department.
3. Dr. Sangjukta Devi, Assistant Professor, Mechanical Engineering Department.
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5. Dr. Pranav RT Peddinti, Assistant Professor, Civil Engineering Department.
6. Dr. Ravi Kumar, Assistant Professor, Physics Department.
7. Dr. Sujith Kalluri, Associate Professor, ECE Department.

SRM University *AP*, Andhra Pradesh

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

Effective Writing and Presentation Skills

Course Code	AEC 107	Course Category		L	T	P	C
				1	0	1	2
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Literature and Languages	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Demonstrate proficiency in written communication, including the ability to compose clear, grammatically structured and organized written documents, as well as deliver well-structured and engaging presentations
- Critically analyse and synthesize information from various sources, conduct research, and effectively use evidence to support their arguments in both written assignments and oral presentations, that will enhance their critical thinking and research skills
- Through a combination of theoretical knowledge and practical exercises, the course aims to enhance students' ability to express ideas clearly, engage an audience, and deliver persuasive and impactful messages in both written and spoken formats.

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 coherent and well-structured written communication by generating clear and concise written content with logical organization, appropriate grammar	2	90%	90%
Outcome 2	Recognize and analyse the expectations of specific target audiences by adjusting tone, language and style to suit the intended purpose of the audience of written communication and tailoring written content to various formats such as reports, essays, emails, and professional correspondence.	3	90%	90%
Outcome 3	Demonstrate confident Public Speaking with the ability to deliver structured, well-organized, and persuasive presentations by employing visual and interactive aids, storytelling techniques.	3	70%	70%
Outcome 4	Develop strong critical thinking and research skills, enabling them to evaluate information critically, synthesize sources effectively, and provide well-reasoned arguments in their written work and presentations.	2	60%	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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1					1	1		3	2	3		3			
Outcome 2					1	1			1	3		3			
Outcome 3					1	1			1	3		2			
Outcome 4					1	1			1	3	3	3			
Average					**1**	**1**		**3**	**1**	**3**	**3**	**3**			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Basics of Grammatically correct writing**	**9**	1	
	SVO	1	1	1a, 2a,b
	Punctuation	3	1	1a, 2a,b
	Articles and Preposition	2	1	1a, 2a, b
	Tense and Apostrophe	1	1	1a, 2a, b
	Subject-Verb-Agreement	2	1	1a, 2a, b
Unit 2	**Categories of Writing**	**9**		
	Emails – different types (Official mails : Requesting Leave/ Enquiring vacancy/ Resigning from job/ requesting internship etc.)	3	1, 2	1b, c
	Notice and Agenda,	2	1, 2	1b, c
	Minutes of Meeting	2	1, 2	1b, c
	Paragraph writing	2	1, 2	1b, c
Unit 3	**Advanced Writing**	**9**		
	Writing Cover Letters	3	1, 2	1e
	Resume writing	2	1, 2	1d
	SOP, Abstract	2	1, 2	1g
	Project Report Writing	2	1, 2	2, d
Unit 4	**Effective Presentation Techniques**	**9**		
	Understanding the elements of successful presentations – Non-verbal communication in presentaions	3	2,3, 4	1f, 2c
	Creating engaging PPTs	2	2,3, 4	1f, 2c
	Structuring presentations for clarity and impact - Logical flow of topics and connected writing in line with storyboard	2	2, 3, 4	1f, 2c
	Handling Questions and Answers	2	2, 3, 4	1f, 2c
Unit 5	**Project Based Learning**	**15**		
	Community Based Project	15	1, 2, 3, 4	NA
	Total Learning Hours	**60**		

Learning Assessment

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

Recommended Resources

1a) Swan, M. (2005). Practical English usage (Vol. 688). Oxford: Oxford university press.
1b) Fenning, C. (2023). Effective Emails: The secret to straightforward communication at work: 1 (Business CommunicationSkills): Sanage Publishing University Press.
1c) Talbot, F. (2009). How to Write Effective Business English: The Essential Toolkit for Composing Powerful Letters, Emails and More, for Today's Business Needs. Kogan Page Publishers
1d) Yate, M. (2016). Knock'em Dead Resumes: A Killer Resume Gets More Job Interviews! Simon and Schuster.
1e) Yate, M. J. (2018). Ultimate Cover Letters: Master the Art of Writing the Perfect Cover Letter to Boost Your Employability (Vol. 5). Kogan Page Publishers.
1f) Carnegie, D. (2013). The Art of Public Speaking. Wyatt North Publishing, LLC.
2a. https://learnenglishteens.britishcouncil.org/
2b. https://www.bbc.co.uk/learningenglish/
2c. https://www.ted.com/?geo=hi
2d .https://www.tifr.res.in/~cccf/data/InternDocs/How_to_write_a_structured_Project_Report.pdf

Other Resources

Course Designers

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

Universal Human Values and Ethics

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

Course Objectives / Course Learning Rationales (CLRs)

- To cultivate deep understanding of human values by teaching students the core principles of universal human values and their significance.
- To promote ethical decision-making skills by equipping the students with the ability to make ethical choices in life, work, and society.
- To foster a diverse and inclusive ethical perspective by sensitizing the students to diversity, equity, inclusion, gender, and cultural differences.
- To highlight the relevance of ethics in society and professions by showcasing the practical importance of ethics in personal, societal, and professional contexts.
- To address common challenges by preparing the students to overcome obstacles to ethical behaviour, fostering a commitment to universal values.

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	Evaluate the significance of value inputs in formal education and start applying them in their life and profession	1	70%	80%
Outcome 2	Students will foster diverse and inclusive perspectives, contributing to more equitable and harmonious communities and workplaces	2	70%	70%
Outcome 3	Students will be able to apply ethical principles effectively in their personal and professional lives, leading to improved relationships and ethical practices in society	3	60%	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			3		2		2	3	3	1	1	3			
Outcome 2			3		2		1	3	3	1	1	3			
Outcome 3			3		2		2	3	3	1	1	3			
Average			3		2		1.6	3	3	1	1	3			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Fundamentals of Human Values and Ethics**	**7**	1	1, 2, 3, 4, 5
	Introduction to human values and ethics.	1		
	Theory of wellbeing	2		
	Purpose and relevance of human values	4		
Unit 2	**Culture and Ethical Principles**	**5**	2	1, 2, 3, 4, 5
	Culture and ethics.	2		
	Ethics in the community and society	3		
Unit 3	**Ethics and Inclusivity**	**6**	2	1, 2, 3, 4, 5
	Ethics and diversity & inclusion	3		
	Equity, equality, and addressing violence	3		
Unit 4	**Ethics in various life spheres**	**6**	3	1, 2, 3, 4, 5
	Ethics in family, society, and workplace	4		
	Ethics in IPR and plagiarism	2		
Unit 5	**Overcoming ethical challenges**	**6**	3	1, 2, 3, 4, 5
	Identifying common challenges	3		
	Strategies to overcome challenges	3		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**		
		CLA-1 (10%)	**CLA 2 (20%)**	**CLA-3 (20%)**
		Theory	**Theory**	**Theory**
Level 1	Remember	50%	50%	50%
	Understand			
Level 2	Apply	50%	50%	50%
	Analyse			
Level 3	Evaluate			
	Create			
Total		**100%**	**100%**	**100%**

Recommended Resources

1. Landau, RS. (2019). Living Ethics. New York: Oxford University Press.
2. Nagarazan, R.S. (2022). A Text book on Professional Ethics and Human Values. New Delhi: New Age International Publisher.
3. Rachels, J., & Rachels, S. (2012). The elements of moral philosophy 7e. McGraw Hill.
4. Singer, P. (1986). Applied Ethics. Oxford: Oxford University Press.
5. Gensler, H., Spurgin, E., & Swindal, J. (2004). Ethics: contemporary readings. Routledge.

Course Designers

1. Department of Psychology, SLASS, SRM University-AP

SRM University *AP*, Andhra Pradesh

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Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Entrepreneurial Mindset

Course Code	SEC 103	Course Category	SEC	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 develop the Entrepreneurial Mindset of Students.
- To provide tools and techniques for navigating the uncertain path of entrepreneurship

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 key entrepreneurship and innovation concepts	1	80%	80%
Outcome 2	Explain concepts of Startup Funding and Pitching	1	80%	80%
Outcome 3	Identify Entrepreneurial Opportunity and ideate solutions	2	80%	70%
Outcome 4	Articulate innovative business plans with sound entrepreneurial concepts.	3	70%	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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1			2				1								
Outcome 2			2						3		3				
Outcome 3		3	3		2				3	2	3	3			
Outcome 4		3	3		2				3		3	3			
Average		**1.5**	**2.5**		**1**		**0.25**		**2.25**	**0.5**	**2.25**	**1.5**			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT-1	**Introduction to Entrepreneurship**	2		
	What and Why of Entrepreneurship		1	1,2
	Need of Entrepreneurship		1	1,2
	Entrepreneurship at SRM-AP		1	1,2
UNIT-2	**Entrepreneurial Orientation**	4		
	Characteristics of successful entrepreneurs		1,2	1,2
	Mindset shifts: from an employee to an entrepreneur		1,2	1,2
	Overcoming challenges and dealing with failures		1,2	1,2
UNIT-3	**Entrepreneurial Skills**	4		
	Skillsets of an Entrepreneur		1,2	1,2
	Design Thinking, Growth Mindset		1,2	1,2
	Design Thinking		1,2	1,2
UNIT-4	**Entrepreneurial Opportunity & Ideation**	2		
	Difference between idea and opportunity		1,2	1,2
	Opportunities in Vibrant Indian Entrepreneurial Ecosystem		1,2	1,2
	Opportunity Recognition (Sources of Opportunity)		1,2	1,2
	Idea Generation		1,2	1,2
UNIT-5	**Business Model Canvas**	2		
	Why BMC		3	1,2
	Value Proposition		3	1,2
	Customer Discovery		3	1,2
	Customer Relationship		3	1,2
	Channels		3	1,2
	Key Partners		3	1,2
	Key Activities		3	1,2
	Key Resources		3	1,2
	Revenue Structure		3	1,2
	Cost Structure		3	1,2
UNIT-6	**Startup Financing & Pitching**	2		
	Stages of Fundraising		4	1,2
	Mode of Investment		4	1,2
	Startup Valuation		4	1,2
	From Pitch to Hitch (Pitch Deck)		4	1,2
UNIT-7	**Growth Mindset and Sales Ability**	2		
	Importance of Sales skill for Entrepreneur		3	1,2
	Sales Techniques		3	1,2
	Developing Growth Mindset		3	1,2
UNIT-8	**Developing the Business Plan**	12	3,4	1,2
	Total Hours	30		

Learning Assessment

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

Recommended Resources

1. Bruce R. Barringer, R. Duane Ireland. Entrepreneurship Successfully Launching New Ventures, Pearson; 2020

2. Robert D. Hasrich, Dean A. Shepherd, Michael P. Peters, Entrepreneurship, McGraw Hill, 2021

Other Resources

1. Best business courses online (n.d.). Coursera. https://www.coursera.org/browse/business/entrepreneurship

Course Designers

1. Dr Aftab Alam, Assistant Professor, Paari School of Business, SRM University-AP
2. Mr Udayan Bakshi, Associate Director, Directorate of Entrepreneurship, SRM University-AP

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

Principles of Management

Course Code	FIC 107	Course Category		L	T	P	C
				3	0	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Management	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Understand the basic principles and theories of management.
- Analyse the roles and functions of managers within organizations.
- Apply management principles to real-world scenarios.
- Develop critical thinking and problem-solving skills in management contexts

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 comprehension of key management theories and concepts.	2	80%	75%
Outcome 2	Evaluate the effectiveness of management practices in different organizational settings.	5	80%	75%
Outcome 3	Apply management principles to solve complex problems and make informed decisions.	4	75%	75%
Outcome 4	Communicate effectively and collaborate with others in managerial roles.	5	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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1		3	2	3	3	3	1	3	2	3	2	3	3	2	3
Outcome 2		3	3	3	3	2	1	3	2	2	3	3	3	3	3
Outcome 3		3	3	3	3	3	1	3	3	3	3	3	3	2	3
Outcome 4		3	3	3	3	3	1	3	3	3	3	3	3	2	2
Average		3	3	3	3	3	1	3	3	3	3	3	3	2	3

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
	Introduction to Management			
Unit No. 1	Definition and nature of management: Understanding what management entails and its significance in achieving organizational goals. Evolution of management theories: Exploring the historical development of management theories from classical to modern approaches. Functions of management: Introduction to the four primary functions of management – planning, organizing, leading, and controlling. Roles and responsibilities of managers: Analysing the various roles managers undertake, including interpersonal, informational, and decisional roles.	12	1	1,3,5,11
Unit No. 2	Planning and Decision-Making Importance of planning in management: Understanding the role of planning in setting organizational objectives and guiding future actions. Types of plans: Strategic, tactical, and operational plans and their relevance at different organizational levels. Decision-making process and techniques: Exploring the steps involved in decision making and different decision-making techniques such as rational, intuitive, and bounded rationality. Setting goals and objectives: Learning how to establish SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goals and objectives to facilitate effective planning.	12	1, 2	1,2,3,5,12
Unit No. 3	Organizational Structure and Design Organizational structure and its types: Understanding the different types of organizational structures, including functional, divisional, matrix, and network structures. Departmentalization and span of control: Examining how organizations group activities into departments and the implications of span of control on managerial effectiveness. Authority, responsibility, and delegation: Understanding the concepts of authority, responsibility, and delegation in organizational settings and their impact on managerial decision making. Factors influencing organizational design: Analysing internal and external factors that influence organizational design, such as strategy, environment, technology, and size.	12	3	4,5,8,9,11

Unit No. 4	Theories of leadership: Exploring various leadership theories, including trait theory, behavioural theory, contingency theory, and transformational leadership. Leadership styles and their effectiveness: Understanding different leadership styles such as autocratic, democratic, laissez-faire, and their impact on employee motivation and performance. Motivation theories: Examining motivational theories such as Maslows hierarchy of needs, Herzberg two-factor theory, and expectancy theory, and their implications for managerial practice. Techniques for motivating employees: Exploring practical techniques and strategies for motivating employees, including recognition, rewards, job enrichment, and empowerment.	12	1, 3	2,3,8,11,13
Unit No. 5	Process of control: Understanding the control process, including establishing standards, measuring performance, comparing results, and taking corrective action. Types of control: Exploring different types of control mechanisms, including feedforward, concurrent, and feedback control, and their applications in organizational settings. Performance appraisal methods: Analysing various performance appraisal methods such as graphic rating scales, behaviourally anchored rating scales (BARS), and 360-degree feedback. Continuous improvement and quality management: Understanding the concepts of continuous improvement and quality management, including Total Quality Management (TQM).	12	4	1,7,12
Total Contact Hours		**60**		

Learning Assessment

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

Recommended Resources

1. Prasad, L.M. (2021), Principles and Practices of Management, Sultan Chand Publisher, New Delhi.

Other Resources

1. Vasishthm, N. & Vasishth, V. (2022), Taxmann's Principles of Management, Taxmann publications.
2. Tripathi, P.C. & Reddy, P.N. (2021), Principles of Management, McGraw Hill
3. Jayashankar, J. (2009) Principles of Management, Margham Publications
4. Mintzberg, H. (2009). Managing. San Francisco, Berrett-Koehler Publishers. P. 26-28.
5. Hannaway, J. (1989). Managers Managing: The Workings of an Administrative System. New York: Oxford University Press, P. 391.
6. Eccles, R. G. & Nohria, N. (1992). Beyond the Hype: Rediscovering the Essence of Management. Boston: The Harvard Business School Press, p. 471.
7. Kotter, J. P. (1982). The General Managers. New York: The Free Press
8. Mintzberg, H. (1973). The Nature of Managerial Work. New York: Harper; Row. P. 371.
9. Kotter, J. P. (1999). “What Effective General Managers Really Do,” Harvard Business Review, March–April 1999, pp. 145–1591.
10. Sproull, L. S. (1984).“The Nature of Managerial Attention,” in L. S. Sproull (ed.)
11. Advances in Information Processing in Organizations. Greenwich, CT: JAI Press1.
12. Stewart, R. (1967). Managers and Their Jobs. London: Macmillan.
13. Pondy, L. R. (1978). “Leadership Is a Language Game,” in M. W. McCall, Jr. and M.
14. M. Lombardo (eds.), Leadership: Where Else Can We Go? Durham, NC: Duke University Press.
15. Mintzberg, H. (2009). Managing. San Francisco, Berrett-Koehler Publishers. P. 26-281.
16. McGregor, J. (2008). “Bezos: How Frugality Drives Innovation,” BusinessWeek,
17. April 28, 2008, pp. 64–661.Katz, Robert L., (1974). “Skills of an Effective Administrator.” Harvard Business Review, September-October 1974.

Course Designers

1.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
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Psychology for Everyday Living

Course Code	FIC 124	Course Category	Generic Elective	L	T	P	C
				3	0	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Psychology	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To understand the fundamental psychological processes in everyday living.
- To apply knowledge of psychology in improving self and others.
- To apply knowledge of psychology in enhancing quality of life.

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 fundamental psychological processes in everyday living	2	80%	70%
Outcome 2	Describe important theories in psychology in the areas of sensation, perception, personality and learning	2	75%	70%
Outcome 3	Illustrate personal, professional and social applications of psychology	4	75%	60%
Outcome 4	Interpret results from certain personality tests	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, 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							1				1			
Outcome 2	1			1					2	1					
Outcome 3	1	1	1				1	1	2	2		2			
Outcome 4	2		2		1			2	1	1		1			
Average	2	1	2	1	1		1	1	2	1		1			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References
Unit No. 1	**Myths and Misconceptions in Psychology**	**12**	1	1
	Definition, nature and goals of psychology	4		
	Common myths and misconceptions about psychology	4		
	Schools of psychology; Basic and applied areas of psychology	4		
Unit No. 2	**The Role of Perception and Attitude towards Understanding the World**	**12**	2, 3	2
	Perception: Understanding perception, Gestalt laws of organization, common illusions	3		
	Perceptual constancy - depth perception, size perception, perception of movement	3		
	Attitude formation	3		
	Attitude change	3		
Unit No. 3	**Intelligence and Learning**	**12**	2, 3	2
	Definitions and nature of intelligence	3		
	Emotional and social intelligence; Measuring IQ, EQ and SQ	3		
	Fundamentals of learning and its applications	3		
	Memory techniques	3		
Unit No. 4	**Understanding the Self**	**12**	2, 4	1
	Definition; Approaches to personality – trait and type	4		
	Psychoanalytical and humanistic theory, Tests of personality – MBTI and NEO-PI	4		
	Identity; Self-concept, self-esteem and self-efficacy	4		
Unit No. 5	**Stress, Coping and Quality of Life**	**12**	2, 3	1
	Nature, sources of stress and its reactions	3		
	Factors influencing stress	3		
	Coping with and managing stress - cognitive and behavioural techniques	3		
	Improving quality of life	3		

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	Th	Th	Th	Th
Level 1	Remember	50%	60%	60%	30%	50%
	Understand					
Level 2	Apply	50%	40%	40%	70%	50%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Baron, R. A. (2001). Psychology. New Delhi: Pearson Education India.
2. Nolen-Hoeksema, S., Fredrickson, B.L. & Loftus, G.R. (2014). Atkinson & Hilgard's Introduction to Psychology. 16th Ed. United Kingdom: Cengage Learning.

Other Resources

1. Morgan, C. T., King, R. A., & Schopler, J. (2004). Introduction to Psychology. New Delhi: Tata McGraw Hill.

Course Designers

1.

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

Concepts of Inorganic Chemistry

Course Code	CHE 104	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	Department of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To address the periodicity of elements in the periodic table and 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	Gain knowledge on the periodicity in the periodic table and different types of chemical bonding	1 & 2	80%	75%
Outcome 2	Understand in depth concepts of radioactivity and applications of isotopes	3	70%	65%
Outcome 3	Provide a clear explanation of the acidic/basic nature of any compound.	3	65%	60%
Outcome 4	Prepare standard solutions, demonstrate the principles of titrimetric and estimate the amount of any analyte in a given solution.	3	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, 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	2	1				2				1	1	
Outcome 2	2	2			2		2	1		1		1	1	2	
Outcome 3	1	1		2	1		1						2	2	
Outcome 4	2	2	2	2	1		2	1	2	1			1	2	
Average	2	2	2	2	1		2	1	2	1		1	1	2	

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	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**
	(e) Electronegativity, Pauling's/ Allred Rochow's scales. Variation of electronegativity with bond order, partial charge, hybridisation, and group electronegativity.	**3**	**1**	**1**
Unit No. 2	Ionic bond: General characteristics, types of ions, size effects, radius ratio rule, and limitations. Packing of ions in crystals.	**1**	**1**	**1**
	Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle, and its application, Solvation energy.	**1**	**1**	**1**
	Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridisation, equivalent and non-equivalent hybrid orbitals.	**1**	**1**	**1**
	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**	**1**	**1**
	Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.	**1**	**1**	**1**
	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**	**1**	**1**
	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**	**1**	**1**
	Noncovalent bonding: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction.	**1**	**1**	**1**
	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**	**1**	**1**
	Metallic bond: Properties of Metallic compounds.	**1**	**1**	**1**

Unit No. 3	Nuclear stability and nuclear binding energy. Nuclear forces: meson exchange theory.	**2**	**2**	**2**
	Nuclear models (elementary idea): Concept of nuclear quantum number, magic numbers.	**2**	**2**	**2**
	Nuclear Reactions: Artificial radioactivity, transmutation of elements, fission, fusion, and spallation.	**2**	**2**	**2**
	Nuclear energy and power generation. Separation and uses of isotopes in tracer techniques.	**2**	**2**	**2**
	Radiochemical methods: Determination of the age of rocks and minerals, radiocarbon dating, hazards of radiation, and safety measures.	**2**	**2**	**2**
Unit No. 4	Arrhenius's concept, theory of solvent system (in H_2O, NH_3, SO_2, and HF), Bronsted-Lowry's concept, the relative strength of acids.	**2**	**3**	**1**
	Amphoteric, Lux-Flood concept, Lewis concept. Superacids, HSAB principle. Acid-base equilibria in aqueous solution and pH.	**3**	**3**	**1**
	Acid-base neutralisation curves; indicator, choice of indicators. Buffer solution, composition, buffer capacity.	**3**	**3**	**1**
Unit No. 5	Rationalization of the inertness of noble gasses, clathrates, preparation.	**2**	**3**	**1**
	Properties of XeF_2, XeF_4, and XeF_6, bonding in these compounds using VBT.	**2**	**3**	**1**
	Shapes of noble gas compounds using VSEPR Theory.	**3**	**3**	**1**
	Total Contact Hours	**45**		

Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	Titrimetric Analysis: (i) Calibration and use of apparatus.	**6**	**4**	**3**
2	(ii) Preparation of solutions of different Molarity/Normality of titrants.	**4**	**4**	**3**
3	Acid-Base Titrations: (i) Estimation of carbonate and hydroxide present together in mixture.	**4**	**4**	**3**
4	(ii) Estimation of carbonate and bicarbonate present together in a mixture.	**4**	**4**	**3**
5	Oxidation-Reduction Titrimetry: (i) Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution.	**4**	**4**	**3**
6	(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.	**4**	**4**	**3**
7	(iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid and external indicator.	**4**	**4**	**3**
	Total Contact Hours	**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (60%)								End Semester Exam (40%)	
		CLA-1 (10%)		CLA-2 (20%)		CLA-3 (10%)		Mid Term (20%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	50%	40%	53%	40%	50%	40%	40%	40%	40%	
	Understand										40%
Level 2	Apply	50%	60%	47%	60%	30%	50%	40%	50%	40%	40%
	Analyse										
Level 3	Evaluate					20%	10%	20%	10%	20%	20%
	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. Essentials of Nuclear Chemistry, H. J. Arnikar, 2022, 5th edition, New Age International.
3. Vogel's Quantitative Chemical Analysis, 6th edition, 2009, Pearson Education.
4. Additional reading
5. Inorganic Chemistry: Mark Weller, Tina Overton, Jonathan Rourke, and Fraser Armstrong, 6th edition, 2014, Oxford University Press.
6. Concepts and Models of Inorganic Chemistry: B. Douglous, D. McDaniel and J. Alexander, 3rd edition, 2006, Wiley-India.
7. Inorganic chemistry, R. Gopalan, 2020, University Press.
8. Basic Inorganic Chemistry, Cotton Wilkinson and Paul L Gaus, 3rd edition, 2007, Wiley.

Other Resources

1.

Course Designers

1. Dr. Balaji Babu.

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Atomic Structure and States of Matter

Course Code	CHE 105	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 understand foundational concepts in atomic structure and quantum mechanics, focusing on hydrogen and polyelectronic atoms.
- To develop a fundamental understanding of the kinetic theory of gases, and analyze molecular collisions, gas viscosity, and real gas behaviors.
- The course enables students to provide comprehensive knowledge on the liquid and solid states, including the structure, properties, and behaviours of liquids and solids, as well as their practical applications and analysis using modern techniques.

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	90%	85%
Outcome 2	Interpret the kinetic theory of gases. Also interpret the relations between various parameters associated with it	2	90%	80%
Outcome 3	Discuss in-depth knowledge on real gases and their deviations	2	90%	80%
Outcome 4	Identify the phase behaviour in liquid states and various factors affecting their properties.	2	85%	75%
Outcome 5	Design and develop a comprehensive analysis using X-ray diffraction data to characterize unknown crystalline materials	3	85%	75%
Outcome 6	Apply and analyze volumetric and conductometric titration techniques	4	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 social 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	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	3	2	2	2	1	1			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	**10**		
	Recapitulation of Bohr's theory, its limitations, and the atomic spectrum of the hydroaromatic.	**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.	**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 $\geq \varepsilon$	**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**
	Solid State	**12**		

Unit No. 5	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	**45**		

Course Unitization Plan-Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	**Volumetric titration of HCl vs NaOH**	**4**	**6**	**1,2,3**
2.	**Standardization of potassium permanganate by Oxalic acid**	**4**	**6**	**1,2,3**
3.	**Determination of hardness of water by EDTA method**	**4**	**6**	**1,2,3**
4.	**Determination of the surface tension of a liquid or a dilute solution using a stalagmometer**	**4**	**6**	**1,2,3**
5.	**Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.**	**4**	**6**	**1,2,3,4,5**
6.	**Perform the following conductometric titration - Strong acid vs. strong base**	**4**	**6**	**1,2,3,4,5**
7.	**Perform the following conductometric titration - Strong acid vs. weak base**	**3**	**6**	**1,2,3,4,5**
8.	**Perform the following conductometric titration - Weak acid vs. strong base**	**3**	**6**	**1,2,3,4,5**
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (60%)								End Semester Exam (40%)	
		CLA-1 (10%)		CLA-2 (20%)		CLA-3 (10%)		Mid Term (20%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	**Remember**	**50%**	**40%**	**53%**	**40%**	**50%**	**40%**	**40%**	**40%**	**40%**	
	Understand										**40%**
Level 2	**Apply**	**50%**	**60%**	**47%**	**60%**	**30%**	**50%**	**40%**	**50%**	**40%**	**40%**
	Analyse										
Level 3	**Evaluate**					**20%**	**10%**	**20%**	**10%**	**20%**	**20%**
	Create										
Total		**100%**	**100%**	**100%**	**100%**	**100%**	**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

Course Designers

1. Dr. Sabayasachi Chakrabortty

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Problem Solving Skills

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

Course Objectives / Course Learning Rationales (CLRs)

- Enter Data

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				
Outcome 2				
Outcome 3				
Outcome 4				

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															
Outcome 2															
Outcome 3															
Average															

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1				
Unit 2				
Unit 3				
Unit 4				
Unit 5				

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					
	Understand					
Level 2	Apply					
	Analyse					
Level 3	Evaluate					
	Create					
Total						

Recommended Resources

1. Enter Data

Other Resources

1. Enter Data

Course Designers

1. Enter Data

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)

1. Introduce basic digital skills that are needed in today's 21st century work environment.
2. develop the skills that they need to effectively integrate technology into their respective professional practices.
3. Learn practical-oriented and will have a lot of hands-on exercises.
4. Understand basic and practical digital skills.
5. learn and use software and hardware systems, including the basic troubleshooting.
6. 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			
Outcome 5					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

Course Designers

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

Fundamentals of Organic Chemistry

Course Code	CHE 201	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	**0**	**1**	**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 learn the nomenclature of organic compounds, the identification of functional groups, and the principles 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 mesmeric 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)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 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%
Outcome 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%
Outcome 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%
Outcome 4	Gain insights in synthesis and reactivity of unsaturated aliphatic compounds such as Alkanes, Alkenes and Alkynes.	2	70%	65%
Outcome 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 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	-	-	-	-	-	-	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	-
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.	Reactive intermediates	**10**		

3	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**		

Course Unitization Plan - Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	To determine the melting point of a given solid substance.	4	1	4
2.	Extraction of organic compounds utilizing the concept of solvent polarity	4	1	4
3	To separate a mixture of Organic Compound by Thin Layer Chromatography (TLC) and identify the amino their Rf values	4	2	4

4	Isolation and Characterization of Organic Compounds from Ginger by using different organic solvents	8	3	4
5	To separate a mixture of Organic Compound by Column Chromatography	6	4	4
6	Nucleophilic Substitution Reactions of Organic Halides	4	5	4
	Total Contact Hours	**30 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 (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. 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

1. Dr. Mannathan.

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

Chemistry of Elements

Course Code	CHE 202	**Course Category**	CC	**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 describe general characteristics, chemical properties and in-depth knowledge on important compounds of s and p - block elements.
- To understand the complex forming ability s-block elements and their structures.
- 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)

	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 classification between s, p, d, and f block elements	1 & 2	80%	75%
Outcome 2	Know about the electronic and structural aspects of some important compounds of p block elements	3	75%	70%
Outcome 3	Develop knowledge about the basic characterisitc features of d and f-block elements.	3	70%	65%
Outcome 4	Learners should be able to attain knowledge on practical application of iodometric titrations	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, 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		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	
Average	2	2	2	2	1				2	2	1	1	2	2	

Course Unitization Plan

Unit No.	Unit Name	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
	Total Contact Hours	**45**		

Course Unitization Plan - Practical

Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically).	6	4	3
2	Iodometric Determination of Ascorbic Acid (Vitamin C).	6	4	3
3	Estimation of available chlorine in bleaching powder iodometrically.	6	4	3
4	Inorganic preparations : Cuprous Chloride, Cu_2Cl_2.	6	4	3
6	Preparation of Aluminium potassium sulphate (Potash alum).	6	4	3
	Total Contact Hours	30		

Learning Assessment theory

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. Inorganic chemistry, Catherine E. Housecroft and Alan G. Sharpe, 2nd edition, 2004, Pearson.
2. Principles Of Inorganic Chemistry, B.R. Puri, L.R. Sharma, K.C. Kalia, 2020, Vishal Publishing Co.
3. Chemistry of the Elements, Greenwood, N.N. & Earnshaw, 2005, Butterworth- Heinemann.
4. Inorganic Chemistry, Miessler, G. L. & Donald, A. Tarr. 5th edition, 2011, Pearson.
5. Beckett A.H., Stenlake J.B., Practical Pharmaceutical Chemistry, 4th edition - Part One, CBS Publishers.

Course Designers

1. Dr. Balaji Babu.

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

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%**

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

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	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**
	Total Contact Hours	**45**		

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 (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	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 Designers

1. Dr. Sabayasachi Chakraborty

SRM University *AP*, Andhra Pradesh

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

Creativity and Critical Thinking Skills

Course Code	AEC 104	**Course Category**	AEC	**L**	**T**	**P**	**C**
				1	0	1	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Literature and Language	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Identify key concepts associated with creative problem-solving and critical analysis.
2. Interpret and summarize various models and frameworks used in fostering creative and critical thinking skills.
3. Apply divergent thinking methods to generate innovative solutions to multifaceted problems.
4. Assess and compare the strengths and weaknesses of various critical thinking approaches in decision-making.

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	Define and describe fundamental concepts and theories related to creativity and critical thinking.	1	80%	80%
Outcome 2	Explain the significance of creativity and critical thinking in problem-solving and decision-making processes.	2	80%	60%
Outcome 3	Implement critical thinking strategies to analyse and evaluate information and arguments effectively.	3	80%	70%
Outcome 4	Analyse and assess the effectiveness of specific creative thinking methods in addressing real-world problems.	4	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	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1			1	3	3			3		3		3			
Outcome 2		3		3	3			3		3		3			
Outcome 3		3	3		3			3		3		3			
Outcome 4		3	3	3	3			3		3		3			
Average		3.0	2.3	3.0	3.0			3		3		3			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Introduction to Creativity and Critical Thinking**	**6**		
	Introduction to key concepts	2	1,3	1
	Importance in personal and professional contexts	2	1,3	1,2
	Understanding the differences	1	2,3	1,4
	Real-world applications	1	1,3	1,3
Unit No. 2	**Overcoming Mental Blocks**	**6**		
	Identifying and addressing barriers	3	1	14
	Exercises for mental flexibility	3	4	1,2
Unit No.3	**Critical Thinking Skills**	**6**		
	Recognizing common pitfalls	1	1,3	1,2
	Examples and group discussion	1	2,3	1,2
	Techniques for assessing information credibility	2	1,3	1
	Case studies and research exercises	2	1,3	3
Unit No. 4	**Application of Creative Solutions**	**6**		
	Practical problem-solving exercises	1	1,3	1,4
	Group projects and case studies	2	2,3	2,3
	Integrating ethics into creative and critical thinking	1	1,3	1
	Discussions on ethical dilemmas and decision-making	2	1,3	3
Unit No. 5	**Application of Creative Solutions**	**6**		
	Quizzes on concepts and techniques	1	1,3	1,2
	Individual and group assignments	1	2,3	1,2
	Applying creativity and critical thinking to a real-world scenario	2	1,3	1
	Presentation and peer evaluation	2	1,3	3
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (75%)			
		CLA-1 (20%)	CLA-2 (20%)	CLA-3 (20%)	Project Work (45%)
Level 1	Remember	30%		10%	
	Understand				
Level 2	Apply	70%	100%	90%	100%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Creative Confidence: Unleashing the Creative Potential Within Us All by Tom Kelley and David Kelley
2. Critical Thinking: An Introduction by Alec Fisher
3. Think Like a Freak: The Authors of Freakonomics Offer to Retrain Your Brain by Steven D. Levitt and Stephen J. Dubner
4. Creative Intelligence: Harnessing the Power to Create, Connect, and Inspire by Bruce Nussbaum

Other Resources

1. Enter Data

Course Designers

1. Enter Data

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		Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- Understand different leadership styles and their applications.
- Develop effective communication and interpersonal skills for leadership.
- Learn strategies for building and leading high-performing teams.
- 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	80%	75%
Outcome 2	Summarize and interpret effective communication strategies for team members and stakeholders.	2	70%	60%
Outcome 3	Evaluate and devise strategies to lead teams in achieving goals and objectives efficiently.	5	80%	75%
Outcome 4	Synthesize and implement problem-solving techniques to address challenges in leadership roles.	5	55%	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, 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				**2**		2	3	**3**	**3**		3	3	1	3
Outcome 2	2				**2**		2	**3**	**3**	**3**		3	3	3	2
Outcome 3	2				**2**		2	**3**	**3**	**3**		3	3	2	1
Outcome 4	3				**2**		2	**3**	**3**	**3**		3	3	3	2
Average	**2**				**2**		**2**	**3**	**3**	**3**		**3**	3	2	2

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**The Evolution of Leadership**		1,2	1,3,7
	Historical Perspectives on Leadership, Leadership during the industrial revolution, Contemporary Leadership Theories and Models		1	
	Trait theory: identifying key traits of effective leaders, Behavioural theory: exploring leadership behaviours and styles, Situational theory: adapting leadership styles to different situations,		1,2	
	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		1	
Unit No. 2	**Emotional Intelligence and Leadership**		2,3	
	Understanding Emotional Intelligence (EQ), Definition and components of emotional intelligence, Importance of EQ in leadership effectiveness,		2	
	Developing Self-Awareness and Empathy as a Leader, Techniques for self-reflection and self-awareness, Practicing empathy and perspective-taking in leadership roles,		2,3	
	Utilizing Emotional Intelligence to Enhance Team Performance, Building rapport and trust within teams, Managing emotions in challenging situations, Resolving conflicts through emotional intelligence.		2	
Unit No. 3	**Transformational Leadership**		2,3,	1,5.6
	Characteristics and Principles of Transformational Leadership, Inspiring vision and purpose, Intellectual stimulation and innovation, Individualized consideration and mentorship, Inspiring and Motivating Teams		2	
	Towards Shared Vision, Communicating a compelling vision for the future, Empowering and motivating team members to achieve goals		2	
	Creating a Culture of Trust and Empowerment Within Organizations, Building trust through transparency and integrity, Delegating authority and fostering autonomy, Celebrating successes and learning from failures.			
Unit No. 4	**Leading with Purpose and Authenticity**		2,3,4	2,11,12,13
	Discovering Personal Values and Aligning Them with Leadership Goals		2	
	Identifying core values and principles, Aligning personal values with organizational mission and vision		2	

	Authentic Leadership: Being True to Oneself While Leading Others, Building Credibility and Trust Through Authentic Leadership Practices, Leading by example and modelling desired behaviours.			
Unit No. 5	**Leading Through Adversity and Crisis**		3,4	1,6,10,11
	Strategies for Leading During Times of Uncertainty and Crisis, Remaining calm and composed under pressure		2	
	Making tough decisions with limited information, Crisis Communication and Decision-Making in Leadership Roles, Communicating effectively with stakeholders during crises,		2,3,4	
	Implementing crisis management plans and protocols, Building Resilience and Fostering Organizational Agility, Encouraging adaptability and flexibility within teams, Cultivating a culture of resilience and innovation.		2,3	

Learning Assessment

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

Recommended Resources

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

Other Resources

1. Recommended Online Resources
2. Maxwell, J. C. (2007). The 21 Irrefutable Laws of Leadership: Follow Them and People Will Follow You (10th Anniversary ed.). Thomas Nelson.
3. Collins, J. (2001). Good to Great: Why Some Companies Make the Leap… and Others Don't. HarperBusiness.
4. Sinek, S. (2009). Start with Why: How Great Leaders Inspire Everyone to Take Action. Portfolio.
5. Sinek, S. (2014). Leaders Eat Last: Why Some Teams Pull Together and Others Don't. Portfolio.
6. Sandberg, S. (2013). Lean In: Women, Work, and the Will to Lead. Knopf.
7. Bennis, W. (2009). On Becoming a Leader (4th ed.). Basic Books.
8. Tzu, S. (2002). The Art of War. Shambhala.
9. Wooden, J., & Jamison, S. (2005). Wooden on Leadership: How to Create a Winning Organization. McGraw-Hill.
10. Goleman, D., Boyatzis, R., & McKee, A. (2013). Primal Leadership: Unleashing the Power of Emotional Intelligence (10th Anniversary ed.). Harvard Business Review Press.
11. Covey, S. R. (2004). The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change (25th Anniversary ed.). Free Press.

Course Designers

1. Enter Data

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	Analytical Chemistry	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 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)

	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 principles and applications of gravimetric analysis, titrations, and electrochemical methods.**	**2**	**80%**	**70%**
Outcome 2	Perform **standardization and calibration procedures and execute acid-base titrations with accurate volumetric calculations**	**3**	**70%**	**65%**
Outcome 3	Analyze **the interaction of radiation and matter in spectrochemical analysis and distinguish between different types of optical instruments**	**4**	**70%**	**60%**
Outcome 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	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	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 (50%)								End Semester Exam (50%)	
		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		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. **Principles Of Chemical Science, MIT OpenCourseWare**
2. **Chemcollective Virtual Labs**
3. **ACS Publications**

Course Designers

1. Dr. Rajapandiyan

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

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	Department of Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To understand the theory, properties of coordination compounds.
- To describe the structure and bonding in organometallic compounds and its applications as catalyst.
- Learners to gain roles of metal ion in biology and its primary functions.
- 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 metalloporphyrin's 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
	Total Contact Hours	45		

Course Unitization Plan - Practical

Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	A. Qualitative semi-micro analysis of mixtures of anions and cations.	16	4	3
2	Verification of spectrochemical series.	4	4	3
	Controlled synthesis of two copper oxalate hydrate complexes: kinetic vs thermodynamic factors.	4	4	3
	Preparation of acetylacetonato complexes of Cu^{2+}/Fe^{3+}. Find the λ_{max} of the complex.	2	4	3
	Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.	4	4	3
	Total Contact Hours	30		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (60%)								End Semester Exam (40%)	
		CLA-1 (10%)		CLA-2 (15%)		CLA-3 (15%)		Mid (20%)			
		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, 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 Education.

Other Resources

1.

Course Designers

1. Dr. Balaji Babu

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	Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To learn the nomenclature of different organic functional groups and the reactivities of different organic functional groups.
- To learn the fundamentals and concepts of oxidation and reduction reactions of organic compounds and the addition of nucleophiles to the various carbonyl compounds.
- 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	**45 Hours**		

Course Unitization Plan - Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	Identification of Various Organic Functional group	6	2	3
2	Synthesis of alkyl halides from Alcohols	4	2	3
3	Synthesis of Pinacolone	4	2	3
4	Aldol condensation reaction by using conventional or general method	4	2,4	3
5.	Generation of Grignard reagent and further reaction with aldehyde, ketone, ester	4	2	3
6	Synthesis of alkene via wittig reaction	4	2	3
7	Synthesis amine by reductive amination	4	2,3,4	3
	Total Contact Hours	**30 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. Enter Data

Course Designers

1. Enter Data

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

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)

- To explain the basic principles of ionic equilibria and their applications in analysing 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.
- 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.
- 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		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 social 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	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's 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**
	Total Contact Hours	**45**		

Course Unitization Plan - Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	pH-metric titration of strong acid vs. strong base	3	4	4
2.	pH-metric titration of weak acid vs. strong base	3	4	4
3.	Determination of the wavelength of maximum absorption (λ_{max}) of $K_2Cr_2O_7$ solution	3	6	4
4.	Determination of the wavelength of maximum absorption (λ_{max}) of $KMnO_4$ solution	3	6	4
5.	Determination of concentration of unknown $K_2Cr_2O_7$ solution by spectrophotometry	4	6	4
6.	Potentiometric titration of strong acid vs. strong base	4	5	4
7.	Potentiometric titration of weak acid vs. strong base	4	5	4
8.	Potentiometric titration of potassium dichromate vs. Mohr's salt	4	5	4
	Total Contact Hours	**30 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	50	30	40	90	30	40	50		40	50
	Understand										
Level 2	Apply	50	50	50	10	50	60	50		50	50
	Analyse										
Level 3	Evaluate	0	20	10	0	20	0			10	0
	Create										
Total		**100%**	**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. P. H. Reiger, Electrochemistry, 2nd Ed., Springer (1994).
2. D. A. McQuarrie and J. D. Simon, Physical Chemistry: A Molecular Approach, Viva Student Edition,
3. Viva Books Pvt. Ltd. (2019).

Course Designers

1. Dr. Sabayasachi Chakrabortty

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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	Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To understand and describe the Fundamentals of Aromatic Compounds.
- To analyze 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, 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		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.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Introduction to Aromaticity	8		
	Introduction to aromatic compounds	1	1	1,2
	Structure of benzene and its stability	2	1	
	Nomenclature of benzene derivatives	1	1	
	Polynuclear aromatic hydrocarbons: Naphthalene and anthracene	1	1	
	Aromatic Character: The Hückel's 4n+2 rule	2	1	
Unit No. 2	Electrophilic Aromatic Substitution	11		
	Mechanism of Electrophilic Aromatic Substitution (EAS) (i) Friedel-Crafts alkylation and acylation (ii) Nitration (iii) Halogenation (iv) Sulfonation	4	2	1,2
	Substituent effects on aromatic reactivity	3	2	
	Reactions of naphthalene and anthracene	2	2	
	Application of EAS in Organic Synthesis	2	2	
Unit No. 3	Benzene with Functional Groups	11		
	Phenols and its derivatives: Structure, preparation, and reactivity	2	3	1,2
	Aryl halides: Structure, preparation, and reactivity	2	3	
	Aromatic carbonyl compounds: Structure, preparation, and reactivity	3	3	
	Nitrobenzene and Benzonitrile: Structure, preparation, and reactivity	2	3	
	Styrene and its derivatives: Structure, preparation, and reactivity	2	3	
Unit No. 4	Benzyne and Diazonium Salts	4		1,2
	Formation and Reactivity of Benzyne: Mechanism of benzyne formation. Applications in synthetic chemistry.	2	3	
	Diazonium Salts: Methods of preparation. Substitution and coupling reactions of diazonium salts.	2	3	
Unit No. 5	Synthesis and Properties of Heterocycles	11		
	Classification and nomenclature	1	4	3
	Synthesis, properties, and mechanism of substitution reactions of Furan, Pyrrole, Thiophene and Pyridine	5	4	
	Synthesis, properties and mechanism of substitution reactions of Indole, Quinoline and Isoquinoline	5	4	
Total Contact Hours		**45**		

Course Unitization Plan-Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	Bromination of any one of the following: a. Acetanilide by conventional methods b. Acetanilide using green approach (Bromate-bromide method)	4	5	4
2	Nitration of any one of the following: a. Acetanilide/nitrobenzene by conventional method b. Salicylic acid by green approach (using ceric ammonium nitrate).	4	5	4
3	Synthesis of Hantzsch ester	4	5	7
4	Fischer indole synthesis	4	5	7
5	Preparation of allylphenyl ether from phenol	4	5	7
6	Preparation of benzonitrile from aniline	4	5	4,6

7	Detection of extra elements (N, X, S) in organic compounds by Lassaigne's test.	6	5	4,6
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (60%)**								**End Semester Exam (40%)**	
		CLA-1 (10%)		**CLA-2 (10%)**		**CLA-3 (20%)**		**Mid (20%)**			
		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. Organic Chemistry, Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Oxford University
2. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
3. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5th Ed. Pearson (2012)

Course Designers

1. Dr. S. Mannathan, Associate Professor, SRM University - AP

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

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 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	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
	Total Contact Hours	60		

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	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. Enter Data

Course Designers

1. Dr. Sabayasachi Chakrabortty

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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, 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	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 (50%)								End Semester Exam (50%)	
		CLA-1 (15%)		CLA-2 (10%)		CLA-3 (10%)		Mid (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. 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. Analytical Sciences Digital Library

Course Designers

1. Dr. Rajapandiyan.

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, 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	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. Enter Data

Course Designers

1. Enter Data

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

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%**

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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	0	1	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)

- 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, 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							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**

Course Unitization Plan - Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	Enolates synthesis.	6	1, 5	6
2	Cross-coupling of organometallics and halides	6	2	6
3	Palladium-catalysed amination of aromatic rings.	6	2	6
4	Asymmetric aldol reactions	6	3	6
5.	pinacol rearrangement	6	4	6
Total Contact Hours		**30 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. 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.

Other Resources

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	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	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

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

1. Enter Data

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 5	**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)														
	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**	**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**
	Step polymerization, 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**
	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 (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
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.

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**
	Total Contact Hours	**60**		

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 (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%		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. Dr. Mannathan

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**
	Total Contact Hours	**60**		

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%)			
		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. A. R. Leach, Molecular Modelling: Principles and Applications, 2nd ed., Pearson, 2001, ISBN: 978-0582382107.
2. C. J. Cramer, Essentials of Computational Chemistry: Theories and Models, 2nd ed., John Wiley and Sons, 2004, ISBN: 978-1-118-71227-6.
3. W. Koch, M. C. Holthausen, A Chemist's Guide to Density Functional Theory, 2nd ed., Wiley-VCH Verlag GmbH, 2001, ISBN: 978-3527303724.
4. D. C. Young, Computational Drug Design: A Guide for Computational and Medicinal Chemists, 1st ed., Wiley-Interscience, 2009, ISBN: 978-0470126851.

Other Resources

1. E- Resources
2. Problem sets

Course Designers

1. Dr. Mahesh Ravva

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**
	Total contact Hours	**60**		

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 (15%)			
		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.

Course Designers

1. Dr. Seema Rani.

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Neerukonda, Mangalagiri Mandal,
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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

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1. Enter Data

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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	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	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.

Course Designers

1. Dr. Rajapandiyan