

DEPARTMENT OF CHEMISTRY, INDIRA GANDHI UNIVERSITY, MEERPUR (2nd Sem)

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture P: Practical T: Tutorial				Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (Th)	Practical (P)	L	T	P	Total	Th	P	Th	P		Th	P
CC-2 MCC-3	Scheme A, B & C	26L4.5-CHE-201	Chemistry-II	4	3	1	3	0	2	5	25	5	50	20	100	3	2
DSEC-1	Scheme C	26L4.5-CHE-202	Chemistry Skill-I	4	3	1	3	0	2	5	25	5	50	20	100	3	2
*CC-M2	Scheme A, B & D	26L4.5-CHE-203	Minor Chemistry-II	2	2	0	2	0	0	2	15	0	35	0	50	2	0
CC-M2	Scheme C	From Available CC-2/MCC-3 of 4 credits as per NEP															
MDC-2	A, B & C	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP															
AEC-2	A, B & C	From Available pool of Ability Enhancement Courses as per NEP															
SEC-2	A, B & C	From Available pool of Skill Enhancement Courses as per NEP															
VAC-2	A, B & C	From Available pool of Value Added Courses as per NEP															
Internship	A, B & C		Internship of 4 Credits of 4-6 weeks duration after 2 nd Semester (Mandatory in case of exit)												100		

Part A – Introduction			
Name of the Programme	Chemistry		
Semester	II		
Nature of Course/Course Composition	Theory + Practical		
Name of the Course	Chemistry-II		
Course Code	26L4.5-CHE- 201		
Course Type	CC/MCC		
Course Level	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO ₁ Explain chemical bonding, molecular geometry, ionic solids, and factors affecting their properties. CLO ₂ Apply the principles of chemical kinetics, distribution law, and intermolecular forces to chemical systems. CLO ₃ Describe the structure, preparation, properties, and reactions of hydrocarbons, and explain metallic bonding and semiconductors. CLO ₄ Perform and interpret experiments involving titrations, chromatography, viscosity, and refractive index measurements.		
	Theory	Practical	Total
Credits	3	1	4
Teaching hours per week	3	2	5
Internal Assessment Marks	25	05	30
End Term Exam Marks	50	20	70
Max. Marks	75	25	100
Examination Duration (in Hours)	3	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u>			
The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.			
<u>Instructions for Practical Examiner</u>			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
	Topics	CLO/s Attempt	Contact Hours
Unit-I	Covalent Bond: Valence bond theory approach, shapes of simple inorganic molecules and ions based on VSEPR theory and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Molecular orbital theory of homonuclear (N ₂ , O ₂) and heteronuclear (CO and NO) diatomic molecules, dipole moment and percentage ionic character in covalent bond.	CLO ₁	15

	Ionic Solids: Ionic structures (NaCl, CsCl, ZnS and CaF ₂), size effects, radius ratio rule and its limitations, lattice energy, Born-Haber cycle, solvation energy and its relationship with solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rules.				
Unit-II	Chemical Kinetics: Concept of reaction rates, rate equation, factors influencing reaction rates, order and molecularity of a reaction, integrated rate expressions for zero and first-order reactions, half-life period, Arrhenius equation. Distribution Law: Nernst distribution law and its thermodynamic derivation, distribution law involving association and dissociation of solute in one phase, determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride.	CLO ₂	15		
Unit-III	Alkanes and Cycloalkanes: Nomenclature, classification of carbon atoms, structure, isomerism, sources, methods of formation (Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation), physical properties, free radical halogenation, reactivity and selectivity. Nomenclature of cycloalkanes, Baeyer's strain theory and its limitations, theory of strainless rings. Alkenes: Nomenclature, structure, methods of formation (dehydration of alcohols, dehydrohalogenation of alkyl halides, Hofmann elimination) and their mechanisms, Saytzeff rule, stability of alkenes. Electrophilic and free radical additions, addition of halogens and hydrogen halides, hydroboration-oxidation, oxymercuration-reduction, ozonolysis and hydration, Markovnikov's rule.	CLO ₃	15		
Practical	• Determination of Mg²⁺ by EDTA (Complexometric titration). • Qualitative analysis of inorganic ions by Paper Chromatography. • Determination of viscosity using Ostwald's Viscometer. • Determination of specific refractivity using Refractometer. • Separation of a mixture of two organic compounds by TLC.	CLO ₄	30		
	Contact Hours		75		
Evaluation Methods					
Internal Assessment	TH-25	PR-05	EndTermExamination:70	TH-50	PR-20
Class Participation:	5	0	Lab record	NA	05
Seminar/presentation/assignment/quiz/class test etc.:	5	NA	Viva-Voce	NA	05
Seminar/Demonstration/Viva-voce/Lab records etc.:	NA	05	Written Examination	50	NA
Mid-Term Exam:	15	NA	Write-up and execution of the practical	NA	10
Part C – Learning Resources					
Recommended Books/e-resources/LMS:					
1. Lee, J.D.; (2010), Concise Inorganic Chemistry , Wiley India.					
2. Kapoor, K.L. (2015), A Text book of Physical Chemistry , Vol 1, 6 th Edition, McGraw Hill Education.					
3. Clayden, J.; Greeves, N.; Warren, S.(2012), Organic Chemistry , Oxford.					
4. Morrison, R.N.; Boyd, R.N. Organic Chemistry , Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).					

5. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), **Senior Practical Physical Chemistry**, R. Chand & Co, New Delhi.
6. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), **Vogel's Text book of Quantitative Chemical Analysis**, John Wiley and Sons.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3	2	1	2	1	1	2	2	3	1	1
CLO ₂	3	2	1	3	1	1	3	3	3	2	1
CLO ₃	3	2	1	2	1	1	2	2	2	3	2
CLO ₄	2	3	2	2	2	3	3	3	2	3	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	12
Entrepreneurship	3
Skill Enhancement	24
Communication Development	5
Indian Knowledge System	2
Environmental Awareness/SDGs	6
Current Issues and Social Awareness	3
Gender issues	2
Public policies	2
Any Other	16

Part A – Introduction			
Name of the Programme	Chemistry		
Semester	II		
Nature of Course/Course Composition	Theory + Practical		
Name of the Course	Chemistry Skill-I		
Course Code	26L4.5-CHE- 202		
Course Type	DSEC		
Course Level	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO₁: Understand laboratory safety practices, chemical handling procedures, and solution preparation techniques. CLO₂ Acquire knowledge of concentration determination, standardization methods, buffer preparation, and analytical techniques. CLO₃ Understand complexometric titrations, purification methods, and the operation of analytical instruments and electrodes. CLO₄ Gain practical skills in titrations, chromatography, synthesis, and determination of physical properties of chemical substances.		
	Theory	Practical	Total
Credits	3	1	4
Teaching hours per week	3	2	5
Internal Assessment Marks	25	05	30
End Term Exam Marks	50	20	70
Max. Marks	75	25	100
Examination Duration (in Hours)	3	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u>			
The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.			
<u>Instructions for Practical Examiner</u>			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
	Topics	CLO/s Attempt	Contact Hours
Unit-I	Familiarization with chemical labeling, handling of hazardous chemicals, handling of glassware, sodium metal disposal. Chemical concepts related to solution preparation and standardization: equivalent mass, molar mass, specific gravity, concentration units (Normality, Molarity, Molality, % w/v, % w/w, % v/v, ppm, ppb), basicity, acidity, solutions of oxidizing and reducing agents. Determination of concentration and percentage purity. Standardization of solutions. Primary and	CLO ₁	15

	secondary standards. Indicators and preparation of indicator solutions. Buffers and preparation of buffer solutions.				
Unit-II	Preparation of complexometric solutions (EDTA solutions) and titrations. Management of chemical waste. Purification of chemicals through distillation, crystallization and sublimation. Operating knowledge including calibration, handling and maintenance of potentiometers and conductometers. Knowledge about different electrodes (Ag, Pt, SCE, Ag/AgCl) and their upkeep.	CLO ₂	15		
Unit-III	Operating knowledge including calibration and maintenance of pH meters and glass electrodes. Refractometer, polarimeter, flame photometer, spectrophotometer, interferometer and dipole meter: principles, operation, calibration, maintenance and applications.	CLO ₃	15		
Practical	• Complexometric titration: Determination of Zn²⁺ by EDTA. • Paper Chromatography: Qualitative analysis of any two inorganic cations/anions (Pb²⁺, Cu²⁺, Ca²⁺, Ni²⁺, Cl⁻, Br⁻, I⁻, PO₄³⁻, NO₃⁻). • Determination of viscosity using Ostwald's Viscometer. • Determination of specific refractivity of at least three liquids using Refractometer. • Preparation of Dibenzalacetone from acetone and benzaldehyde. • Preparation of 2,4-DNP derivative of benzophenone. • Separation of a mixture of two organic compounds by TLC.	CLO ₄	30		
	ContactHours		75		
Evaluation Methods					
Internal Assessment	TH-25	PR-05	End Term Examination: 70	TH-50	PR-20
Class Participation:	5	0	Lab record	NA	05
Seminar/presentation/assignment/quiz/class test etc.:	5	NA	Viva-Voce	NA	05
Seminar/Demonstration/Viva-voce/Lab records etc.:	NA	05	Written Examination	50	NA
Mid-Term Exam:	15	NA	Write-up and execution of the practical	NA	10
Part C – Learning Resources					
Recommended Books/e-resources/LMS:					
1. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), Senior Practical Physical Chemistry, R. Chand & Co, New Delhi.					
2. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), Vogel’s Textbook of Quantitative Chemical Analysis, John Wiley and Sons.					

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	2	1	1	3	2	3	2	2	1	2	1
CLO ₂	3	2	1	2	2	2	3	3	2	3	1

CLO ₃	2	2	1	2	2	2	3	2	3	3	2
CLO ₄	2	3	2	2	2	3	3	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	15
Entrepreneurship	4
Skill Enhancement	25
Communication Development	5
Indian Knowledge System	2
Environmental Awareness/SDGs	8
Current Issues and Social Awareness	5
Gender issues	2
Public policies	4
Any Other	5

Part A – Introduction			
Name of the Programme	Chemistry		
Semester	II		
Nature of Course/Course Composition	Theory		
Name of the Course	Minor Chemistry-II		
Course Code	26L4.5-CHE- 203		
Course Type	CC-M		
Course Level	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO ₁ Explain periodic properties, hybridization, and ionic solids. CLO ₂ Describe metallic bonding, semiconductors, electronic effects, and stereochemistry of organic compounds.		
	Theory	Practical	Total
Credits	2	0	2
Teaching hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Duration (in Hours)	02	0	
PartB-ContentsoftheCourse			
<u>Instructions for Paper- Setter:</u> The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 07 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Periodic table and atomic properties: Atomic properties: atomic and ionic radii, ionisation energy, electron affinity and electronegativity definition, methods of determination or evaluation, trend in periodic table, effective nuclear charge, Slater's rules. Directional characteristics of covalent bond, various type of hybridisation and shapes of simple inorganic molecules and ions (BeF ₂ , BF ₃ , CH ₄ , PF ₅ , SF ₆ , IF ₇ , SO ₄ ²⁻ , ClO ₄ ⁻ , NO ₃ ⁻). Ionic Solids: Stoichiometric and Non-stoichiometric defects in crystals, Lattice energy and Born-Haber cycle, Solvation energy and its relationship with solubility of Ionic solids, Polarizing power and Polarisability of ions, Fajan's rule. Metallic bond – Qualitative idea of valence bond and Band theories of metallic bond (conductors, semiconductors, insulators)	CLO ₁	16
II	Structure and Bonding in Organic Compounds: Localized and delocalized chemical bond, Van der Waal's interactions, resonance: conditions, resonance effect and its applications, hyperconjugation, inductive effect, Electrometric effect & their comparison. Stereochemistry of Organic Compounds: Concept of isomerism. Types of isomerism. Optical isomerism, elements of symmetry,	CLO ₂	14

	enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules (upto two stereogenic centres), diastereomers, threo and erythro diastereomers, meso compounds, Relative and absolute configuration, sequence rules, R & S systems of nomenclature. Geometrical isomerism. Determination of configuration of geometric isomers.		
	Total Contact hours	30	
Evaluation Methods			
Internal Assessment: 15 Marks		End Term Examination: 35 Marks	
• Class Participation:	5	Written Examination: 35	
• Seminar/presentation/assignment/quiz/ class test etc.:	5		
• Mid-Term Exam:	5		
PartC-LearningResources			
RecommendedBooks/e-resources/LMS:			
1. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry - Principles of Structure and Reactivity, Pearson education.			
2. Atkins, P.W.; Paula, J.de. (2014), Atkin’s Physical Chemistry Ed., 10th Edition, Oxford University Press.			
3. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 1, 6 th Edition, McGraw Hill Education.			
4. Nasipuri, D. (2018), Stereochemistry of Organic Compounds: Principles and Applications, 3rd Edition, New Age International.			
5. Gunstone, F. D. (1975), Guidebook to Stereochemistry, Prentice Hall Press.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3	1	1	1	-	1	2	2	2	1	-
CLO ₂	3	2	1	1	-	1	2	2	2	1	-

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	8
Entrepreneurship	1
Skill Enhancement	7
Communication Development	2
Indian Knowledge System	1
Environmental Awareness/SDGs	2
Current Issues and Social Awareness	3
Gender issues	0
Public policies	1
Any Other	5

Part A – Introduction			
Name of the Programme	Chemistry		
Semester	II		
Nature of Course/Course Composition	Theory + Practical		
Name of the Course	Introductory Chemistry-II		
Course Code	26L4.5-MDC-CHE- 201		
Course Type	MDC		
Course Level	0-99		
Pre-requisite for the course (if any)	Higher secondary other than science discipline		
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO₁ Describe the contributions of renowned Indian scientists and explain the classification, properties, and applications of metals and non-metals. CLO₂ Explain the classification and properties of matter, important chemical compounds, soil fertility, fertilizers, and environmental issues. CLO₃ Perform simple laboratory experiments involving preparation of chemical compounds and study of chemical reactions.		
	Theory	Practical	Total
Credits	2	1	3
Teaching hours per week	2	2	4
Internal Assessment Marks	15	05	20
End Term Exam Marks	35	20	55
Max. Marks	50	25	75
Examination Duration (in Hours)	02	02	
Part B - Contents of the Course			
<u>Instructions for Theory Paper-Setter</u>			
The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
<u>Instructions for Practical Examiner</u>			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
	Topics	CLO/s Attempt	Contact Hours
Unit-I	Renowned Indian Scientists: Brief Biography of Renowned Indian Scientists (Hargobind Khurana, Dr. P.C. Ray, Sir C.V. Raman, Dr. A.P.J. Abdul Kalam, C.N.R. Rao, Dr. Vikram Sarabhai, Dr. Homi Jahangir Bhabha, Dr. J.C. Bose, Dr. S.N. Bose). Metals & Non-Metals Periodic table, classification of elements, physical and chemical aspects of metals and non-metals, ore and minerals of Iron, Copper, Aluminum, alloys.	CLO ₁	15
Unit-II	Physical Properties of Matter, Soil and Fertilizers: Classification of matter, properties, uses, ideal gas	CLO ₂	15

	equation, real gas equation, some important compounds (baking soda, washing soda, plaster of Paris, gypsum, glass). Green revolution, soil: types of soil and their components for fertility, growth condition, pH, irrigation, biofertilizers, chemical fertilizers and their uses, acid rain.				
Practical Components	• To prepare Plaster of Paris • To prepare Potash Alum • To study the effect of acid on Baking and washing soda • To perform the action of water on quick lime and identify the nature of reaction (Exo / Endothermic)	CLO ₃	30		
Total		60			
Evaluation Methods					
Internal Assessment	TH-15	PR-5	End Term Examination: 55TH-35	PR-20	
Class Participation:	5	0	Lab record	NA	05
Seminar/presentation/assignment/quiz/class test etc.:	5	NA	Viva-Voce	NA	05
Seminar/Demonstration/Viva-voce/Lab records etc.:	NA	5	Written Examination	35	NA
Mid-Term Exam:	5	NA	Write-up and execution of the practical	NA	10
Part C – Learning Resources					
Recommended Books/e-resources/LMS:					
1. Chemistry In Daily Life: Third Edition by Kirpal Singh, PHI Learning					
2. General Chemistry: Principles, Patterns, and Applications, Bruce Averill, Strategic Energy Security Solution, Patricia Eldredge, R.H. Hand, LLC, Copyright Year: 2011					
3. The Great Indian Scientists Paperback – 1 January 2017, Cengage Learning India					

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3	2	1	2	1	1	-	2	1	1	-
CLO ₂	3	2	1	3	1	1	-	3	1	1	-
CLO ₃	2	2	2	2	1	2	2	2	1	1	1

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	8
Entrepreneurship	3
Skill Enhancement	18
Communication Development	5
Indian Knowledge System	6
Environmental Awareness/SDGs	8
Current Issues and Social Awareness	5
Gender issues	0
Public policies	2

Any Other	5
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