Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
III	*CC*	***P24MCH301***	***Coordination Chemistry - I***	***60***	***5***	***25***	***75***	***100***

Objectives:

- To gain insights into the modern theories, Spectral and Magnetic properties of coordination compounds and to learn kinetics and electron transfer reactions in complexes.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Illustrate the energy level diagrams, and recall the modern theories of Coordination compounds	**K2**
CO2	Construct Correlation diagrams and predict the electronic transitions that are taking place in the complexes	**K3**
CO3	Determine the stability constants of complexes and learn the magnetic property of the complexes	**K4**
CO4	Formulate the mechanistic pathways for substitution reactions in the complexes	**K5**
CO5	Justify the mechanism of electron transfer reactions in Octahedral complexes	**K5**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

UNIT-I Modern theories of coordination compounds: (15 Hours)

Crystal field theory - splitting of d orbitals in octahedral, tetrahedral and square planar symmetries - measurement of 10Dq - factors affecting 10Dq - spectrochemical series - evidences for crystal field splitting - Jahn Teller distortions and its consequences. Molecular Orbital Theory and energy level diagrams concept of Weak and strong fields, Sigma and pi bonding in octahedral, square planar and tetrahedral complexes.

UNIT II Spectral characteristics of complexes: (15 Hours)

Term states for d ions - characteristics of d-d transitions - charge transfer spectra - selection rules for electronic spectra - Orgel correlation diagrams - Sugano-Tanabe energy level diagrams - nephelauxetic series - Racah parameter and calculation of inter-electronic repulsion parameter.

UNIT III Stability and Magnetic property of the complexes: (15 Hours)

Stability of complexes: Factors affecting stability of complexes, Thermodynamic aspects of complex formation, Stepwise and overall formation constants, Stability correlations, statistical factors and chelate effect, Determination of stability constant of the complexes: Potentiometric method, Spectrophotometric method, Polarographic method, Magnetic property of complexes: Spin-orbit coupling, effect of spin-orbit coupling on magnetic moments, quenching of orbital magnetic moments.

UNIT IV Kinetics and mechanisms of substitution reactions of octahedral and square planar complexes: (15 Hours)

Inert and Labile complexes; Associative, Dissociative and SNCB mechanistic pathways for substitution reactions; acid and base hydrolysis of octahedral complexes; Classification of metal ions

based on the rate of water replacement reaction and their correlation to Crystal Field Activation Energy; Substitution reactions in square planar complexes: Trans effect, theories of trans effect and applications of trans effect in synthesis of square planar compounds; Kurnakov test.

UNIT V Electron Transfer reactions in octahedral complexes: (15 Hours)

Outer sphere electron transfer reactions and Marcus-Hush theory; inner sphere electron transfer reactions; nature of the bridging ligand in inner sphere electron transfer reactions. Photo-redox, photo-substitution and photo-isomerization reactions in complexes and their applications.

Recommended Text:

1. Ajay Kumar, Coordination Chemistry, 8th Edition, Aaryush Education. 2023.
2. R Gopalan and V Ramalingam, Concise Coordination Chemistry, 1st Reprint, Vikas Publishing House Pvt. Ltd., 2017.
3. Kamlodvab Jha, Coordination Chemistry, 1St Edition, Vishal Publishing Co. 2022.
4. J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006.
5. G L Meissler and D ATarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008.

Reference Books:

1. Peter Atkins and Tina Overton, Shriver and Atkins' Inorganic Chemistry, 5th Edition, Oxford University Press, 2010.
2. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, P. L. Guas, John Wiley, 2002, 3rd edition.
3. Catherine E Housecraft and Alan G Sharpe, Inorganic Chemistry, 3rd edition, Pearson Publishers, UK, 2008.

Website and e-learning sources:

1. https://ocw.mit.edu/courses/5-04-principles-of-inorganic-chemistry-ii-fall2008/pages/syllabus/
2. https://onlinecourses.nptel.ac.in/noc19_cy19/preview
3. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/96

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	3	3	3	3
CO2	2	3	2	-	2	-	-	2	3	2	3
CO3	3	2	3	-	3	-	-	2	3	3	2
CO4	2	3	2	-	3	-	-	3	3	3	3
CO5	3	3	3	-	3	-	-	2	3	3	2
	2.6	**2.8**	**2.6**	**-**	**2.6**	**-**	**-**	**2.4**	**3**	**2.8**	**2.6**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. Z. ANSAR ALI	Dr. S. ZAHEER AHMED

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
III	*CC*	***P24MCH302***	***Physical Chemistry - II***	***60***	***4***	***25***	***75***	***100***

Objectives:

- To understand the essential characteristics of wave functions and need for the quantum mechanics.
- To know the importance of quantum mechanical models of particle in a box, rigid rotor and harmonic oscillator.
- To apply the quantum mechanics to hydrogen and polyelectronic systems.
- To familiarize the symmetry in molecules and predict the point groups.
- To predict the vibrational modes, hybridization using he concepts of group theory.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (On the successful completion of the course, the students will be able to)	Cognitive Level
CO1	Interpret the significance of wave functions	**K2**
CO2	Apply Schrodinger wave equation to various quantum models and to find solutions	**K5**
CO3	Explain the solution for hydrogen atom and various approximation methods in Quantum chemistry	**K2**
CO4	Predict the point groups in molecules using symmetry elements	**K3**
CO5	Analyze the vibrational modes, hybridization and electronic spectra of molecules using the concepts of group theory	**K4**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

Unit–I Basics of Quantum Chemistry (15 Hours)

1.1: Black Body Radiation, Photoelectric Effect, Wave-particle Duality and Uncertainty principle.

1.2: Introduction to Quantum Mechanics – Schrodinger wave equation – Time dependent and Time independent. Characteristics and significance of wave function, Normalization and Orthogonality.

1.3: Operators: Eigen value and Eigen function. Linear momentum operator, Hermitian operators – properties of Hermitian operator, postulates of quantum mechanics.

Unit – II Quantum Models (15 Hours)

2.1: Application of Schrodinger wave equation: Particle in one dimensional and three-dimensional box – Concept of degeneracy.

2.2: Application to Harmonic oscillator – Wave equation and solution – Significance of E and Ψ.

2.3: Rigid rotor – Quantum mechanical results – Wave equation and solution.

Unit – III Hydrogen Atom and Approximation Methods (15 Hours)

3.1: Hydrogen atom – Schrodinger wave equation and solution – Radial and angular functions – radial distribution functions.

3.2: Approximation Methods: Variation method – Application to one dimensional box and hydrogen atom. Perturbation method: First order perturbation and application to helium atom.

3.3: Hartree-Fock Self consistent method, electron spin, Pauli's exclusion principle and Slater orbitals.

Unit – IV Group Theory **(15 Hours)**

4.1: Symmetry elements and symmetry operations, Group postulates, Types of groups – sub groups, Abelian and non – abelian groups, order of a group – point groups- C_n, C_{nh}, C_{nv}, D_n, D_{nh}, D_{nd}, T_d and O_h. Group multiplication table for C_{2v} and C_{3v} point groups.

4.2: Matrix representation of symmetry operations, Similarity transformation and classes, reducible, irreducible and direct product representations.

4.3: The Great orthogonality theorem – Properties of irreducible representations, construction of character table for C_{2v}, C_{3v}, #C_{2h} and D_{2h}# point groups.

Unit – V Application of Quantum and Group Theory **(15 Hours)**

5.1: Hydrogen molecule: Heitler and London (Valence Bond) treatment and molecular orbital theory – Hydrogen molecule ion: Linear variation function and LCAO method.

5.2: Huckel Molecular orbital theory: Application to ethylene, butadiene, #cyclopropyl, cyclobutadiene and benzene#.

5.3: Applications of Group Theory: Standard reduction formula – Hybrid orbitals in CH_4, BF_3, SF_6, and NH_3. Determination of representations of vibrational modes in non-linear molecules (H_2O, BF_3 and NH_3). Symmetry selection Rules for IR and Raman spectra. Electronic spectra of ethylene.

 # _____# Self Study Component for Seminar/Assignment:
(Questions should not be asked from self-study component in the End Semester Examinations)

Text Books:

1. R.K. Prasad, Quantum Chemistry, New Age International Publishers, New Delhi, 2010, 4th revised edition.

2. F. A. Cotton, Chemical Applications of Group Theory, John Wiley & Sons, 2003, 2nd edition.

3. A. Vincent, Molecular Symmetry and Group Theory. A Programmed Introduction to Chemical Applications, John and Willy & Sons Ltd., 2013, 2nd Edition.

4. T. Engel & Philip Reid, Quantum Chemistry and Spectroscopy, Pearson, New Delhi, 2018, 4th edition.

5. G. K. Vemulapalli, Physical Chemistry, Prentice Hall of India Pvt. Ltd. 2001. 6. D.A. McQuarrie, Quantum Chemistry, Viva Books PW. Ltd, 2013, 2nd edition.

Reference Books:

1. N. Levine, Quantum Chemistry, Allyn& Bacon Inc, 1983, 4th edition.

2. D.A. McQuarrie and J. D. Simon, Physical Chemistry, A Molecular Approach, Viva Books Pvt. Ltd, New Delhi, 2012.

3. R. P. Rastogi & V. K. Srivastava, An Introduction to Quantum Mechanics of Chemical Systems, Oxford & IBH Publishing Co., New Delhi, 1999.

4. R.L. Flurry. Jr, Symmetry Group Theory and Chemical applications, Prentice Hall. Inc, 1980

5. J. M. Hollas, Symmetry in Molecules, Chapman and Hall, London, 2011, Reprint.

e-Resources

Introduction to Quantum Chemistry - https://youtu.be/xUmfYWaTr1M
Fundamentals of Quantum Mechanics - https://youtu.be/kmihrxZPj2I
- https://youtu.be/-X3FdzBdaM0
Operators in Quantum Mechanics - https://youtu.be/osUV4mdLsYs

Particle in a Box - https://youtu.be/kmNsawkbJ4M
Linear Harmonic Oscillator - https://youtu.be/OWcCAWLWXyo
- https://youtu.be/cXFX0Xr8ruM
Rigid Rotor - https://youtu.be/w0nfCImO6xU ; https://youtu.be/oml0W58b-50
Hydrogen Atom - https://youtu.be/_pj4TQSZCKo
Symmetry Elements and Symmetry Operators - https://youtu.be/yIGbSfl096c ;
- https://youtu.be/zVwtsXVE-1Y
Definition of Groups and its Characteristics - https://youtu.be/_QvwmJ6MrPk
Products of symmetry operations - https://youtu.be/Oni8zDApg3M
Symmetry Equivalent Atoms and Elements - https://youtu.be/4yX2gqga_nM

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	2	3	3	3
CO2	3	3	3	-	-	-	-	2	3	3	3
CO3	3	3	3	-	-	-	-	2	3	3	3
CO4	3	3	3	-	-	-	-	2	3	3	3
CO5	3	3	3	-	-	-	-	2	3	3	3
	3	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**3**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. M.S.M. KAMIL Dr. S. MOHAMMED SAFIULLAH	Dr. S. ZAHEER AHMED

Sem	Category	Course Code	Course Title	Hours	Credits	Int. Marks	Ext. Marks	Max. Marks
III	CC	P24MCHP31	INORGANIC CHEMISTRY PRACTICALS - II	75	4	25	75	100

Objectives:

- To understand the principle of conductivity experiments through conductometric titrations.
- To evaluate the order of the reaction, temperature coefficient, and activation energy of the reaction by following pseudo first order kinetics.
- To construct the phase diagram of two component system forming congruent melting solid and find its eutectic temperatures and compositions.
- To determine the kinetics of adsorption of oxalic acid on charcoal.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Learn concepts of kinetics of chemical reaction and adsorption isotherm.	K1
CO2	Learn the concepts and measurement of equivalent conductance.	K2
CO3	Analyze the phase transformations.	K3
CO4	Experiment the concepts of conductometric titrations.	K4
CO5	Perform calculation and report the data graphically and make comparisons	K5

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

UNIT-I: Conductivity Experiments

1. Determination of the equivalent conductance of a weak acid at different concentrations and verify Ostwald's dilution law and calculate the dissociation constant of the acid.
2. Determination of equivalent conductance of a strong electrolyte at different concentrations and examine the validity of the Onsager's theory as limiting law at high dilutions.
3. Verification of Kohlrausch's Law for weak electrolytes.
4. Determination of solubility of a sparingly soluble salt.
5. Acid-base titration (strong acid and weak acid vs NaOH).
6. Titration of mixture of HCl and CH_3COOH Vs NaOH.
7. Titration of NH_4Cl Vs NaOH.
8. Titration of CH_3COONa Vs HCl.

UNIT-II: Kinetics

1. Comparison of strengths of acid A and B by studing the kinetics of acid hydrolysis of an ester.
2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half-life method and determine the order with respect to iodine and acetone.

UNIT-III: Phase diagram

Construction of phase diagram for a simple binary system

1. Naphthalene - Biphenyl
2. Naphthalene - phenanthrene
3. Benzophenone - diphenyl amine

Adsorption

Adsorption of oxalic acid on charcoal & determination of surface area (Freundlich isotherm only).

Recommended Text

1. Venkateswaran V, Veeraswamy R and Kulandaivelu A R, *Basic Principles of Practical Chemistry*, 2nd Edition, Sultan Chand & sons, New Delhi, 1997.
2. Daniels, Mathews F, Howard J and John Warren W, *Experimental Physical Chemistry*, 7th Edition, Mc Graw Hill, New York, 1970.
3. Findlay A, *Practical Physical Chemistry*, 7th Edition, Longman, London, 1959.
4. V. K. Ahluwalia, Sunita Dhingra Adarsh Gulati, College Practical Chemistry, University Press (India) Private Limited, Reprint 2008.
5. David Shoemaker, Joseph Nibler, Carl Garland, Experiments in Physical Chemistry, 7th Edition, 2003.
6. B. D. Khosla, V. C. Garg, Adarsh Gulati, Senior Practical Physical Chemistry, R. Chand and Co., Edition 2007.
7. B. Viswanathan and P.S. Raghavan, Practical Physical Chemistry, Viva Books, New Delhi, 2009.
8. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996.
9. V.D. Athawale and Parul Mathur, Experimental Physical Chemistry, New Age International (P) Ltd., New Delhi, 2008.

Reference Books

1. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001.
2. G.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th edition, McGraw Hill, 2009.
3. J. N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987.
4. Shailendra K Sinha, Physical Chemistry: A laboratory Manual, Narosa Publishing House Pvt, Ltd., New Delhi, 2014.
5. F. Jensen, Introduction to Computational Chemistry, 3rd Ed., Wiley-Blackwell.
6. https://web.iitd.ac.in/~nkurur/2015-16/Isem/cmp511/lab_handout_new.pdf

SCHEME OF VALUATION

End Semester Examination	Marks	Internal Assessment	Marks
Procedure	10	Two Tests	10
Calculation	10	Attendance / Regularity	10
Graph	10	Results accuracy	5
Results	30		
Record	5		
Viva voce	10		
TOTAL	**75**	**TOTAL**	**25**

Error Calculation:

<2% Error 50 Marks
3% 40 Marks
4% 30 Marks
>4% 20 Marks

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	-	2	-	-	3	3	3	3
CO2	3	2	2	-	2	-	-	3	3	3	3
CO3	3	3	3	-	3	-	-	3	3	3	3
CO4	3	3	3	-	3	-	-	3	3	3	3
CO5	3	3	3	-	3	-	-	3	3	3	3
	2.8	**2.6**	**2.4**	**-**	**2.6**	**-**	**-**	**3**	**3**	**3**	**3**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. S. SYED TAJUDEEN	Dr. S. ZAHEER AHMED

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
III	*DSEC*	***P24ECH301***	***Biomolecules and Heterocyclic Compounds (Elective - V)***	***75***	***3***	***25***	***75***	***100***

Objectives:

- To learn the basic concepts and biological importance of biomolecules and natural products.
- To distinguish the structures of mono, di & polysaccharides and their conformations.
- To explain the various functions of proteins, nucleic acids, steroids and hormones.
- To understand the mechanism of electrophilic and nucleophilic substitution reactions of fused ring heterocycles.
- To understand the principle, theory and applications of IR, ^{1}H & ^{13}C NMR and mass spectra.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (On the successful completion of the course, the students will be able to)	Cognitive Level
CO1	Classify carbohydrates, Explain the properties, & structure of Monosaccharide, Oligosaccharide, Polysaccharide.	**K2**
CO2	List the biological functions and synthesis of Steroids & Harmones.	**K4**
CO3	Summarize the synthesis & biological functions of proteins, Nucleic Acid.	**K2**
CO4	Rephrase the preparation, properties of fused ring heterocyclic compounds and explain the mechanism of reactions of heterocycles.	**K4**
CO5	elucidate the structure of unknown organic compounds using spectral data	**K5**

Cognitive Levels (**K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create)

Syllabus:

UNIT–I: Chemistry and metabolism of carbohydrates: (15 Hours)

1.1 Monosaccharides - The reactions of monosaccharides - oxidation and reduction reactions of monosaccharides – Acetylation – Glycoside formation – Reaction with phenylhydrazine - glucose and fructose - anomerization - epimerization - mutarotation - Kiliani-Fischer synthesis - Ruff's degradation - the Wohl degradation - measuring the blood glucose level in diabetes - anomeric effect in glucose.

1.2 Disaccharides – structure and function - maltose - lactose – cellobiose - gentiobiose.

1.3 Polysaccharides - Glycogen, insulin and Chitin - structure and function - cyclodextrins - types.

1.4 Glycolysis of carbohydrates.

UNIT–II: Steroids and Hormones: (15 Hours)

2.1 Steroids – Introduction, occurrence, nomenclature, configuration of substituents. Sterols – colour reactions of sterols.

2.2 Constitution of Cholesterol – Position of the Hydroxyl Group and Double Bond, nature and position of the side-chain, position of the angular methyl Group, biosynthesis of cholesterol from squalene.

2.3 Hormones - Introduction, Conversion of cholesterol to progesterone, estrone and testosterone. Structure and functions of non–steroidal hormones – Adrenaline.

UNIT–III: Proteins and nucleic acids: (15 Hours)

3.1 Proteins: Classification of Proteins. Primary, Secondary and Tertiary Structure of Proteins.

3.2 Nucleic Acids: Structures and names of nucleosides and nucleotides - ATP - carrier of chemical energy - structures of dinucleotides - NAD+, NADP+, NADH, NADPH and GTP.

3.3 Nucleic acids - DNA and RNA - primary and double helical structures - base pair - replication - transcription - ribosomal RNA - transfer RNA - translation.

UNIT–IV Fused Ring Heterocyclic Compounds: (15 Hours)

4.1 Benzo fused five member rings: Indole, isoindole, benzofuran, benzothiophene and Isatin - preparation and properties.

4.2 Benzo fused six membered rings: Quinoline and isoquinoline: Preparation by ring closure reactions and properties.

4.3 Reactions: Mechanism of electrophiic and nucleophiic substitutions, oxidation and reduction reactions.

UNIT–V Spectral Identification of Organic Compounds: (15 Hours)

5.1 Infrared spectroscopy: Finger print region and its importance, typical group frequencies for – CH, -OH, N-H, C-C, -CO and aromatic systems.

5.2 Nuclear Magnetic Resonance Spectroscopy (^{1}H NMR): Shielding and deshielding of magnetic nuclei-chemical shift and its measurements, – spin-spin interactions- coupling constant J. ^{13}C NMR Spectroscopy: Similarities and Differences between PMR and CMR.

5.3 Mass spectrometry Mass spectral fragmentation of organic compounds, Common functional groups, molecular ion peak, meta stable peak, Mc Lafferty rearrangement, Nitrogen rule.

5.4 Determination of structure of organic compounds by comprehensive (IR, NMR (^{1}H&^{13}C) and mass) spectral data (Students will be able to deduce structures of simple to moderately complex organic molecules by combining the spectral data obtained using two or more spectral techniques).

#_____# Self Study Component for Seminar / Assignment:

(Questions should not be asked from self study component in the End Semester Examinations)

Text Books:

1. T. K Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH, North America, 2007.
2. L. Finar, Organic Chemistry Vol-2, 5th edition, Pearson Education Asia, 1975.
3. V. K. Ahluwalia and M. Goyal, Textbook of Heterocyclic compounds, Narosa Publishing, New Delhi, 2000.
4. M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2017.
5. V. K. Ahluwalia, Steroids and Hormones, Ane books pub., New Delhi, 2009.
6. Raj K Bansal, Heterocyclic Chemistry, WILEY EASTERN LIMITED, 1990.
7. Y.R. Sharma, Elementary Organic Spectroscopy-Principles and Chemical Applications, S. Chand & Company Ltd. New Delhi. 2005.

Reference Books:

1. L. Finar, Organic Chemistry Vol-1, 6thedition, Pearson Education Asia, 2004.
2. Pelletier, Chemistry of Alkaloids, Van Nostrand Reinhold Co, 2000.
3. Shoppe, Chemistry of the steroids, Butterworthes, 1994.
4. A. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad,2004.
5. M. P. Singh. and H. Panda, Medicinal Herbs with their formulations, Daya Publishing House, Delhi,2005.
6. Sujata V. Bhat, B. A. Nagasmpagi, S. Meenakshi, Natural Products Chemistry and Applications, Narosa Publishing House, 2011
7. U. Satyanarayana, U. Chakrapani, Essential of Biochemistry Books & Allied (P) Ltd. Second Edition, 2008.

e – Resources:

https://www.organic-chemistry.org/
https://www.studyorgo.com/summary.php
https://www.clutchprep.com/organic-chemistry

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	-	3	-	-	3	3	3	3
CO2	2	2	3	-	2	-	-	3	2	2	2
CO3	2	2	3	-	2	-	-	3	2	2	2
CO4	3	3	3	-	3	-	-	3	3	3	3
CO5	2	3	2	-	3	-	-	2	3	3	3
	2.2	**2.4**	**2.8**	**-**	**2.6**	**-**	**-**	**2.8**	**2.6**	**2.6**	**2.6**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. V. SALEEM MALIK	Dr. S. ZAHEER AHMED

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
III	*DSEC*	***P24ECH302***	***Pharmacognosy and Phytochemistry (Elective - V)***	***75***	***3***	***25***	***75***	***100***

Objectives:

- To develop the knowledge of natural products, biological functions and pharmacological uses.
- To develop knowledge on primary and secondary metabolites and their sources.
- To understand the concepts of isolation methods and separation of bioactive compounds.
- To provide the knowledge on selected glycosides and marine drugs.
- To familiarize the guidelines of WHO and different sampling techniques.

Course Outcomes (COs) and Cognitive Level Mapping:

Cos	CO Statement (On the successful completion of the course, the students will be able to)	Cognitive Level
CO1	Recall the sources of natural medicines and analysis of crude drugs.	**K1**
CO2	Explain the methods of evaluation based on various parameters.	**K2**
CO3	Analyze the isolated drugs	**K4**
CO4	Apply various techniques to discover new alternative medicines.	**K3**
CO5	Evaluate the isolated drugs for various pharmacological activities	**K5**

Cognitive Levels (**K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create)

Syllabus:

UNIT–I: Pharmacognosy and Standardization of Herbal drugs: (15 Hours)

Introduction, definition, development classification and Source of Drugs: Biological, mineral, marine,and plant tissue cultures. Study of pharmacognostic of a crude drug. Biosynthesis: Shikimic acid pathway and acetate pathway. Systematic analysis of Crude drugs. Standardization of Herbal drugs. WHO guidelines, Sampling of crude drug, Methods of drug evaluation. Determination of foreign matter, moisture Ash value. Phytochemical investigations-General chemical tests.

UNIT–II: Extraction Techniques: (15 Hours)

#General methods of extraction, types – maceration, Decoction, percolation, Immersion and soxhlet extraction#.

Advanced techniques- counter current, steam distillation, supercritical gases, sonication, Microwaves assisted extraction. Factors affecting the choice of extraction process.

UNIT–III: Drugs containing Terpenoids and volatile oils: (15 Hours)

Terpenoids: Classification, Isoprene rule, Isolation and separation techniques, General properties Camphor, Menthol, Eucalyptol. Volatile Oils or Essential Oils: Method of Preparations, Classifications of Volatile oils, Camphor oil, Geranium oil, Citral- Structure uses. Pentacyclic triterpenoids: amyrines; taraxasterol: Structure and pharmacological applications.

UNIT–IV Drugs containing alkaloids: (15 Hours)

Occurrence, function of alkaloids in plants, pharmaceutical applications. Isolation, Preliminary Qualitative tests and general properties. General methods of structural elucidation. Morphine, Reserpine, papaverine - chemical properties, structure and uses. papaverine - structure, chemical properties and uses.

UNIT–V Plant Glycosides and Marine drugs: (15 Hours)

Glycosides: Basic ring system, classification, isolation, properties, qualitative analysis. Pharmacological activity of Senna glycosides, Cardiac glycosides-Digoxin, digitoxin, Steroidal saponins glycosides- Diosgenin, hecogenin. Plant pigments: Occurrence and general methods of structure determination, isolation and synthesis of quercetin and cyanidin chloride. Marine drugs - Selected Drug Molecules: Cardiovascular active substances, Cytotoxic compounds, antimicrobial compounds, antibiotic compounds, Anti-inflammatory agents. Marine toxins.

#_____# Self Study Component for Seminar / Assignment:

(Questions should not be asked from self study component in the End Semester Examinations)

Text Books:

1. Gurdeep R Chatwal (2016), Organic chemistry of Natural products, Volume I & II, 5th edition, Himalaya publishing House.

2. S. V. Bhat, B. A. Nagasampagi, M. Sivakumar (2014), Chemistry of Natural Products, Revised edition, Narosa Publishers.

Reference Books:

1. Jeffrey B. Harborne (2012), Phytochemical methods: A Guide to Modern Techniques of Plant Analysis, 4th edition, Indian reprint, Springer.

2. Ashutoshkar (2007), Pharmacognosy and Pharmacobiotechnology, 2nd edition, New age international (P) limited, New Delhi.

e – Resources:

https://www.amdhs.org

https://www.eolss.net

https://www.study.com

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	3	3	3	3
CO2	2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	3	3	2	3	3	3
CO4	2	3	3	3	3	2	3	3	3	3	3
CO5	2	3	2	3	3	2	3	2	3	3	3
	2.4	**3**	**2.6**	**3**	**2.8**	**2.4**	**3**	**2.6**	**3**	**3**	**3**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. V. SALEEM MALIK	Dr. S. ZAHEER AHMED

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
III	*SEC*	***P24SCHP31***	***Practical - Orgin Lab (SBS - II)***	***30***	***2***	***25***	***75***	***100***

Objectives:

- To familiarize students with the Origin software used for data analysis and graphical representation.
- To equip students with the ability to handle large datasets, perform statistical analyses, and generate high-quality plots and graphs.
- To develop skills in interpreting experimental data through various data analysis techniques and applying them to real-world chemistry problems.

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Apply Origin software for data analysis and visualization	**K3**
CO2	Import, manipulate, and analyze large datasets in the context of chemistry experiments	**K4**
CO3	Perform statistical analyses and curve fitting to interpret chemical data	**K5**
CO4	Generate high-quality plots and reports suitable for scientific publication or presentation	**K6**
CO5	Develop the ability to solve real-world chemistry problems through computational methods and statistical analysis	**K6**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

Unit-I Introduction to Origin Software **(4 hours)**

Overview of Origin software - Installation, interface, file management, and basic navigation.
Workspace overview - Menus, toolbars, and options.
Types of data in Origin - Workbooks, worksheets, and matrices.
Basic plotting - 2D and 3D plots (Line, Bar, Scatter, etc.).

Unit-II Data Importing and Handling **(4 hours)**

Importing data - From text files, Excel files, and databases.
Data transformation - Sorting, filtering, and editing datasets.
Data manipulation tools - Mathematical operations, column statistics, and data interpolation.

Unit – III Statistical Analysis in Origin **(6 hours)**

Basic statistical analysis - Descriptive statistics (mean, median, standard deviation).
Regression analysis - Linear regression.
Curve fitting and model fitting - Using built-in models and custom functions.
Error analysis - Calculating error propagation in data.

Unit - IV Advanced Plotting Techniques **(6 hours)**

Multilayered graphs - Combining different types of plots (e.g., scatter with line).
Customization of graphs - Axis scaling, annotations, legends, and color schemes.
3D plotting - 3D surface plots and contour plots.
Exporting plots - Saving and exporting graphs for presentations/publications.

Unit - V Data Analysis for Chemical Experiments **(10 hours)**

Kinetic data analysis - Analyzing reaction rates and concentration vs. time data.

Spectroscopic data analysis - Analyzing UV-Vis, IR, XRD, and TGA data.

Report Generation and Presentation - Creating reports in Origin, Exporting results.

Textbooks

1. Douglas A. Skoog, Donald M. West, F. James Holler, R. Crouch, Fundamentals of Analytical Chemistry, 9th Edition. Publisher: Mary Finch, Cengage.

Books for Reference

1. Getting Started Manual: https://www.originlab.com/pdfs/gettingstarted.pdf
2. Tutorial for Origin 9: https://www.originlab.com/pdfs/tutorials.pdf

Web Resources

OriginPro Full Course: https://youtu.be/TwVyvh628wE

Getting Started Manual: https://www.originlab.com/pdfs/gettingstarted.pdf

Tutorial for Origin 9: https://www.originlab.com/pdfs/tutorials.pdf

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	3	3	3	3
CO2	3	3	3	3	1	-	-	3	3	3	3
CO3	3	3	3	3	2	-	-	3	3	3	3
CO4	3	3	3	3	3	-	-	3	3	3	3
CO5	3	3	3	3	3	-	-	3	3	3	3
	3	**3**	**3**	**2.6**	**2**	**-**	**-**	**3**	**3**	**3**	**3**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. M.S.M. KAMIL Dr. S. MOHAMMED SAFIULLAH	Dr. S. ZAHEER AHMED

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*CC*	***P24MCH401***	***Organic Synthesis and Photochemistry***	***75***	***6***	***25***	***75***	***100***

Objectives

- To understand the molecular complexity of carbon skeletons and the presence of functional groups and their relative positions.
- To study various synthetically important reagents for any successful organic synthesis.
- To apply disconnection approach and identifying suitable synthons to effect successful organic synthesis.
- To impart knowledge in the theory and applications of various aspects of photochemistry and pericyclic reactions.
- To understand the synthesis and mechanisms of various reactions related to the synthesis by cycloaddition, photochemistry.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Recall organic synthesis reactions and methodologies.	**K1**
CO2	Implement the synthetic strategies in the preparation of various organic compounds.	**K3**
CO3	Compare different types of pericyclic reactions (electrocyclization, cycloaddition, sigmatropic rearrangements).	**K4**
CO4	Illustrate the types of photo chemical reactions	**K2**
CO5	Analyze the mechanism of various photochemical reactions.	**K5**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

UNIT-I: Planning an Organic Synthesis and Control elements: (15 Hours)

1.1 Definitions: Synthons and synthetic equivalents - types of synthons: donor and acceptor synthons, Target molecule, Functional group interconversion and Planning for Synthesis of Organic Compounds.

1.2 Disconnection approach, Classification of synthesis – linear, convergent and Divergent synthesis. One group C-X disconnection and two group C-X disconnection. one group C-C and two group C-C disconnections.

1.3 Chemoselectivity, Reversal Polarity (Umpolung concept of Seebach) and Ammine Synthesis.

1.4 Stereochemical Control of Products – Selective Aldol and Michael Reactions.

UNIT-II: Organic Synthetic Methodology: (15 Hours)

2.1 Retrosynthetic analysis; Alternate synthetic routes. Synthesis of target molecules based on disconnection and synthon approach - asprin, paracetamol, ibuprofen, longifolene, 4-methoxy acetophenone.

2.2 Retrosynthesis of some heterocycles containing nitrogen atoms – saccharine, morpholine, Benzocaine, salbutamol, reserpine.

2.3 Protection and deprotection of functional groups (hydroxyl, amino, carbonyl and carboxyl groups).

UNIT-III: Pericyclic Reactions: (15 Hours)

3.1 Classification and Orbital Symmetry, pi Molecular orbital diagrams of polyene systems

3.2 Electrocyclic Reactions - Thermal and Photochemical cyclisation and ring openings. Stereochemistry, Woodward-Hofmann Rules (con and dis rotation), Frontier Molecular Orbital approach and Correlation Diagrams for butadiene to cyclobutene and 1,3,5-hexatriene to 1,3-cyclohexadiene systems

3.3 Cycloaddition and retrocycloaddition Reactions - Thermal and Photochemical, Stereochemistry, Woodward–Hofmann rules, FMO and Correlation Diagrams of (2+2 and 4+2) Reactions. Diels-Alder and retro Diels-Alder reaction. Cationic, anionic, and 1, 3-dipolar additions.

3.4 Sigmatropic rearrangements – FMO method only – (1,3), (1,5), (1,7) and (3,3) sigmatropic rearrangements, Claisen, Cope and oxy-Cope rearrangements. Cope rearrangement of divinylcyclopropane and degenerate Cope rearrangement.

UNIT-IV: Organic Photochemistry-I: (15 Hours)

4.1 The Fate of the Excited Molecule—Physical Processes: Jablonski Diagram;

4.2 Photochemistry of Carbonyl Compounds - Norrish Type I reaction, Norrish Type – II reaction, Photocycloaddition Reaction (Paterno- Buchi reaction), Photo reduction & photo enolisation; photochemical Oxidations.

4.3 Photodimerisation of Carbonyl Compounds; photochemistry of α, β-unsaturated ketones.

UNIT-V: Organic Photochemistry-II: (15 Hours)

5.1 Photo Rearrangements: Di-π-Methane (DPM) Rearrangement, Aza-Di-π-Methane Rearrangement; Photo Fries rearrangement of Phenolic acetates;

5.2 Photochemistry of Alkenes, Dienes and Aromatic Compounds - Cis-Trans Isomerisation of alkenes (Direct and sensitized) (Photoisomerisation of Stilbene), Dimerisations of alkenes; Photochemistry of conjugated Dienes - Photochemistry of Butadiene; Photochemistry of Benzene and substituted benzene (1,2-, 1,3-, 1-4- additions).

5.3 Photochemistry of Nitrite esters (Barton reaction).

Recommended Text

1. V. K. Ahluwalia, Organic Synthesis: Special Techniques, Narosa Publishing House, 2nd Edition, 2005.

2. R. E. Ireland, Organic synthesis, Prentice Hall India, Goel publishing house, 1990.

3. Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, Second Edition, 2016.

4. M. B. Smith, Organic Synthesis 3rd edn, McGraw Hill International Edition, 2011.

5. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th Edition, Springer, New York, 2007.

6. Michael B. Smith and Jerry March, Advanced Organic Chemistry, John Wiley & Sons, 7th Edition, 2016.

7. K.K. Rohatgi-Mukherjee, Fundamentals of Photochemistry, 4th edition, New Age International Publications, New Delhi, 1978.

8. Nicholas J. Turro V. Ramamurthy J. C. Scaiano, Principles of Molecular Photochemistry An Introduction, University Science books 2009.

Reference Books

1. Stuart Warren, Organic Synthesis: The Disconnection Approach, Wiley Student Edition, Reprint 2007.

2. Puneet Karnad, Organic Synthesis, RBSA Publishers, 2007.

3. Gill and Wills, Pericyclic Reactions, Chapman Hall, London, 1974.

4. W. Caruthers, Some Modern Methods of Organic Synthesis 4th edn, Cambridge University Press, Cambridge, 2007.

5. H. O. House. Modern Synthetic reactions, W.A. Benjamin Inc, 1972.

6. Jagdamba Singh and Jaya Singh, Photochemistry and Pericyclic Reactions, New Age International Publishers, New Delhi, 2012.

7. I. L. Finar, Organic Chemistry Vol. I & Vol. II, Longman (Cambridge), 2011.

8. Jerry March, Advanced Organic Chemistry, John Wiley & Sons, 5th Edition, 2001.

Web Resources

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5 (P014-Retrosynthesis, disconnection approach)

2. https://nptel.ac.in/courses/104/105/104105038/

3. https://swayam.gov.in

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	-	3	-	-	3	3	3	3
CO2	2	2	3	-	2	-	-	3	2	2	2
CO3	2	2	3	-	2	-	-	3	2	2	2
CO4	3	3	3	-	3	-	-	3	3	3	3
CO5	2	3	2	-	3	-	-	2	3	3	3
	2.2	**2.4**	**2.8**	**-**	**2.6**	**-**	**-**	**2.8**	**2.6**	**2.6**	**2.6**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. S. SYED TAJUDEEN	Dr. S. ZAHEER AHMED

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*CC*	***P24MCH402***	***Coordination Chemistry - II***	***75***	***5***	***25***	***75***	***100***

Objectives:

- To recognize the structural aspects and reaction pathways of Organometallic compounds, and to illustrate the inorganic applications of spectroscopy.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Describe the fundamental and structural aspects of organometallic compounds	**K2**
CO2	Develope the mechanisms of catalytic reactions in organometallic compounds	**K3**
CO3	Deduce the structure of inorganic compounds by IR and NMR spectroscopy	**K4**
CO4	Evaluate the applications of ESR spectroscopy to coordination compounds	**K5**
CO5	Perform absolute configuration of complexes using CD and ORD and illustrate the Photo Electron spectroscopy	**K6**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

UNIT-I Chemistry of organometallic compounds: (15 Hours)

Classification of organometallic compounds based on M-C bond – 18 and 16 electron rule; Bonding in metal – olefin complexes - Ziese's salt, metal-acetylene and metal-allyl complexes; Metal-cyclopentadienyl complexes – Examples and MO approach to bonding in metallocenes; fluxional isomerism. Metal – carbonyl complexes: MO diagram of CO; Structure and bonding − bonding modes, MO approach of M-CO bonding, π-acceptor nature of carbonyl group, synergistic effect - stabilization of lower oxidation states of metals.

UNIT II Reactions and catalysis of organometallic compounds: (15 Hours)

Reactions of organometallic compounds: Oxidative addition, reductive elimination (α and β eliminations), migratory insertion reaction and metathesis reaction. Organometallic catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (oxo process), oxidation of olefin (Wacker process), olefin isomerization, water gas shift reaction, cyclo-oligomerisation of acetylenes using Reppe's catalysts, Monsonto process.

UNIT III Inorganic spectroscopy -I: (15 Hours)

IR spectroscopy: Effect of coordination on the stretching frequency-sulphato, carbonato, sulphito, aqua, nitro, thiocyanato, cyano, thiourea, DMSO complexes; IR spectroscopy of carbonyl compounds. NMR spectroscopy: Introduction, applications of ^{1}H, ^{15}N, ^{19}F, ^{31}P-NMR spectroscopy in structural identification of inorganic complexes, fluxional molecules, quadrupolar nuclei- effect in NMR spectroscopy.

UNIT IV Inorganic spectroscopy-II: (15 Hours)

ESR spectroscopy: Introductory terminologies: g and A parameters-definition, explanation and factors affecting g and A; Applications of ESR to coordination compounds with one and more than one unpaired electrons – hyperfine and secondary hyperfine splitting and Kramer's doublets; ESR spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II), Cu(II) complexes, bis(salicylaldimine)copper(II) and $[(NH_3)_5Co\text{-}O_2\text{-}Co(NH_3)_5]^{5+}$.

Mossbauer spectroscopy: Mossbauer effect, Recoil energy, Mossbauer active nuclei, Doppler shift, Isomer shift, quadrupole splitting and magnetic interactions. Applications of Mössbauer spectra to Fe and Sn compounds.

UNIT V Inorganic spectroscopy-III: (15 Hours)

Photo Electron Spectroscopy: Theory, Types, origin of fine structures - shapes of vibrational fine structures – adiabatic and vertical transitions, PES of homonuclear diatomic molecules (N_2, O_2) and heteronuclear diatomic molecules (CO, HCl) and polyatomic molecules (H_2O, CO_2, CH_4, NH_3) – evaluation of vibrational constants of the above molecules. Koopman's theorem- applications and limitations.

Optical Rotatory Dispersion: Principle of CD and ORD; Δ and λ isomers in complexes, Assignment of absolute configuration using CD and ORD techniques.

Recommended Text:

1. Indrajeet Kumar, Organometallic Compounds,6th Edition, Pragati Prakashan Educational Publishers, 2018
2. B D Gupta and AJ Elias, Basic Organometallic Chemistry, 2nd Edition, Universities Press (India) Pvt. Ltd., 2013
3. R C Mehrotra and A Singh, Organometallic Chemistry, 2nd Edition, New Age International Publishers, 2000
4. Jagdamba singh, Mrituanjay D Pandey and Jaya Singh, Spectroscopy of Inorganic Compounds, 1st Edition, 2021
5. Kazuo Nakamoto, Infrared and Raman Spectra of Inorganic and Coordination Compounds,5th Edition, A Wiley-Interscience Publication, 1997.
6. B D Gupta and A K Elias, Basic Organometallic Chemistry: Concepts, Syntheses and Applications, University Press, 2013.

Reference Books:

1. J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006
2. G L Meissler and D ATarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008
3. Crabtree, Robert H. The Organometallic Chemistry of the Transition Metals. 3rd ed. New York, NY: John Wiley, 2000.
4. P Gütlich, E Bill, A X Trautwein, Mossbauer Spectroscopy and Transition Metal Chemistry: Fundamentals and Applications, 1st edition, Springer-Verlag Berlin Heidelberg, 2011.
5. Peter Atkins and Tina Overton, Shriver and Atkins' Inorganic Chemistry, 5th Edition, Oxford University Press, 2010.
6. Catherine E Housecraft and Alan G Sharpe, Inorganic Chemistry, 3rd edition, Pearson Publishers, UK, 2008.

Website and e-learning sources:

1. https://archive.nptel.ac.in/courses/104/101/104101100/
2. https://ocw.mit.edu/courses/5-04-principles-of-inorganic-chemistry-ii-fall2008/pages/syllabus/
3. https://onlinecourses.nptel.ac.in/noc19_cy19/preview
4. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/96

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	3	3	3	3
CO2	2	3	2	3	1	-	-	2	3	2	2
CO3	3	3	2	3	2	-	-	1	3	3	2
CO4	3	3	2	3	3	-	-	2	3	2	2
CO5	3	3	3	3	3	-	-	3	3	3	3
	2.8	**3**	**2.4**	**2.6**	**2**	**-**	**-**	**2.2**	**3**	**2.6**	**2.4**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
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Sem	Category	Course Code	Course Title	Hours	Credits	Int. Marks	Ext. Marks	Max. Marks
IV	CC	P24MCHP41	Practical IV - Analytical Instrumentation Technique	75	4	25	75	100

Objectives:

- To Impart the training in operating different instruments used in the analysis of various chemical constituents.
- To analyze different constituents through instrumental methods of analysis.
- To evaluate different contaminants in materials using turbidimetry and conductivity measurements.
- To design chromatographic methods for identification of species.
- To analyze constituents in materials using emission and absorption techniques.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	understand the concept of electrode potential	K1
CO2	apply the concepts of potentiometric titrations.	K3
CO3	investigate the presence of trace metal ions using colorimetry.	K4
CO4	demonstrate proficiency in operating instruments such as flame photometry, Spectrophotometer, CV, etc.	K3
CO5	analyse the results by plotting the graph with the data obtained.	K5

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

UNIT-I:

1. Potentiometric titration of Strong acid Vs NaOH
2. Potentiometric titration of Weak acid Vs NaOH
3. Potentiometric titration of a mixture of acids Vs NaOH
4. Determine the dissociation constant of acetic acid titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
5. Potentiometric titration of FAS Vs $K_2Cr_2O_7$.
6. Potentiometric titration of KI Vs $KMnO_4$.
7. Potentiometric titration of a mixture of Chloride and Iodide Vs $AgNO_3$.
8. Determination of the pH of buffer solution by EMF method using Quinhydrone and Calomel electrode.
9. Study of the inversion of cane sugar in the presence of acid by Polarimetric method.

UNIT-II:

1. Estimation of Fe, Cu and Ni by colorimetric method.
2. Estimation of chlorophyll in leaves and phosphate in waste water by colorimetry.
3. Determination of spectrophotometrically the mole ratio of the ferrithiocyanate complex and equilibrium constant for the complex formation.
4. Determination of the amount (mol/L) of ferricyanide present in the given solution using cyclic voltammetry.
5. Determination of the diffusion coefficient of ferricyanide using cyclic voltammetry.

6. Determination of the standard redox potential of ferri-ferrocyanide redox couple using cyclic voltammetry.
7. Estimation of the amount of sulphate present in the given solution using Nephelometric turbidimeter.
8. Estimation of the amount of nitrate present in the given solution using spectrophotometric method.
9. Heavy metal analysis in textiles and textile dyes by AAS
10. Determination of caffeine in soft drinks by HPLC
11. Analysis of water quality through COD, DO, BOD measurements.
12. Assay of Riboflavin and Iron in tablet formulations by spectrophotometry
13. Estimation of chromium in steel sample by spectrophotometry
14. Estimation of Fe(II) by 1,10 phenonthroline using spectrophotometry.
15. Determination of ascorbic acid in real samples using Differential Pulse Voltammetry and comparing with specifications
16. Separation of (a) mixture of Azo dyes by TLC (b) mixture of metal ions by Paper chromatography
17. Estimation of Na and K by flame photometric method.
18. Determination of Stern-Volmer constant of Iodine quenching by fluorimetry

Recommended Text

1. Vogel's Text book of Practical Organic Chemistry, 5th Ed, ELBS/Longman, England, 2003.
2. G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney, *Vogel's Textbook of Quantitative Chemical Analysis*; 6th ed., ELBS, 1989.
3. J. D. Woollins, *Inorganic Experiments*; VCH: Weinheim, 1995.
4. B. Viswanathan and P.S. Raghavan, Practical Physical Chemistry, Viva Books, New Delhi, 2009.
5.Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996.

Reference Books

1. N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Labmanual, S. Viswanathan Co. Pvt. Ltd, 2009.
2. J. N. Gurtu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 2011.
3. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001.
4. G.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th edition, McGraw Hill, 2009.
5. J. N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987.

e-Resources

1. https://bit.ly/3QESF7t
2. https://bit.ly/3QANOnX

SCHEME OF VALUATION

End Semester Examination	Marks	Internal Assessment	Marks
Procedure	10	Two Tests	10
Calculation	10	Attendance / Regularity	10
Graph	10	Results accuracy	5
Results	30		
Record	5		
Viva voce	10		
TOTAL	**75**	**TOTAL**	**25**

Error Calculation:

<2% Error 50 Marks
3% 40 Marks
4% 30 Marks
>4% 20 Marks

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	-	2	-	-	3	3	3	3
CO2	3	2	2	-	2	-	-	3	3	3	3
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CO4	3	3	3	-	3	-	-	3	3	3	3
CO5	3	3	3	-	3	-	-	3	3	3	3
	2.8	2.6	2.4	-	2.6	-	-	3	3	3	3

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. S. SYED TAJUDEEN	Dr. S. ZAHEER AHMED

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*DSEC*	***P24ECH401***	***Polymer Chemistry (Elective VI)***	***75***	***3***	***25***	***75***	***100***

Objectives:

- To learn the basic concepts and bonding in polymers.
- To explain various types of polymerization reactions and kinetics.
- To understand the importance of industrial polymers and their synthetic uses.
- To determine the molecular weight of polymers.
- To predict the degradation of polymers and conductivities.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	**CO Statement** (After completing the course, the students will be able to)	**Cognitive Level**
CO1	Illustrate the characterization and molecular weight determination of polymer**.**	**K2**
CO2	Categorize the kinetics of polymerization with mechanism	**K3**
CO3	Explicate the Techniques of polymerization and degradation.	**K4**
CO4	Elucidate the preparation, properties and application of Industrial, speciality polymers**.**	**K5**
CO5	Discuss the polymer processing and Techniques**.**	**K6**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

Unit – I Characterization, Molecular weight and its Determination: (15 Hours)

Classification-Nomenclature-Primary and secondary bond forces in polymers; cohesive energy, molecular structure, chemical tests, thermal methods, Tg, molecular distribution, stability.

Determination of Molecular mass of polymers: Number Average molecular mass (M_n) and Weight average molecular mass (M_w) of polymers. Molecular weight determination of high polymers by physical method (Viscosity, cryoscopy method) and chemical method (End group Analysis, Functional group analysis)

Unit – II Mechanism and kinetics of Polymerization: **(15 Hours)**

Chain growth polymerization: Cationic, anionic, free radical polymerization, Stereo regular polymers: Ziegler Natta polymerization.

Unit – III Techniques of Polymerization and Polymer Degradation: (15 Hours)

Bulk, Solution, Emulsion, Suspension, solid, interfacial and gas phase polymerization. Types of Polymer Degradation, Thermal degradation, mechanical degradation, photodegradation, Photo stabilizers, Solid and gas phase polymerization.

Unit – IV Polymers of Industrial Importance (15 Hours)

Industrial Polymers: Preparation of fibre forming polymers, elastomeric material. Thermoplastics: Polyethylene, Polypropylene, polystyrene, Polyacrylonitrile, Poly Vinyl Chloride, Poly tetrafluoro ethylene, nylon and polyester.

Thermosetting Plastics: Phenol formaldehyde and expoxide resin.

Elastomers: Natural rubber and synthetic rubber - Buna - N, Buna-S and neoprene.

Specialty polymer: Bio polymers, biodegradable polymers, biomedical polymer, conducting polymer, polymer blend, electroluminescent polymer. Polymer composites.

Unit – V Polymer Processing Techniques (15 Hours)

Compounding: Polymer Additives: Fillers, Plasticizers, antioxidants, thermal stabilizers, fire retardants and colorants. Processing Techniques: Calendaring, die casting, compression moulding, injection moulding, blow moulding and reinforcing. Film casting, Thermoforming, Foaming. Catalysis and catalysts – Polymerization catalysis, catalyst support, clay compounds, basic catalyst, auto-exhaust catalysis, vanadium, heterogeneous catalysis and active centres.

Text Books:

1. V.R. Gowariker, *Polymer Science*, Wiley Eastern, 1995.

2. G.S. Misra, *Introductory Polymer Chemistry*, New Age International (Pvt) Limited, 1996.

3.M.S. Bhatnagar, A Text Book of Polymers, vol-I & II, S.Chand & Company, New Delhi, 2004.

Reference Books:

1. F. N. Billmeyer, *Textbook of Polymer Science*, Wiley Interscience, 1971.

2. A. Kumar and S. K. Gupta, *Fundamentals and Polymer Science and Engineering*, Tata McGraw-Hill, 1978.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	3	2	3	3	3	3
CO2	2	3	3	2	3	3	2	3	3	3	3
CO3	3	3	3	2	3	3	2	3	3	3	3
CO4	2	3	3	2	3	3	2	3	3	3	3
CO5	2	3	3	2	3	3	2	3	3	3	3
	2.2	3	3	2	3	3	2	3	3	3	3

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. Z. ABDUL VAHEITH	Dr. S. ZAHEER AHMED

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*DSEC*	***P24ECH402***	***Chemistry Of Natural Products (Elective VI)***	***75***	***3***	***25***	***75***	***100***

Objectives:

- To learn the basic concepts and biological importance of biomolecules and natural products.
- To explain various of functions of carbohydrates, proteins, nucleic acids, steroids and hormones.
- To understand the functions of alkaloids and terpenoids.
- To elucidate the structure determination of biomolecules and natural products.
- To extract and construct the structure of new alkaloids and terpenoids from different methods.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (On the successful completion of the course, the students will be able to)	Cognitive Level
CO1	Understand the biological importance of chemistry of natural products.	**K2**
CO2	Scientifically plan and perform the isolation and characterization of synthesized natural products.	**K3**
CO3	Elucidate the structure of alkaloids, terpenoids, carotenoids, falvanoids and anthocyanins.	**K4**
CO4	Determine the structure of phytochemical constituents by chemical and physical methods.	**K5**
CO5	Interpret the experimental data scientifically to improve biological activity of active components.	**K6**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

Unit – I Alkaloids **(15 Hours)**

Introduction, occurrence, classification, isolation and functions of alkaloids. Classification, general methods of structural elucidation. Chemical methods of structure determination of Coniine, Piperine, Nicotine, Atropine, Quinine, Belladine, Cocaine, Heptaphylline, Papaverine and Morphine.

Unit – II Terpenoids **(15 Hours)**

Introduction, occurrence, Isoprene rule, classification. General methods of determining structure.. Structure determination of Camphor, Abietic acid, Cadinene, Squalene, Zingiberine. Carotenoids: Introduction, geometrical isomerism, Structure, functions and synthesis of β-carotene and vitamin-A.

Unit – III Anthocyanines and flavones **(15 Hours)**

Anthocyanines: Introduction to anthocyanines. Structure and general methods of synthesis of anthocyanines. Cyanidine chloride: structure and determination. Flavones: Biological importance of flavones. Structure and determination of flavone and flavonoids. Quercetin: Structure determination and importance.

Unit – IV Purines and Steroids **(15 Hours)**

Purines: Introduction, occurrence and isolation of purines. Classification and spectral properties of steroids. biological importance, Structure and synthesis of Uric acid and Caffeine. Steroids: Steroids-Introduction, occurrence, nomenclature, configuration of substituents, Diels' hydrocarbon, stereochemistry, classification, Diels' hydrocarbon, biological importance, colour reactions of

sterols, cholesterol-occurrence, tests, physiological activity, biosynthesis of cholesterol from squalene.

Unit – V Natural Dyes **(15 Hours)**

Occurrence, classification, isolation, purification, properties, colour and constitution. Structural determination and synthesis of indigoitin and alizarin.

Text Books:

1. G. K. Chatwal, Organic Chemistry on Natural Products, Vol. 1, Himalaya Publishing House, Mumbai, 2009.
2. G. K. Chatwal, Organic Chemistry on Natural Products, Vol. 2, Himalaya Publishing House, Mumbai,2009.
3. O. P. Agarwal, Chemistry of Organic Natural Products, Vol. 1, Goel Publishing House, Meerut,1997.
4. O. P. Agarwal, Chemistry of Organic Natural Products, Vol. 2, Goel Publishing House, Meerut,1997.
5. I. L. Finar, Organic Chemistry Vol-2, 5thedition, Pearson Education Asia, 1975.

Reference Books:

1. I. L. Finar, Organic Chemistry Vol-1, 6thedition, Pearson Education Asia,2004.
2. Pelletier, Chemistry of Alkaloids, Van Nostrand Reinhold Co,2000.
3. Shoppe, Chemistry of the steroids, Butterworthes,1994.

I. A. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad,2004.

e-Resources

https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	2	3	3	3
CO2	3	3	3	-	-	-	-	2	3	3	3
CO3	3	3	3	-	-	-	-	2	3	3	3
CO4	3	3	3	-	-	-	-	2	3	3	3
CO5	3	3	3	-	-	-	-	2	3	3	3
	3	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**3**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. M.S.M. KAMIL Dr. S. MOHAMMED SAFIULLAH	Dr. S. ZAHEER AHMED

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*DSEC*	***P24ECH403***	***Molecular Spectroscopy (Elective - VII)***	***75***	***3***	***25***	***75***	***100***

Objectives:

- To understand the influence of rotation and vibrations on the spectra of the polyatomic molecules.
- To study the principle of Raman and Electronic spectroscopy
- To interpret the first and second order NMR spectra in terms of splitting and coupling patterns using correlation techniques.
- To highlight the significance of Mossbauer and ESR spectroscopic techniques.
- To carry out the structural elucidation of molecules using XPS and fragmentation patterns in Mass spectroscopy.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (On the successful completion of the course, the students will be able to)	Cognitive Level
CO1	Evaluate the molecular properties using the basic concepts of rotational and IR spectroscopy.	**K5**
CO2	Discuss the fundamentals of Raman and Electronic spectroscopy techniques.	**K2**
CO3	Analyze different NMR spectra of simple organic molecules.	**K4**
CO4	Outline the theory of Mossbauer and ESR spectroscopy techniques.	**K2**
CO5	Elucidate the structure of simple molecules using Mass and photoelectron spectroscopy.	**K4**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

Unit–I Microwave and IR Spectroscopy (15 Hours)

1.1: Rotational spectroscopy of diatomic molecules: Rigid rotor – Rotational energy – Intensities of rotational spectral lines – Effect of isotopic substitution. Non-rigid rotor – Rotational spectra of polyatomic molecules.

1.2: IR Spectroscopy: Vibrational energy of diatomic molecule – Simple harmonic oscillator model – Anharmonic Oscillator – Overtones. Diatomic vibrating rotator – Origin of PQR branches. Vibrations of polyatomic molecules – CO_2, SO_2 and H_2O. Combination bands, accidental degeneracy and Fermi-Resonance.

Unit – II Raman and Electronic Spectroscopy (15 Hours)

2.1: Raman Spectroscopy: Classical and quantum theory of Raman effect – Molecular polarizability – Pure rotational spectra of linear molecules, symmetric top and asymmetric top molecules. Stokes and Anti-stokes lines. Vibrational Raman spectra, Raman activity of vibration – Rule of mutual exclusion principles. Rotational fine structure.

2.2: Electronic Spectra of diatomic molecules: Franck-Condon Principle – Dissociation and predissociation spectra, Types of electronic transition – Symmetry selection rule for electronic transitions – Effect of solvent.

Unit – III NMR Spectroscopy (15 Hours)

3.1: Interaction of spin and magnetic field, Chemical shift; Factors affecting chemical shift – Mechanism of Shielding and De-shielding effect. Spin-spin coupling. Applications of NMR spectra of AX, AX_2 and AMX type. Coupling constant: Vicinal, germinal and long range coupling. Spin de-coupling and Nuclear Overhauser effect.

3.2: Spin Relaxation process, Restricted rotation. C^{13} NMR Spectroscopy – Principle and Applications to simple molecules. Basics of F^{19} and P^{31} NMR spectroscopy. Brief introduction to 2D NMR – COSY, NOESY.

Unit – IV ESR and Mossbauer Spectroscopy **(15 Hours)**

4.1: ESR Spectroscopy: Principle – *g* factor. Hyperfine structure of ESR. Mc-Connel's Equation – Zero-field splitting and Kramer's degeneracy. Application to organic and inorganic systems.

4.2: Mossbauer Spectroscopy: Principle, Doppler shift and Recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications: Mossbauer spectra of Fe and Sn complexes.

Unit – V Mass Spectroscopy **(15 Hours)**

Mass Spectroscopy: Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI), isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution. Effect of isotopes on the appearance of mass spectrum.

 # _____# Self Study Component for Seminar/Assignment:
(Questions should not be asked from self study component in the End Semester Examinations)

Text Books:

1. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill, New Delhi, 2000.

2. R. M. Silverstein and F. X. Webster, Spectroscopic Identification of Organic Compounds, 6th Ed., John Wiley & Sons, New York, 2003.

3. W. Kemp, Applications of Spectroscopy, English Language Book Society, 1987.

4. D. H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, 4th Ed., Tata McGraw-Hill Publishing Company, New Delhi, 1988.

5. R. S. Drago, Physical Methods in Chemistry; Saunders: Philadelphia, 1992.

Reference Books:

1. P.W. Atkins and J. de Paula, Physical Chemistry, 7th Ed., Oxford University Press, Oxford, 2002.

2. I. N. Levine, Molecular Spectroscopy, John Wiley & Sons, New York, 1974.

3. A. Rahman, Nuclear Magnetic Resonance-Basic Principles, Springer-Verlag, New York,1986.

4. K. Nakamoto, Infrared and Raman Spectra of Inorganic and coordination Compounds, PartB: 5th ed., John Wiley& Sons Inc., New York, 1997.

5. J. A. Weil, J. R. Bolton and J. E. Wertz, Electron Paramagnetic Resonance; Wiley Interscience, 1994.

e-Resources

Overview of Molecular Spectra, Rigid Diatomic Molecule - https://youtu.be/1El9coT8qVE
Rotational Spectra and Bond Lengths of Diatomic Molecules- https://youtu.be/ykFRjUIwRqw
Introduction to vibrational spectroscopy, review of line- https://youtu.be/kqV2dh0Krak
Moment of Inertia Tensor - https://youtu.be/p_5vp7Hxa_s
Rayleigh and Raman Scattering - https://youtu.be/XJcbBgL1m4M
Shielding. Quantum mechanical treatment of a two-spin system - https://youtu.be/gzcjNIPxoO8

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	2	3	3	3
CO2	3	3	3	-	-	-	-	2	3	3	3
CO3	3	3	3	-	-	-	-	2	3	3	3
CO4	3	3	3	-	-	-	-	2	3	3	3
CO5	3	3	3	-	-	-	-	2	3	3	3
	3	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**3**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. M.S.M. KAMIL Dr. S. MOHAMMED SAFIULLAH	Dr. S. ZAHEER AHMED

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*DSEC*	***P24ECH404***	***Pharmaceutical Chemistry (Elective - VII)***	***75***	***3***	***25***	***75***	***100***

Objectives:

- To understand the advanced concepts of pharmaceutical chemistry.
- To recall the principle and biological functions of various drugs.
- To train the students to know the importance as well the consequences of various drugs.
- To have knowledge on the various analysis and techniques.
- To familiarize on the drug dosage and its structural activities.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (On the successful completion of the course, the students will be able to)	Cognitive Level
CO1	Identify the suitable drugs for various diseases	**K2**
CO2	Apply the principles of various drug action and drug design.	**K3**
CO3	Acquire the knowledge on product development based on SAR.	**K4**
CO4	Apply the knowledge on applications of computers in chemistry	**K3**
CO5	Synthesize new drugs after understanding the concepts SAR.	**K6**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

Unit – I Physical properties in Pharmaceuticals (15 Hours)

Physical properties of drug molecule: physical properties. Refractive index- Definition, explanation, formula, importance, determination, specific & molar refraction. Optical activity\rotation-monochromatic & polychromatic light, optical activity, angle of rotation, specific rotation examples, measurement of optical activity. Dielectric constant & Induced Polarization- Dielectric constant explanation & determination. Rheology of pharmaceutical systems: Introduction, Definition, Applications, concept of viscosity, Newton's law of flow, Kinematic, Relative, Specific, Reduced & Intrinsic viscosity. Newtonian system, non-Newtonian system- Plastic flow, Pseudoplastic flow, Dilatent flow. Viscosity measurements- selection of viscometer for Newtonian and non-Newtonian system.

Unit – II Isotopic Dilution analysis (15 Hours)

principle and applications, Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning. Introduction to radiopharmaceuticals. Properties of various types of radiopharmaceuticals, Radiopharmaceuticals as diagnostics, as therapeutics, for research and sterilization. Physico Chemical Properties and drug action. Physico chemical properties of drugs (a) Partition coefficient, (b) solubility (c) surface activity, (d) degree of ionization.

Unit – III Drug dosage and product development (15 Hours)

Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms. Drug dosage and product development. Introduction to drug dosage Forms & Drug Delivery system –

Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms.

Unit – IV Development of new drugs **(15 Hours)**

Introduction, procedure followed in drug design, the research for lead compounds, molecular modification of lead compounds. Structure-Activity Relationship (SAR): Factors effecting bioactivity, resonance, inductive effect, isoterism, bioisosterism, spatial considerations, biological properties of simple functional groups, theories of drug activity, occupancy theory, rate theory, induced-fit theory, Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions, the additivity of group contributions, physico-chemical parameters, lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator-variables.

Unit – V Computers in Pharmaceutical Chemistry **(15 Hours)**

Need of computers for chemistry. Computers for Analytical Chemists-Introduction to computers: Organization of computers, CPU, Computer memory, I/O devices, information storage, software components. Application of computers in chemistry: Programming in high level language (C+) to handle various numerical methods in chemistry – least square fit, solution to simultaneous equations, interpolation, extrapolation, data smoothing, numerical differentiation and integrations.

Text Books:

1. Physical Chemistry- Bahl and Tuli.
2. Text Book of Physical Pharmaceutics, IInd edition, Vallabh Prakashan-. C.V.S. Subramanyam.
3. Medicinal Chemistry (Organic Pharmaceutical Chemistry), G.R Chatwal, Himalaya Publishing house.
4. Instrumental method of Analysis: Hubert H, Willard, 7th edition.
5. Textbook of Pharmaceutical Chemistry by, Jayshree Ghosh, S. Chand & company Ltd.
6. Pharmaceutical Chemistry by Dr. S. Lakshmi, Sultan chand & Sons.

Reference Books:

1. Computers in chemistry, K.V. Raman, Tata Mc.Graw-Hill, 1993.
2. Computers for Chemists, S.K Pundir, Anshu bansal, A pragate prakashan., 2 nd edition, New age international (P) limited, New Delhi.
3. Physical Pharmacy and Pharmaceutical Sciences by Martins, Patrick J. Sinko, Lippincott. William and Wilkins.
4. Cooper and Gunn's Tutorial Pharmacy ,6th edition by S.J. Carter, CBS Publisher Ltd.
5. Ansels pharmaceutical Dosage forms and Drug Delivery System by Allen Popvich and Ansel, Indian edition-B.I. Publication Pvt. Ltd.

e-Resources

1. https://www.ncbi.nlm.nih.gov/books/NBK482447/
2. https://training.seer.cancer.gov/treatment/chemotherapy/types.html

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	2	3	3	3
CO2	3	3	3	-	-	-	-	2	3	3	3
CO3	3	3	3	-	-	-	-	2	3	3	3
CO4	3	3	3	-	-	-	-	2	3	3	3
CO5	3	3	3	-	-	-	-	2	3	3	3
	3	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**3**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. A. AHMED RAZA	Dr. S. ZAHEER AHMED

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*SEC*	***P24SCH401***	***Industrial Chemistry (SBS - III)***	***75***	***3***	***25***	***75***	***100***

Objectives:

- To learn the Industrial hazards management and safety protocols.
- To understand good manufacturing practices, quality assurance and ISO standards.
- To explore the production processes of essential chemicals, petrochemicals.
- To discuss the industrial problem in corrosion ant its control measures.
- To gain Knowledge about Industrial materials.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Implement industrial safety protocols risk assessment techniques**.**	**K3**
CO2	Illustrate ISO standards, Manufacturing practices and safety	**K2**
CO3	Elucidate the petroleum refining process and manufacturing of key petrochemicals	**K4**
CO4	Conduct laboratory experiments and industrial case studies to bridge theory with practice.	**K5**
CO5	Importance of Abrasives and refractory in Industry.	**K5**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

Unit – I Industrial hazards and safety measures: (6 Hours)

Safety signs and colours in industries – Industrial hazards – Definition – Chemical hazards – Dust hazard – Electrical hazard – Preventive measures **-** Material Safety Data Sheet (MSDS).

Unit – II Industrial Quality control and Emerging Technology: (6 Hours)

Standardization (ISO, cGMP, USFDA), Analytical Techniques – ICP-OES, GC, HPLC, Spectroscopy, Nano technology in industrial application, Robotics and machine learning in chemical manufacturing, Pharmaceutical and biotechnology advancement.

Unit – III Petrochemical Industries: (6 Hours)

Petroleum Refining – Crude oil composition and refining process, fractional distillation and cracking, reforming and hydro processing.

Petrochemicals – Production of Ethylene, propylene, benzene, toluene and Xylene (BTX), Industrial synthesis of methanol, formaldehyde, acetone.

Unit – IV Industrial materials (6 Hours)

Abrasives – Definition, classification, Grinding wheel, abrasive paper and cloth. Refractories – definition, characteristics, classification, properties – refractoriness, RUL, dimensional stability, thermal spalling, thermal expansion**.**

Unit – V Corrosion and corrosion control (6 Hours)

Chemical corrosion – Electrochemical corrosion – Different types – Galvanic and differential aeration corrosion – Factor influencing corrosion – Corrosion control – Sacrificial anode and Impressed cathodic current method**.**

 # _____# Self Study Component for Seminar/Assignment:
(Questions should not be asked from self-study component in the End Semester Examinations)

Text Books:

1. Shreve's chemical process industries" – George T.Austin & R.Norris Shreve
2. "Industrial Chemistry'' – B.K. Sharma
3. "Fundamentals of Petroleum and petrochemical Engineering " – S. maiti
4. " Industrial safety and pollution control Handbook " – National Safety Council of India.

Reference Books:

1. "Chemical processing principles " – O.A.Hougen,K.M.Watson & R.A.Ragatz
2. "Modern Petroleum Refining Processes" – B.K.Rao
3. "Quality control in the chemical Industry" – P.Stein

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	3	3	2	3	3
CO2	3	3	3	2	3	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	3	3
CO4	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	2	3	3	3	3	3	3	3
	3	3	3	2	3	2.8	3	3	2.8	3	3

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. Z. ABDUL VAHEITH	Dr. S. ZAHEER AHMED