

Semester	6
Course	Major
Paper Code	C3CH230641T
Paper Title	Organic Chemistry 6
No. of Credits	4 Theory
Theory / Practical / Composite	Theory
Minimum No. of preparatory hours per week a student has to devote	10
Number of Modules	04
Syllabus	Module I: Heterocyclic Chemistry (12 Lectures) <i>Heterocyclic compounds:</i> 5- and 6-membered rings with one heteroatom; reactivity, orientation and important reactions (with mechanism) of furan, pyrrole, thiophene and pyridine; synthesis (including retrosynthetic approach and mechanistic details): pyrrole: Knorr synthesis, Paal-Knorr synthesis, Hantzsch; furan: Paal-Knorr synthesis, Feist-Benary synthesis and its variation; thiophenes: Paal-Knorr synthesis, Hinsberg synthesis; pyridine: Hantzsch synthesis; benzo-fused 5- and 6-membered rings with one heteroatom: reactivity, orientation and important reactions (with mechanistic details) of indole, quinoline and isoquinoline; synthesis (including retrosynthetic approach and mechanistic details): indole: Fischer, Madelung and Reissert; quinoline: Skraup, Doebner- Miller, Friedlander; isoquinoline: BischlerNapieralski synthesis. Module II: Organic Spectroscopy II (12 Lectures) <i>NMR Spectroscopy:</i> introduction; nuclear spin; NMR active molecules; basic principles of Proton Magnetic Resonance; equivalent and non-equivalent protons; chemical shift and factors influencing it; ring current effect; significance of the terms: up-/downfield, shielded and deshielded protons; spin coupling and coupling constant (1st order spectra); relative intensities of <i>first-order</i> multiplets: chemical and magnetic

equivalence in NMR ; elementary idea about *non-first-order* splitting; anisotropic effects in alkene, alkyne, carbonyls and aromatics; NMR peak area, integration; relative peak positions with coupling patterns of common organic compounds (both aliphatic and benzenoid-aromatic) and functional groups like alkene, alkyne, alcohol, ether, amines, carbonyls, acids and its derivatives, aromatic compounds; rapid proton exchange; interpretation of NMR spectra of simple organic compounds.

Mass spectrometry: Principles, instrumentation and applications of mass spectrometry. Methods of generation of ions in EI, CI, FD and FAB and other techniques. Detection of ions, ion analysis, ion abundance, molecular ion peak, metastable peak, isotopes, ion-molecule interaction and analysis of fragmentation patterns. Applications of mass spectroscopy to simple structural and mechanistic problems.

Module III: Carbohydrates (12 Lectures)

Monosaccharides: Aldoses up to 6 carbons; structure of D-glucose & D-fructose (configuration & conformation); ring structure of monosaccharides (furanose and pyranose forms). Ring size determination of D-glucose. Haworth representations and non-planar conformations; anomeric effect (including stereoelectronic explanation); mutarotation; epimerization; reactions (mechanisms in relevant cases): Fischer glycosidation, osazone formation, bromine-water oxidation, HNO₃ oxidation, selective oxidation of terminal –CH₂OH of aldoses, reduction to alditols, Lobry de Bruyn-van Ekenstein rearrangement; stepping-up (Kiliani-Fischer method) and stepping-down

	(Ruff's & Wohl's methods) of aldoses; endgroup-interchange of aldoses; acetonide (isopropylidene) and benzylidene protections; & related conversions. <i>Disaccharides</i>: Glycosidic linkages, concept of glycosidic bond formation by glycosyl donor-acceptor; structure of sucrose, inversion of cane sugar. Module IV: Bio-Organic Chemistry (12 Lectures) <i>Amino acids</i>: synthesis with mechanistic details: Strecker, Gabriel, acetamido malonic ester, Erlenmeyer azlactone, Bücherer hydantoin synthesis, synthesis involving diketopiperazine; isoelectric point, zwitterions; electrophoresis, reaction (with mechanism): ninhydrin reaction, Dakin-West reaction; resolution of racemic amino acids. <i>Peptides</i>: peptide linkage and its geometry; syntheses (with mechanistic details) of peptides using <i>N</i>-protection & C-protection, solid-phase (Merrifield) synthesis; peptide sequence: C-terminal and Nterminal unit determination (Edman, Sanger & 'dansyl' methods); partial hydrolysis; specific cleavage of peptides: use of CNBr. <i>Nucleic acids</i>: Definition and classification of nucleic acids. Structure of nucleosides and nucleotides, primary and secondary structure of DNA, Watson-Crick model, Types of RNA and their functions.
Learning Outcomes	Theory: Students will have <i>knowledge about</i> i) Study of Heterocyclic compounds ii) ¹H NMR spectroscopy and mass spectrometry of organic molecules iii) Chemistry of Carbohydrates iv) Study of Biomolecules (Amino acids, peptides and nucleic acids)
Reading/Reference Lists	Theory:

	1. Clayden, J., Greeves, N., Warren, S. <i>Organic Chemistry</i>, Second edition, Oxford University Press 2012. 2. Sykes, P. <i>A guidebook to Mechanism in Organic Chemistry</i>, Pearson Education, 2003. 3. Smith, J. G. <i>Organic Chemistry</i>, Tata McGraw-Hill Publishing Company Limited. 4. Loudon, G. M. <i>Organic Chemistry</i>, Fourth edition, Oxford University Press, 2008. 5. Morrison, R. N. & Boyd, R. N. <i>Organic Chemistry</i>, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 6. Finar, I. L. <i>Organic Chemistry (Volume 1 & Volume 2)</i> Pearson Education. 7. Graham Solomons, T.W., Fryhle, C. B. <i>Organic Chemistry</i>, John Wiley & Sons, Inc. 8. Gilchrist, T. L. <i>Heterocyclic Chemistry</i>, Pearson, 2005. 9. Pavia, D. L. <i>Introduction to Spectroscopy</i>, Cengage India Private Limited, 2015. 10. Joule, J. A., Mills, K. <i>Heterocyclic Chemistry</i>, Wiley, 2010. 11. Kalsi, P. S. <i>Spectroscopy of Organic Compounds</i>, New Age International (P) Limited, 2005. 12. Kemp, W. <i>Organic Spectroscopy</i>, Palgrave Macmillan, 1991. 13. Gross, J. H., <i>Mass Spectrometry</i>, Springer, 2011. 14. Voet, D. & Voet, J. G. <i>Biochemistry</i>, Wiley, 2010.
Evaluation	Theory: 100 Internal: 30 (CIA:20, Other mode of Assesment:5, Attendance: 5) Semester Exam:70
Paper Structure for Theory Semester Exam	Answer SEVEN out of NINE questions, of 10 marks each.