## Course: Discipline Specific Core 1

<table>
<tr><td>Semester</td><td>1</td></tr>
<tr><td>Paper Number</td><td>HCHCR1012T (60 MARKS) & HCHCR1012P (40 MARKS)</td></tr>
<tr><td>Paper Title</td><td>CORE COURSE 1: ORGANIC CHEMISTRY</td></tr>
<tr><td>No. of Credits</td><td>Theory-04, Practicals-02</td></tr>
<tr><td>Theory/Composite</td><td>Composite</td></tr>
<tr><td>No. of periods assigned</td><td>Th: 4<br>Pr: 3</td></tr>
<tr><td>Name of Faculty member(s)</td><td>Dr. Ankur Ray<br>Prof. Dipankar Das</td></tr>
<tr><td>Course description/objective</td><td>Theory:<br>To have basic knowledge about the introductory concepts of Organic Chemistry, stereochemistry and reaction mechanisms<br>Practical:<br>To identify the special elements and functional groups in an unknown organic sample.</td></tr>
<tr><td>Syllabus</td><td>Annexure Core Course: 1</td></tr>
<tr><td>Texts</td><td></td></tr>
<tr><td>Reading/Reference Lists</td><td>Theory:<br>1. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.<br>2. Keeler, J., Wothers, P. Chemical Structure and Reactivity – An Integrated approach, Oxford University Press.<br>3. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.<br>4. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.<br>5. Carey, F. A., Guiliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.<br>6. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.<br>7. Nasipuri, D. Stereochemistry of Organic Compounds, Wiley Eastern Limited.<br>8. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).<br>9. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)<br>10. Fleming, I. Molecular Orbitals and Organic Chemical Reactions, Reference/Student Edition, Wiley, 2009.<br>11. James, J., Peach, J. M. Stereochemistry at a Glance, Blackwell Publishing, 2003.<br>12. Robinson, M. J. T., Stereochemistry, Oxford Chemistry Primer, Oxford University Press, 2005.<br>Practical: Nad, Mahapatra, Ghosal-Practical Chemistry</td></tr>
<tr><td>Evaluation</td><td><table><tr><td>Theory: 60 marks</td><td>Practical: 40 marks<br>(Continuous Assessment)</td></tr><tr><td>CIA: 10<br>End-Sem: 50</td><td>Internal Assessment Exams: 30<br>Viva (End Sem): 8<br>Attendance: 2</td></tr></table></td></tr>
<tr><td>Paper Structure for the End Sem Theory Exam (50 marks)</td><td>6 (SIX) Questions (each of 10 marks) will be set and the students will have to answer any 5 (FIVE).<br>Each of the Questions (10 marks) will consist of 2 or 3 parts (of 2/ 3/ 4/ 5 )</td></tr>
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# Annexure Core Course (CC): 1

# (Credits: Theory-04, Practicals-02)

## Theory: 60 Lectures

**Basics of Organic Chemistry**

**Bonding and Physical Properties (25 Lectures)**

*Valence Bond Theory:* concept of hybridisation, shapes of molecules, resonance (including hyperconjugation); calculation of formal charges and double bond equivalent (DBE); orbital pictures of bonding ($sp^3$, $sp^2$, sp: C-C, C-N & C-O systems and *s-cis* and *s-trans* geometry for suitable cases).

Electronic effects and their influence on acidity-basicity*:* inductive effect, field effect, mesomeric effect, resonance energy; bond polarization and bond polarizability; electromeric effect; steric effect, steric inhibition of resonance.

*MO theory:* qualitative idea about molecular orbitals, bonding and antibonding interactions, idea about $\sigma$, $\sigma^*$, $\pi$, $\pi^*$, $n$ – MOs; basic idea about Frontier MOs (FMO); concept of HOMO, LUMO and SOMO; interpretation of chemical reactivity in terms of FMO interactions; sketch and energy levels of $\pi$ MOs of i) acyclic p orbital system (C=C, conjugated diene, triene, allyl and pentadienyl systems) ii) cyclic p orbital system (neutral systems: [4], [6]-annulenes; charged systems: 3-,4-,5-membered ring systems); Hückel's rules for aromaticity up to [10]-annulene (including mononuclear heterocyclic compounds up to 6-membered ring); concept of antiaromaticity and homoaromaticity; non-aromatic molecules; Frost diagram.

*Physical properties:* influence of hybridization on bond properties: bond dissociation energy (BDE) and bond energy; bond distances, bond angles; concept of bond angle; melting point/boiling point and solubility of common organic compounds in terms of covalent & non-covalent intermolecular forces; polarity of molecules and dipole moments; relative stabilities of isomeric hydrocarbons in terms of heat of hydrogenation, heat of combustion and heat of formation.

**General Treatment of Reaction Mechanism -I (10 Lectures)**

*Mechanistic classification:* ionic, radical and pericyclic (definition and example);

reaction type: addition, elimination and substitution reactions (definition and example); nature of bond cleavage and bond formation: homolytic and heterolytic bond fission, homogenic and heterogenic bond formation; curly arrow rules in representation of mechanistic steps; reagent type: electrophiles and nucleophiles (elementary idea); electrophilicity and nucleophilicity in terms of FMO approach.

*Reactive intermediates:* carbocations (carbenium and carbonium ions), carbanions, carbon radicals, carbenes: generation and stability, structure using orbital picture and electrophilic/nucleophilic behavior of reactive intermediates (elementary idea).

**Stereochemistry -I** **(25 Lectures)**

*Bonding geometries of carbon compounds and representation of molecules:* tetrahedral nature of carbon and concept of asymmetry; Fischer, sawhorse, flying-wedge and Newman projection formulae and their inter translations.

*Concept of chirality and symmetry:* symmetry elements, molecular chirality and centre of chirality; asymmetric and dissymmetric molecules; enantiomers and diastereomers; concept of epimers; concept of stereogenicity, chirotopicity and pseudoasymmetry; chiral centres and number of stereoisomerism: (n=odd and n= even)systems involving 1/2/3-chiral centre(s) (AA, AB, ABA and ABC types).

*Relative and absolute configuration:* D/L and *R/S* descriptors; *erythro/threo* and *meso* nomenclature of compounds; *syn/anti* nomenclatures for aldols; *E*/*Z* descriptors for C=C, conjugated diene, triene, C=N and N=N systems; combination of *R/S*- and *E/ Z*- isomerisms.

*Optical activity of chiral compounds:* Concept of plane polarised light and polarimeter, optical rotation, specific rotation and molar rotation; racemic compounds, racemisation (through cationic, anionic, radical intermediates and through reversible formation of stable achiral intermediates); resolution of acids, bases and alcohols via diastereomeric salt formation; optical purity and enantiomeric excess; invertomerism of chiral trialkylamines.

**CC: 1 (Practical) 42 Lectures**

**1. Separation,** based upon solubility, by using common laboratory reagents like water (cold, hot), dil. HCl, dil. NaOH, dil. $NaHCO_3$, *etc*., of components of a binary solid mixture; purification of **any one** of the separated components by crystallization and determination of its melting point. The composition of the mixture may be of the following types: Benzoic acid/*p*-Toluidine; *p*-Nitrobenzoic acid/*p*-Aminobenzoic acid; *p*-Nitrotolune/*p*-Anisidine; *etc*.

2. **Determination of boiling point** of common organic liquid compounds e.g., ethanol, cyclohexane, chloroform, ethyl methyl ketone, cyclohexanone, acetylacetone, anisole, crotonaldehyde, mesityl oxide, *etc*. [Boiling point of the chosen organic compounds should preferably be less than 160 °C]

3. **Identification of a Pure Organic Compound**

*Solid compounds*: oxalic acid, tartaric acid, citric acid, succinic acid, resorcinol, urea, glucose, cane sugar, benzoic acid and salicylic acid

*Liquid Compounds*: formic acid, acetic acid, methyl alcohol, ethyl alcohol, acetone, aniline, dimethylaniline, benzaldehyde, chloroform and nitrobenzene.