This is the repository of lecture materials prepared during the period Sept. 2019 to March 2021.

For More recent study materials [relating to even semesters (April-July 2021)],
please visit: http://www.spcmc.ac.in/lecture-notes-study-materials-for-even-semester-april-july-2021-cema/

Sem-1: Paper CC-1:

Lecture on M.P. and B.P. of organic molecules can be found here (uploaded on 22.09.2019) (Note: revised version (2020) is uploaded, for link, see below).

Lecture on heats of combustion and heats of hydrogenation as tools for determining the relative stability between isomeric hydrocarbons can be found here. (uploaded on 16.11.2019)

Basics of Organic Chemistry Lecture Series

Lecture-1 can be found here (Organic Chemistry – What and Why? Shapes and energies of the atomic orbitals commonly used in describing structure of organic molecules.) (uploaded on 15.12.2020).

Lecture-2 can be found here (Valence Bond Theory (VBT) – The concept of hybridisation) (uploaded on 19.12.2020).

Orbital pictures can be found here (uploaded on 20.12.2020).

Lecture-3 can be found here (Formal charges, how to calculate them, what do they mean?, Double Bond Equivalent (DBE) or Index of Hydrogen Deficiency, how to calculate DBE and what to do with it?) (uploaded on 04.01.2021).

Lecture-4 can be found here (polar covalent bonds – how to spot them; Electrostatic Potential Maps – utility, Electronic effects – inductive effect, origin, features, consequence, +I and -I groups; field effect – distinction from inductive effect; electromeric effect, resonance and resonance effect) (uploaded on 05.01.2021).

Lecture-5 can be found here (Resonance – salient features, Resonance Energy (RE) – what is it and its salient features, assessing relative contribution of different resonance canonicals towards the hybrid – a user guide, the concept of steric hindrance, steric inhibition of resonance) (uploaded on 14.01.2021).

Handout on resonance – how to spot the structural patterns to facilitate drawing canonicals can be found here (uploaded on 14.01.2021).

Molecular Orbitals in Organic Chemistry Lecture Series

Lecture-1 can be found here (Molecular Orbital theory (MOT) – basics, LCAO approach to construct MOs from AOs, Bonding and Antibonding MOs, sigma and pi MOs, MOs of homonuclear and heteronuclear diatomics, concept of Frontier MOs (FMOs), Highest Occupied MO (HOMO), Lowest Unoccupied MO (LUMO), correlation of nucleophilicity and electrophilicity with HOMO and LUMO energies, substituent effects on MO energy, demonstration of MOT in determining regioselectivity of nucleophilic attack to C=O, C-X) (uploaded on 17.01.2021).

Lecture-2 can be found here (Molecular Orbital theory (MOT) contd. – Huckel pi-MOs of acyclic and cyclic conjugated polyenes, systems: ethylene, allyl cation, radical, anion, 1,3-butadiene – s-cis and s-trans forms, pentadienyl cation, radical, anion, 1,3,5-hexatriene – *Z*– and *E*-isomers, cyclopropenyl – cation, radical, anion, cyclobutadiene (CBD) i.e. [4]annulene, cyclopentadienyl – cation, radical, anion, benzene i.e. [6]annulene; preliminary ideas about Coulomb integral and resonance integral; Frost-Musulin circle mnemonic in determining the energy levels of pi-MOs of cyclic conjugated polyenes, calculation of pi-electron delocalisation energy (DE) in terms of resonance integral; relative DE of cyclobutadiene versus 1,3-butadiene and of benzene versus 1,3,5-hexatriene.) (uploaded on 21.01.2021).

Aromaticity in Organic Chemistry Lecture Series

Lecture-1 can be found here (RE of benzene, its determination from heat of hydrogenation, concept of aromaticity, criteria of aromaticity, Huckel's 4n+2 rule, justification from Frost-Musulin circle, concept of antiaromaticity, non-aromatic molecules, how to check if a molecule is aromatic, antiaromatic or non-aromatic, aromaticity in cyclic polyenes, three membered rings, cation, anion and radical, proof of aromatic or antiaromatic behaviour) (uploaded on 01.02.2021).

Lecture-2 can be found here (aromaticity in cyclic polyenes, four membered rings, cyclobutadiene, its dication and dianion, square versus rectangular geometry, five membered rings, cation, radical, anion, calicene, fulvene, aromaticity in heterocycles like pyrrole, furan, thiophene) (uploaded on 08.02.2021).

Lecture-3 can be found here (aromaticity in cyclic polyenes, benzene, pyridine, seven membered rings, cation, radical, anion, cyclooctatetraene (COT) and its dication and dianion, proof of tub-shaped COT, concept of homoaromaticity) (uploaded on 08.02.2021, revised version on 10.02.2021).

Dipole Moment in Organic Chemistry – lecture can be found here (dipole moment, definition, units, bond moment and group moment, polar and non-polar molecules, sigma and pi-moment, factors controlling dipole moments, correlating dipole moment with physical properties) (uploaded on 11.02.2021).

Bond Length, Bond Angle, Bond Energy and Bond Dissociation Energy (BDE) – lecture can be found here (bond length and bond angle as structural parameters, definition, units, common bonds encountered in organic chemistry, factors controlling these parameters, their variance; bond energy and BDE – definition and difference between these two, factors, BDE as an indicator of radical stability) (uploaded on 12.02.2021).

Intermolecular Non-covalent Forces, Melting Point and Boiling Points – lecture can be found here (Melting and boiling points, use of these concepts in organic synthesis, classes of intermolceular forces/non-covalent interactions,: dipole-dipole, dipole induced dipole, instantaneous dipole-induced dipole (London dispersion forces), H-bonding, variation of melting point and boiling points depending upon molecular mass, size and shape, carnelly's rule, role in symmetry in melting and boiling point) (uploaded on 17.02.21, revised and expanded version of 2019 lecture)

Solvents in Organic Chemistry – lecture can be found here (Solvents and solute, thermodynamics of solvation, classification of solvents based upon polarity, proticity and donor ability, solubility of covalent and ionic compounds, why water is such a good solvent for ionic compounds, hydrophobic effect, changing the solubility of organic compounds by acid-base reaction, separation of binary mixtures based upon solubility – mixtures of acidic and neutral compounds, of basic and neutral compounds, and of water soluble and insoluble compounds) (uploaded on 22.02.21)

Reactive Intermediates Lecture Series

Lecture on carbocations (introduction to reactive intermediates (RIs), classification of RIs, definition of carbocation – carbenium and carbonium ions (non-classical carbocations), classification, factors to be considered when judging relative stability of different carbocations, common methods of generation and common reaction types that carbocations undergo) can be found here. (uploaded on 27.02.21)

Lecture on carbanions (definition of carbanions, base-nucleophile dichotomy for carbanion species, structure and classification, factors to be considered when judging relative stability of different carbanions, common methods of generation and common reaction types that carbanions undergo) can be found here. (uploaded on 02.03.21)

Sem-2: Paper CC-3:

Lecture on Kinetic Isotope Effect can be found here (uploaded on 29.03.2020).

Lecture on Intramolecular versus Intermolecular reactions (including High Dilution Technique principles) and Crossover experiments can be found here (uploaded on 30.03.2020).

Acid-Base Chemistry Lecture Series

Lecture on Concepts of Acidity and Basicity-1 can be found here (uploaded on 03.04.2020).

Lecture on Concepts of Acidity and Basicity-2 can be found here (uploaded on 07.04.2020).

Lecture on Concepts of Acidity and Basicity-3 can be found here (uploaded on 12.04.2020).

Lecture on Concepts of Acidity and Basicity-4 can be found here (uploaded on 17.04.2020).

Lecture on Concepts of Acidity and Basicity-5 can be found here (uploaded on 22.04.2020).

Lecture on Concepts of Acidity and Basicity-6 can be found here (uploaded on 27.04.2020).

Lecture on Concepts of Acidity and Basicity-7 can be found here (uploaded on 29.04.2020).

Tautomerism Lecture Series

Lecture-1 on Tautomerism can be found here (uploaded on 08.05.2020).

Lecture-2 on Tautomerism can be found here (uploaded on 13.05.2020).

Lecture-3 on Tautomerism can be found here (uploaded on 15.05.2020).

Lecture-4 on Tautomerism can be found here (uploaded on 20.05.2020).

Lecture-5 on Tautomerism can be found here (uploaded on 27.05.2020).

Halogenation of Alkanes Lecture Series

Lecture-1 on Halogenation of Alkanes can be found here (uploaded on 07.06.2020).

Lecture-2 on Halogenation of Alkanes can be found here (uploaded on 11.06.2020).

Elimination Lecture Series

Lecture-1 on Elimination Reaction can be found here (uploaded on 13.06.2020).

Lecture-2 on Elimination Reaction can be found here (uploaded on 15.06.2020).

Lecture-3 on Elimination Reaction can be found here (uploaded on 18.06.2020).

Lecture-4 on Elimination Reaction can be found here (uploaded on 20.06.2020).

Lecture-5 on Elimination Reaction can be found here (uploaded on 22.06.2020).

Lecture-6 on Elimination Reaction can be found here (uploaded on 24.06.2020).

Sem-3: Paper CC-7:

Lecture on Michael Reaction, Robinson Annulation, Stetter Reaction can be found here (uploaded on 22.09.2019).

Lecture on Favorskii Rearrangement can be found here (uploaded on 29.09.2019)

Lecture on synthetic applications of silyl enol ethers as specific enolate equivalents can be found here. (uploaded on 24.10.2019)

Addition reactions of alkenes and alkynes Lecture Series:

Lecture-1 on chemistry of alkenes and alkynes (electrophilic addition to alkenes) can be found here (uploaded on 17.08.2020).

Lecture-2 on chemistry of alkenes and alkynes (concerted addition to alkenes, part-1) can be found here (uploaded on 23.08.2020).

Lecture-3 on chemistry of alkenes and alkynes (concerted addition to alkenes, part-2, Diels-Alder cycloaddition) can be found here (uploaded on 06.09.2020).

Lecture-4 on chemistry of alkenes and alkynes (allylic halogenation and electrophilic addition to alkynes including hydroboration and Hg(II)-catalyzed hydration) can be found here (uploaded on 17.09.2020).

Lecture-5 on chemistry of alkenes and alkynes (semihydrogenation/partial reduction of alkynes to alkenes, both *trans*– and *cis*-stereoselective; conversion of terminal alkyne to internal alkyne and *vice versa*; Birch reduction of benzenoid aromatics; electrophilic addition to allenes) can be found here (uploaded on 24.09.2020).

Chemistry of organometallic compounds Lecture Series:

Lecture-1 on chemistry of organometallic compounds (introduction, definition, base-nucleophile dichotomy in organometallic chemistry, general methods for preparation, Grignard reagents: preparation, structure, reaction –

formation of C-H bond; formation of C-C bond – synthesis of alcohols and the corresponding retrosynthetic analysis) can be found here (uploaded on 17.11.2020).

Lecture-2 on chemistry of organometallic compounds (special cases of alcohol synthesis, synthesis and retrosynthetic analysis of carboxylic acids using Grignard reagents, abnormal reaction of Grignard reagents – base nucleophile dichotomy, anomalous reaction of Grignard reagents with epoxides) can be found here (uploaded on 13.01.2021).

Lecture-3 on chemistry of organometallic compounds (reaction of Grignard reagents with a,b-unsaturated carbonyls, enones and enals, retrosynthetic analysis and synthesis of ketones using grignard reagents, problems faced and solutions devised) can be found here (uploaded on 13.01.2021).

Lecture-4 on chemistry of organometallic compounds (organolithiums – preration and reactions; as strong bases in organic chemistry, similarity and difference in reactivity with Grignard reagents, organocoppers: Gilman reagent – prepration and reactions; similarity and difference in reactivity with Grignard reagents, Corey-House synthesis, organozincs – Reformatsky and Blaise reactions) can be found here (uploaded on 20.01.2021).

Aromatic Electrophilic Substitution Lecture Series:

Lecture-1 on SEAr (aromatic electrophilic substitution – definition, basic aspects, kinetics, addition versus substitution – importance of preserving aromaticity, two-step mechanism of SEAr, KIE in SEAr, the Wheland Intermediate and its importance in determining the approximate structure of the RDS TS, orientation and reactivity of SEAr on mono-substituted benzene, the activating and deactivating groups, ortho-,meta- and para-orienting groups, electronic effect of the substituents present, ipso substitution) can be found here (uploaded on 10.02.2021).

Lecture-2 on SEAr (orientation of SEAr in disubstituted benzenes, competition and cooperation between substituents already present; reagents used, mechanism, scope of reaction, synthetic utility of aromatic nitration, nitrosation, halogenation, sulfonation) can be found here (uploaded on 12.02.2021).

Lecture-3 on SEAr (Friedel-Crafts reactions – alkylation and acylations, scope, synthetic utility, limitations; introduction of one-carbon electrophiles into the benzene ring – Blanc chloromethylation, Gattermann-Koch reaction, Gattermann aldehyde synthesis, Houben-Hoesch reaction, Vilsmeyer-Haack reaction, Reimer-Tiemann reaction, Kolbe-Schmitt carboxylation) can be found here (uploaded on 21.02.2021).

Aromatic Nucleophilic Substitution Lecture Series:

Lecture-1 on SNAr (aromatic nucleophilic substitution – definition, basic aspects, kinetics of addition-elimination mechanism – reluctance of aryl halides to undergo nucleophilic substituion, activation of ring towards nucleophilic attack by electron-withdrawing groups, role of leaving group, synthetic scope of SNAr, cine substitution, von Richter reaction, SN1 reaction of diazonium salts, proof of mechanism, synthetic scope) can be found here (uploaded on 25.02.2021).

Lecture-2 on SNAr (aromatic nucleophilic substitution – by elimination-addition mechanism – intermediacy of benzynes – structure and reactivity of arynes, proff of benzyne mechanism, applications and synthetic scope including Diels-Alder cycloaddition of benzyne with anthracene and furan) can be found here (uploaded on 25.02.2021).

Sem-3: Paper SEC-A2 (Analytical Clinical Biochemistry):

Lecture on techniques related to the determination of the primary sequence of a protein can be found here (uploaded on 29.10.2019).

Lecture-1 on chemistry of carbohydrates (introduction, classification, structural representation, ATP production and consumption, ATP as cellular currency) can be found here (uploaded on 17.08.2020).

Lecture-2 on chemistry of carbohydrates (biological, medical importance of carbohydrates, glucose metabolism – overview, details of glycolysis and Krebs cycle, net ATP production by oxidation of glucose) can be found here (uploaded on 30.08.2020).

Lecture-3 on chemistry of amino acids and proteins (amino acids – overview, structure and stereochemistry, concept of peptide bond, di-, tri-, and oligopeptides, acid-base chemistry of amino acids, zwitterionic forms) can be found here (uploaded on 06.09.2020).

Lecture-4 on chemistry of amino acids and proteins (classification of proteins, protein structure hierarchy, primary, secondary, tertiary and quaternary structures, forces responsible for protein folding, denaturation of protein) can be found here (uploaded on 18.09.2020).

Lecture-5 on chemistry of amino acids and proteins (denaturation of protein-2, protein purification by salting out, dialysis chromatography methods [including gel filtration, ion exchange, hydrophobic interaction, reverse phase, affinity], electrophoresis, SDS-PAGE, isoelectric focusing, 2DE) can be found here (uploaded on 01.11.2020).

Lecture-6 on chemistry of nucleic acids (DNA and RNA – basic structural units, nucleosides, nucleotides, Watson-Crick model of duplex DNA, primary and secondary structure of DNA, base-pairing, stacking interactions) can be found here (uploaded on 14.01.2021).

Lecture-7 on chemistry of nucleic acids (RNA – Jack of all trades, master of none, functions, primary and secondary structure of RNA, base-pairing, points of distinction with DNA, importance of 2′-hydroxyl in RNA, significance of of the 5-methyl group in thymine, why phosphate?) can be found here (uploaded on 20.01.2021).

Sem-4: Paper CC-8:

Organonitrogen Compounds Lecture Series:

Lecture on synthesis, reactions and identification of aliphatic amines can be found here (uploaded on 17.03.2020).

Lecture on synthesis, reactions and identification of aromatic amines and aromatic nitro can be found here (uploaded on 25.03.2020).

Lecture on synthesis, reactions and identification of aliphatic nitro can be found here (uploaded on 02.04.2020).

Lecture on reactions of aromatic diazonium salts can be found here (uploaded on 07.04.2020).

Lecture on synthesis and reactions of organocyanides and isocyanides can be found here. (uploaded on 12.04.2020)

Lecture on synthesis and reactions of diazomethane and diazoacetic ester can be found here. (uploaded on 20.04.2020)

Logic of Organic Synthesis Lecture Series:

Lecture-1 on logic of organic synthesis can be found here. (uploaded on 04.05.2020)

Lecture-2 on logic of organic synthesis can be found here. (uploaded on 07.05.2020)

Lecture-3 on logic of organic synthesis can be found here. (uploaded on 11.05.2020)

Lecture-4 on logic of organic synthesis can be found here. (uploaded on 18.05.2020)

Lecture-5 on logic of organic synthesis can be found here. (uploaded on 27.05.2020)

Lecture-6 on logic of organic synthesis can be found here. (uploaded on 02.06.2020)

Lecture-7 on logic of organic synthesis (protecting groups-1) can be found here. (uploaded on 06.06.2020)

Lecture-8 on logic of organic synthesis (protecting groups-2) can be found here. (uploaded on 08.06.2020)

Sem-5: Paper CC-12:

Chemistry of Heterocycles Lecture Series

Lecture-1 on chemistry of heterocyclic compounds (chemistry of pyrroles and furans) can be found here. (uploaded on 17.08.2020)

Lecture-2 on chemistry of heterocyclic compounds (retrosynthetic analysis and synthesis of pyrroles and furans) can be found here. (uploaded on 23.08.2020).

Lecture-3 on chemistry of heterocyclic compounds (synthesis and reactions of indoles) can be found here. (uploaded on 30.08.2020).

Lecture-4 on chemistry of heterocyclic compounds (reactions of pyridine, quinoline, isoquinoline, Part-1) can be found here. (uploaded on 11.09.2020)

Lecture-5 on chemistry of heterocyclic compounds (reactions of pyridine, quinoline, isoquinoline, Part-2) can be found here. (uploaded on 18.09.2020)

Lecture-6 on chemistry of heterocyclic compounds (retrosynthetic analysis and synthesis of pyridine, quinoline, isoquinoline) can be found here. (uploaded on 25.09.2020)

Chemistry of Carbohydrates Lecture Series

Lecture-1 on chemistry of carbohydrates (definition and classification of carbohydrates, Fischer projection of aldotrioses, tetroses, pentoses and hexoses, D,L-designation, bonding connectivity of glucose, cyclic structure of D-(+)-glucose, Haworth projection formula, conversion of Fischer projection to Haworth projection, Reeves formula, Mills formula, mutarotation of carbohydrates) can be found here. (uploaded on 12.11.2020)

Lecture-2 on chemistry of carbohydrates (anomeric effect – origin and explanation, epimerisation of monosachharides, Fischer glycosidation, Williamson etherification of monosachharides) can be found here. (uploaded on 19.11.2020)

Lecture-3 on chemistry of carbohydrates (cyclic acetals of sugars with acetone and benzaldehyde- – acetonides and benzylidene derivatives, regioselective protection of sugar hydroxyls and a few transformations banking on this concept) can be found here. (uploaded on 20.01.2021)

Lecture-4 on chemistry of carbohydrates (osazone formation and the importance of this reaction, mechanism incorporating Amadori-type rearrangement; reducing sugars – reactions with Benedict's solution, Fehling's solution, Tollens' reagent; oxidation of carbohydrates with bromine water, dilute nitric acid, periodic acid; ring size determination based upon periodate oxidation – Hudson's method, reduction of monosaccharides and derivatives; end-group interchange ("head-tail swap") of a monosacchharide) can be found here. (uploaded on 20.01.2021)

Lecture-5 on chemistry of carbohydrates (Kiliani-Fischer chain ascension / extension, Wohl and Ruff chain degradation, a few important transformations) can be found here. (uploaded on 29.01.2021)

Lecture-6 on chemistry of carbohydrates (Emil Fischer's determination of relative configuration of glucose – a simplified treatment, concept of glycosidic bond formation, glycosyl donors and acceptors, issues in glycosyl bond formation – ways to avoid them, structure of sucrose, inversion of cane sugar, ring size determination of glucose and fructose units in sucrose, basic structure of two polysaccharides) can be found here. (uploaded on 10.02.2021)

Chemistry of Polynuclear Aromatic Hydrocarbons (PAHs) Lecture Series

Lecture-1 on chemistry of PAHs (alternant and non-alternant hydrocarbons, cata-condensed and peri-condensed PAHs, naphthalene – structure elucidation, partial bond fixation, Fries rule, Clar sextet, SEAr on naphthalene and monosubstituted naphthalenes, regioselectivity, KCP and TCP in sulfonation, Bucherer reaction, diazo-coupling of naphthols, Haworth synthesis of naphthalenes and its derivatives) can be found here (uploaded on 11.02.2021).

Lecture-2 on chemistry of PAHs (anthracenes and phenanthrenes, introduction, relative stability, partial bond fixation, RE compared to benzene and naphthalene, oxidation and reduction reactions, SEAr, exploitation of the diene character of anthracene and alkene character of phananthrene) can be found here (uploaded on 17.02.2021).

Lecture-3 on chemistry of PAHs (retrosynthetic analysis and synthesis of anthracenes and phenanthrenes, Haworth synthesis, Elbs synthesis of anthracene, synthesis of anthracene using Diels-Alder strategy, Haworth, Pschorr, Bardhan-Sengupta and Bogert-Cook synthesis of phenanthrene and derivatives) can be found here (uploaded on 21.02.2021).