ESSENTIALS OF OXIDATION, REDUCTION AND C-C BOND FORMATION. APPLICATION IN ORGANIC SYNTHESIS

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PRE-REQUISITES : BSc (Chemistry: specially organic chemistry courses)
INTENDED AUDIENCE : MSc in Chemistry
INDUSTRIES APPLICABLE TO : Dr. Reddys Laboratory, Syngene, Bristol-Myers Bangalore, Syngenta(Goa), Pharma Industries

COURSE OUTLINE :

In this course I will deal, in detail, of some of the modern and important methods/aspects of (a) Oxidation (b) Reduction and (c) C-C Bond Formation with special emphasis on addressing (i) Selectivity [Regio-, Chemo- and Stereo- (Enantio- and Diastereoselectivity)] (ii) Mechanism (iii) Stereochemistry (wherever necessary) and (iv) Application in solving some synthetic problems using the synthetic reactions discussed

ABOUT INSTRUCTOR :

Prof. Yashwant D Vankar was a Professor of Chemistry (Organic Chemistry to be more precise) Kanpur since March 1981 to October 2018. Over the years (more than 37 years at IIT Kanpur) I have taught a variety of compulsory and elective courses to Ph. D., M.Sc, and B.Tech students which were well appreciated by the student community. Besides getting a number of commendation letters, almost every semester, from the Director of IIT Kanpur for excellent teaching, he was given Distinguished Teachers Award by IIT Kanpur in 2015. He has also been very active in research in organic chemistry.

COURSE PLAN :

Week 1: Introduction to organic synthesis, importance of selectivity and basics of oxidation of alcohols and development of sulfur based oxidations: Swern oxidation and related concepts; Continuation of Swern oxidation and the utility of intermediates derived from Swern oxidation including Pummerer intermediates; Oxidations using selenium compounds such as SeO2 and organoselenium compounds

Week 2: Dess-Martin, IBX and related hypervalent iodine based oxidations; Silver carbonate/celite, Prevost reactions and its modern variation. Microbial oxidations such as Pseudomonas Putida etc.

Week 3: Oxidations with RuO4 and other Transition metal catalysed oxidations; Tamao-Fleming Oxidation; Oxidations with Dimethyl dioxirane (DMDO) and 2-sulfonyloxaziridines and chiral versions; Oxidations at unfunctionalised carbons, Photosensitized oxidations

Week 4: Reduction of Carbonyl compounds with Boron and Aluminium based reagents such as Luche Reduction, NaCN(BH3), DIBAL, Red-Al, L-and K-Selectrides, Superhydrides and associated selectivities.

Week 5: Low Valent Titanium species and Microbial reductions (NADH model etc.); Dissolving Metal Reductions; Reduction with Silanes

Week 6: Sharpless epoxidation and synthetic utility of the chiral epoxy alcohols; Katsuki-Jacobsen epoxidation and mechanistic details; OsO4 based and related Sharpless Asymmetric Dihydroxylation

Week 7: Coreys oxazaborilidines in asymmetric reductions; Noyoris Ruthenium catalysed reduction of ketones; Asymmetric Hydrogenations with BINAP

Week 8: C-C Bond formation via Carbanions alpha to electron withdrawing groups; Boron and Silicon Enolates: Formation and Use in C-C Bond Formation; Imines in C-C Bond Formation; Simmons-Smith Cyclopropanation in Organic Synthesis

Week 9: Use of Allyl Boron, Allyl and Vinyl Silanes and Allyl Tin compounds in C-C Bond Formation

Week 10: Introduction to SAMP and RAMP chiral ligands for asymmetric C-C bond formation; Introduction to Oppolzers Sultam based chiral ligands and their reactions for organic synthesis; Evans Oxazolidinone for asymmetric synthesis

Week 11: Synthesis of selected natural products using above discussed methods of oxidation, reduction and C-C Bond formations

Week 12: Synthesis of selected natural products using above discussed methods of oxidation, reduction and C-C Bond formations