1. NAME : **Dr. Raju Singha**

2. DEPARTMENT : Chemistry

3. ACADEMIC QUALIFICATION/DEGREE :

M.Sc. in Chemistry (IIT Kharagpur)

Ph.D. (IIT Kharagpur) in Synthetic Organic Chemistry; Supervisor: Prof. J. K. Ray

4. DESIGNATION **:** Assistant Professor

5. AREA OF RESEARCH/INTEREST **:**

Synthetic Organic Chemistry, Catalysis, Sustainable Chemistry

6. ONGOING PROJECTS BY YOU **:** NO

7. LIST OF PUBLICATIONS **: Annexure I**

8. AWARDS AND HONOURS **:**

9. COURSES TAUGHT IN THIS SESSION **: Annexure II**

10. OTHER INVOLVEMENTS/SOCIAL RESPONSIBILITY **:**

11. LECTURE NOTES IN DIGITAL FORM TO BE INCLUDED: Annexure III

12. YOUR PERSONAL WEBSITE **:**

13. PHONE NUMBER **:+91-9641222701**

ANNEXURE I

List of publications

1. **Singha, R**.; Nandi, S.; Ray, J. K. Bromine-mediated cyclization of 1,4-diaryl buta-1,3-diyne to 1,2,3-tribromo-4-arylnaphthalene. *Tetrahedron Lett.* **2012**, *53*, 6531.

2. **Singha, R**.; Roy, S.; Nandi, S.; Ray, P.; Ray, J. K. Palladium- catalyzed one-pot Suzuki-Miyaura cross coupling followed by oxidative lactonization: a novel and efficient route for the one-pot synthesis of benzo[c]chromene-6-ones. *Tetrahedron Lett.* **2013**, *54*, 657.

3. **Singha, R**.; Dhara, S.; Ray, J. K. A modular approach toward the synthesis of 2,4-disubstituted pyridines. *Tetrahedron Lett.* **2013**, *54*, 4841.

4. **Singha, R**.; Dhara, S.; Ray, J. K. Highly stereo-selective synthesis of (Z)-2,3-diiodo-1,4-diarylbut-2-ene-1,4-diones via oxidative iodination of 1,4-diarylbuta-1,3-diynes. *RSC Adv.* **2013**, *3*, 23989.

5. **Singha, R**.; Ray, J. K. Transition metal free synthesis of 2,4,6-trisubstituted pyrimidines via Cope-type hydroamination of 1,4-diarylbuta-1,3-diynes. *RSC Adv.* **2014**, *4*, 44052.

6. **Singha, R**.; Dhara, S.; Ghosh, M.; Ray, J. K. Copper catalyzed room temperature lactonization of aromatic C-H bond: a novel and efficient approach for the synthesis of dibenzopyranones. *RSC Adv.* **2015**, *5*, 8801.

7. **Singha, R**.; Ahmed, A.; Nuree, Y.; Ghosh, M.; Ray, J. K. KOtBu mediated efficient approach for the synthesis of fused heterocycles via intramolecular O-/N-arylations. *RSC Adv.* **2015**, *5*, 50174.

8. **Singha, R**.; Ghosh, M.; Nuree, Y.; Ray, J. K. TBHP-promoted and iodide-catalyzed synthesis of anhydrides via cross dehydrogenative coupling (CDC) of aldehydes. *Tetrahedron Lett.* **2016**, *57*, 1325.

9. **Singha, R**.; Ghosh, M.; Das, S.; Das, D.; Ray, J. K. Synthesis of 1,3-dibromo-2-aryl-1H-indenes via NBS mediated unusual bromination of 2-alkynylbenzaldoximes. *New J. Chem*., **2016**, DOI: 10.1039/C6NJ01201A.

10. Nuree, Y.; **Singha, R**.; Ghosh, M.; Roy, P.; Ray, J. K. Cu(I) catalyzed synthesis of anhydrides from aldehydes via CDC-pathway at ambient temperature. *Tetrahedron Lett.* **2016**, *57*, 1479.

11. Ghosh, M.; **Singha, R**.; Dhara, S.; Ray, J. K. Synthesis of 4,5,6-trisubstituted-1,3-dihydroisobenzofurans by virtue of palladium-catalyzed domino carbopalladation of bromoenynes and intern *RSC Adv.* **2015**, *5*, 85911.

12. Ahmed, A.; **Singha, R**.; Ray, J. K. Ligand-free copper powder-catalyzed and KOtBu-accelerated expeditious synthesis of substituted benzoxazoles. *Tetrahedron Lett*. **2015**, *56*, 2167.

13. Nandi, S.; **Singha, R**.; Ray, J. K. Palladium catalyzed intramolecular cascade type cyclizations: interesting Approach towards naphthoquinone derivatives having an O-containing heterocyclic skeleton. *Tetrahedron* **2015**, *71*, 669.

14. Dhara, S.; **Singha, R.**; Ahmed, A.; Mandal, H.; Ghosh, M.; Nuree, Y.; Ray, J. K. Synthesis of α, β and γ-carbolines via Pd-mediated Csp2-H/N-H activation. *RSC Adv.* **2014**, *4*, 45163.

15. Dhara, S.; **Singha, R.**; Ghosh, M.; Ahmed, A.; Nuree, Y.; Das, A.; Ray, J. K. Pd-free Sonogashira coupling: one pot synthesis of phthalide via domino Sonogashira coupling and 5-exo-dig cyclization. *RSC Adv.* **2014**, *4*, 42604.

16. Dhara, S.; **Singha, R.**; Nuree, Y.; Ray, J. K. One-pot synthesis of isoquinoline and related compounds via Cu-mediated tandem cross-coupling and cyclization. *Tetrahedron Lett*. **2014**, *55*, 795.

17. Nandi, S.; **Singha, R.**; Samanta, S.; Ray, J. K. Synthesis of pentalongin and C(1)- and C(3)-substituted pentalongin using intramolecular Heck reaction. *Tetrahedron Lett*. **2012**, *53*, 2659.

18. Ahmed, A.; Dhara, S.; **Singha, R.**; Nuree, Y.; Sarkar, P.; Ray, J. K. Palladium catalyzed one-pot synthesis of 2-(pyridin-4-yl)quinolines via a multicomponent unprecedented reaction of pyridine-4-carbaldehydes, 2-iodoanilines and triethylamine. *RSC Adv.* **2014**, *4*, 53137.

19. Ghosh, M.; Ahmed, A.; **Singha, R.**; Ray, J. K. Domino Suzuki coupling and condensation reaction: an efficient strategy towards synthesis of phenanthridines. *Tetrahedron Lett*. **2015**, *56*, 353 al alkynes. *RSC Adv.* **2015**, *5*, 85911.

ANNEXURE II

COURSES TAUGHT IN THE SESSION - 2016-2017

UG 1st Year

Optical activity of chiral compounds; specific rotation, optical purity (enantiomeric excess), recemic compounds, racemisation (through cationic, anionic and radical intermediates), resolution of acids, bases and alcohols via diastereomeric salt formation.

Topicity of ligand and faces (elementary idea):

Homotopic, enatiotopic and diastereotopic ligands, Prochirality, Pro- R/Pro-S descriptors, homotopic ,enatiotopic and diastereotopic faces, Re/Si descriptors.

Conformation: Staggered and eclipsed conformations, dihedral angle, torsion angle, energy barrier of rotation, relative stability of conformers on the basis of steric effect, dipole-dipole interaction, hydrogen bonding; conformational analysis of ethane, propane, n-butane, 1,2-dihaloethane, 1,2-glycols, 1,2-halohydrin, invertomerism of trialkyl amines.

Stereochemistry of alicyclic compounds:

Static stereochemistry: Bayer strain theory; energy profile of ring inversion of cyclohexane, symmetry properties of chair, boat and twist boat form. Conformational analysis of methyl cyclohexane 1,2-,1,3-,and 1,4 dimethyl cyclohexane. Conformational energy of substituents in cyclohexane.

Preferred conformations of disubstituted derivatives of cyclohexane (1- methyl-1-phenyl cyclohexane, cis and trans-1,3- and -1,4- ditertiary butyl cyclohexane, cis and trans-1,2-dibromo cyclohexane, cis and trans cyclohexane-1,3-diol). Physical properties with respect to dipole moment and acid strength in cyclohexane system.

UG 2nd Year

Addition reactions:

Addition to Carbon- Carbon multiple bond: electrophilic and free radical mechanism, stability of alkenes-heat of hydrogenation and heat of combustion. Mechanism of the following reactions: Halogenation, hydrohalogenation (regioselectivity, peroxide effect), hydration of alkene (including oxymercuration-demercuration, hydraboration-oxidation), epoxidation, hydroxylation, ozonolysis (involving 1, 3-dipolar mechanism), hydration of alkyne, stereochemistry of bromination, hydroxylation and carbine addition. Electrophilic addition to allene and butadiene. Dissolving metal reduction of alkynes and benzenoid aromatics (Birch).

Dynamic stereochemistry: Conformations and reactivity in cyclohexane system: E2 elimination, nucleophilic substitution (SN1, SN2, NGP), rearrangement (pinacol-pinacolone and related rearrangements, Favorski rearrangement). Oxidation of cyclohexanol, esterification, saponification and lactonization.

UG 3rd Year

IR Spectroscopy: Stretching and bending vibrations, Hooke's law, characteristics stretching frequencies of O-H, N-H, C-H, C-D, C=C, C=N, C=O functions, factors affecting stretching frequencies (H-bonding, mass effect, electronic factors, bond multiplicity, ring size).

Amino acids, peptides and nucleic acids

Amino acids: Synthesis of α-amino acids (Gabriel, Strecker, azolactone, acetamidomalonic ester methodologies), isoelectronic point, ninhydrin reaction.

Peptides: peptide linkage, peptide synthesis including Merrifield resin, Cterminal, N-terminal and their determination (Edmann, Sanger and dansyl chloride).

Nucleic acids: structure of nucleosides and nucleotides, pyrimidine and purine bases (structure and nomenclature only), elementary idea of RNA and DNA; Watson-Crick model, complimentary base-pairing in DNA.

PG SEM I

Natural Products - Alkaloids**:** Alkaloids : Phenyl ethyl amine, quinine, nicotine, peptides, nucleoside and nucleotide structure, synthesis, biogenesis.

PG SEM II

Stereochemistry 1 **:** Different projection formulae and their interconversions. Conformational and configurational enantiomers. Stereochemical nomenclatures : (E, Z), chiral centre, chiral axis, chiral plane, helicity, threo-erythro, pref-parf, chiral simplex. Stereogencity and chirotopicity. Symmetry and molecular chirality. Stereochemical features : cyclohexane and its derivatives conformation and physical properties. Computation of stereoisomers of different systems. Conformation and relative reactivity of diastereomers. 2-, 3-, and 4- Alkyle ketone effects.

Stereochemistry 2 **:** Prochirality and Prostereoisomerism. Topicity and Reactivity. A symmetric synthesis : Addition of a chiral reagents to chiral ketones and aldehydes, models of stereochemical control : Cram, Felkin and Karabatsos. Atropisomerism Molecular rearrangements with Neighbouring group participations. Stereospecific and stereoselective reactions. Sharpless expoxidation.

PG SEM III

Green Chemistry**:** The current status of chemistry and the environment. What is green chemistry? How Green and Renewables are related to sustainabilty. Principles, methodologies and techniques in Green Chemistry. Synthesis in aqueous media, Catalytic methods in synthesis, Examples of green chemistry. Future trends in green chemistry. Unconventional energy sources in synthesis: solar energy.

PG SEM IV

Stereochemistry-3: Conformation and Chemical Reactivity : Curtin-Hammett principle, its derivation under different conditions and applications; quantitative treatement of mobile systems, Winstein Holress equation and Eliel equation - their applications ; □□-Strain and □□-strain, allylic 1,2 - and 1, 3-strain (in pseudoallylic systems also), their applications.

ANNEXURE III

LECTURE NOTES:

For stereochemistry

https://www.youtube.com/watch?v=yZ8JDDnyxC4

https://www.youtube.com/watch?v=bj13zmUE7y0

https://www.youtube.com/watch?v=oG19d7vqWkw

For sustainable chemistry

https://www.youtube.com/watch?v=rIE4T2HLW7c

https://www.youtube.com/watch?v=drINEQFXbPY