# Abstract

**Chapter I: A general introduction of C-hetero bonds**:

Though, for most of organic compounds C-C bond is the backbone, but their functions are derived by the presence of hetero atoms such as oxygen, nitrogen and sulphur etc. in the moiety. These molecules act as most imperious subtype of organic molecules in the dominion of biomedical science, pharmaceutical and also in material sciences. For example, suitable derivatives of C-hetero molecules basically C-N heteroatom bonds act as important fragments for many naturally occurring and also in synthetic drugs to heal diseases, non-classical isosteres for the carboxylic acid moiety of biologically active molecules and are also useful to ligand modeling for transition metal complexes in both biological and non-biological system etc. The vast importance and wide scope of carbon-hetero bond make the author to carry out the methodological work on C-hetero bond formation reactions.

**Chapter II: $Fe_3O_4$-CTAB nanoparticles catalyzed an efficient synthesis of nitriles from aldehydes:**

**Section A:** Chapter II (section A) is comprised with the basic information of nitriles and also a methodological literature review for their synthesis. Nitriles are useful intermediate for many organic transformation and heterocyclic moiety formations. For this a number of methodologies using different catalysts or precursors are available. But drawbacks associating with those existing methodologies make a scope to develop a new protocol for their synthesis.

**Section B:** ChapterII (section B) contains $Fe_3O_4$-CTAB nanoparticles catalysed synthesis of nitriles from aromatic, aliphatic and hetero aromatic aldehydes under mild reaction condition. Here, a reaction between an aldehyde (0.5 mmol), hydroxylamine hydrochloride (0.75mmol) $Fe_3O_4$ -CTAB nanoparticles (5.7 mg) is carried out in dry DMF (5 ml) under reflux condition. This reaction protocol gives excellent yield of nitriles for both aromatic and heteroaromatic aldehydes except for the aliphatic aldehyde which give relatively lower yield.

**Chapter III: Reactions catalysed by 3, 5 Di-nitrobenzoic Acid Derived Copper (II) Complex:**

**Section A:** Chapter III (section A) contains general information of imidazole and the synthetic literature survey for the preparation of 2, 4, 5-trisubstituted imidazole. Imidazoles has N-

containing heteroaromatic moiety. They serve as a major building block of many biological active compounds, amphiphilic molecule for drug delivery and also for treatment of many parasitic decreases. Their importance attracts researcher to find a suitable and most efficient protocol for the preparation of imidazole. Several reaction methodologies are available for the preparation but most of them are associated with drawbacks. So, there is always a scope to find a new protocol for the preparation.

**Section B:** Chapter III (section B) deals with the preparation of 2, 4, 5-trisubstituted imidazole using 3, 5 Di-nitrobenzoic acid derived Copper (II) Complex as a catalyst under mild and solvent free reaction condition. We used reaction of benzil/benzoin (0.5 mmol), aldehydes (0.5mmol), $NH_4OAc$ (1mmol), catalyst (2.5 mol %) and silica-gel (750 mg) at $70^0C$ for our reaction protocol. This protocol stands well for aromatic, aliphatic and heteroaromatic aldehydes. It gives excellent to good yield of desired product. This protocol can easily omits certain drawbacks such as tedious work-up process, usage of hazardous catalyst and also the formation of other unwanted side products etc.

**Chapter IV: Highly efficient polymeric-Cu (II) catalysed one pot multi-component synthesis of substituted N-heterocycles *via* double condensation/ tandem oxidation-cyclisation/elimination-cyclisation reactions from diverse starting precursors under milder reaction conditions.**

**Section A:** ChapterIV (section A) compares with the general introduction and methodological literature survey about the synthesis of pyrazine and quinoxaline. Pyrazine is an aromatic heterocyclic moiety contains nitrogen at 1 and 4 position of the heterocyclic ring. It is an important component of aromas in vegetables, fruits and wines. It also serves important building block for biological potent molecules. Whereas quinoxaline has a fused heteroaromatic structure in which nitrogen atoms are present at 1 and 4 position of one of the two fused ring. They show an inhabiting effect against of transplantable tumors and also for Gram-positive bacteria etc. A number of methodologies using various catalyst and precursors are available for the preparation of pyrazine and quinoxaline. But many of them are associated with the major drawbacks. So, there is always a need to developea new and acceptable methodology for them.

**Section B:** Chapter IV (section B) deals with the preparation of pyrazine and quinoxaline derivatives form diverse precursor using 3, 5 Di-nitrobenzoic acid derived Copper (II) Complex

as a potent catalyst under mild reaction condition. We used different 1, 2- diketones and alkyl *vic*-diamine as pyrazine's precursor. In our primary attempt we choose benzil both substituted or unsubstituted/α-hydroxy ketone (1 mmol), *vic*-diamine/2-methyl *vic*-diamine (1 mmol), Cu (II)-catalyst (5 mol %) and methanol (3 ml) at $50^0$ C. In our $2^{nd}$ attempt we replaced one or both the aromatic ring of benzil with H or other alkyl group and do the reaction under same reaction condition. Then we choose electron withdrawing substituent for the *vic*-diamine. We used 2, 3-diaminomaleonitrile as our *vic*-diamine source and continued our reaction at the optimized reaction condition. In all the cases we get good to excellent yield of desired product, i.e. pyrazine derivative. Then we check the activity of catalyst for quinoxaline preparation. We choose 1, 2-di ketone (1 mmol), o- phenylene diamine (1 mmol), Cu (II)-catalyst (2.5 mol %) and methanol (3 mL) at $40^0$ C for preparation of 2, 3-disubstituted quinoxaline. After getting satisfactory result we choose phenacyl bromide (substituted/unsubstituted) as another precursor for quinoxaline synthesis. We find phenacyl bromide (1 mmol), o- phenylene diamine (1 mmol), copper catalyst (10 mol %), $Na_2CO_3$ (1 equiv.) and methanol (3 mL) at refluxed condition, as our optimized reaction condition. We check the applicability of the protocol against some substituted phenacyl bromide/ o- phenylene diamine. We get expected result for all the cases.

**Section C:** Chapter IV (section C) deals with the preparation of 2, 3-disubstituted quinoxaline from an unconventional but easily available precursor. To omit the drawbacks related to the conventional precursor we used 2-idobenzoic acid as our precursor. In this investigation we took benzil (1mmol), 2-iodobenzoic acid (1mmol), Cu (II)-catalyst (10 mol %), $NH_4OH$ (1 mol %) and $NaN_3$ (1 mmol) in DMSO (3 mL) under reflux condition for our reaction. We got good to moderate yield of required product during our reaction. Diketones with low boiling points give poor yield during the reaction.