PREFACE

Graphs can represent the pair wise relations between the objects from a collection and can be denoted as $G(V,E)$, where V and E signifies the set of vertices and set of edges respectively. Graphs find application in several real life areas like in the GPS system, social networking sites, telecommunication industry, computer science and mathematics etc. In most of the applications, weighted graphs are used, where the weights associated with the edges and the nodes represent the parameters like delay, cost, time, score, distance, capacity etc., which cannot be determined precisely. Therefore, the best way to deal with prevailing uncertainty, is to use fuzzy numbers (instead of crisp numbers) to represent these parameters.

Here, two major graph problems have been considered, namely the orienteering problem and the constrained shortest path problem. Some fuzzy and intuitionistic fuzzy models have been proposed to deal with the problem. Since the orienteering problem is NP-Hard and the constrained shortest path problem is NP-Complete, some heuristics / meta-heuristic have also been proposed to tackle the two problems.

Firstly, a new ranking method has been proposed for the Quasi-Gaussian fuzzy number and applied on the shortest path problem, minimum spanning tree problem and the Steiner tree problem. Few latest ranking methods, available for the trapezoidal fuzzy numbers, have been applied on the constrained shortest path problem with the aim to determine the ranking method, which is appropriate for practical applications. A max-min formulation has been presented for the fuzzy version of the orienteering problem. Also, a parallel formulation has been presented for the fuzzy orienteering problem.

Next, a new type of fuzzy number called the Quasi-Gaussian intuitionistic fuzzy number (QGIFN) has been defined. Also, a centroid based ranking method has been proposed for QGIFN. A centroid based ranking method has been suggested for the trapezoidal intuitionistic fuzzy number (TIFN) that uses a more generalized, eight parameter representation. Another, centroid of centroids method of ranking has been proposed for TIFN. These intuitionistic fuzzy numbers (IFN) and their respective ranking methods have been applied on the constrained shortest path problem. A max-min formulation has also been stated for the intuitionistic fuzzy version of the orienteering problem. A theoretical analysis, called the work-depth analysis has been performed for the intuitionistic fuzzy orienteering problem (IFOP) to determine its parallelism. A new intuitionistic fuzzy metric space using the concept of intuitionistic fuzzy points has been proposed. Further, the distance metric proposed has been applied on IFOP.

Finally, a roulette wheel selection heuristic (RWS_OP) has been proposed for the orienteering problem that can be applied on incomplete as well as complete graphs. A flower pollination meta-heuristic (FPA_OP) have been stated that can be applied on complete graphs only and a bidirectional search heuristic for the constrained shortest path problem has been presented.