Non-dominated Sorting Genetic Algorithm II (NSGA-II) is an enhanced algorithm of Non-dominated Sorting Genetic Algorithm (NSGA) which belongs to the class of Elitist Multi-objective Genetic Algorithm. As comparing to basic Genetic Algorithm, NSGA-II with the improved non-dominated sorting method together with simulated binary and polynomial mutation genetic operator, it is able to solve multi-objective optimization problems. In this project, the performance of NSGA-II in solving different complexity of multi-objective optimization problem is tested using three benchmarking functions and various parameter settings. The performance of this algorithm is evaluated based on its capability to produce optimal solutions which is close to the Pareto front. Subsequently, the experiment carried out in this project is also extended to solving the Generalized Assignment Problem (GAP) which is a real world problem. This project highlights the bi formulation GAP which is different from the traditional GAP in terms of the number of conflicting objectives and constraint involved in this problem. Consequently, some components of the original NSGA-II have been modified by including a constraint handling method in the algorithm in order to solve the GAP. Two simulation runs each using a different problem complexity are carried out to find out the efficiency and effectiveness of NSGA-II in solving the real world optimization problem.