# Advanced Numerical Simulation
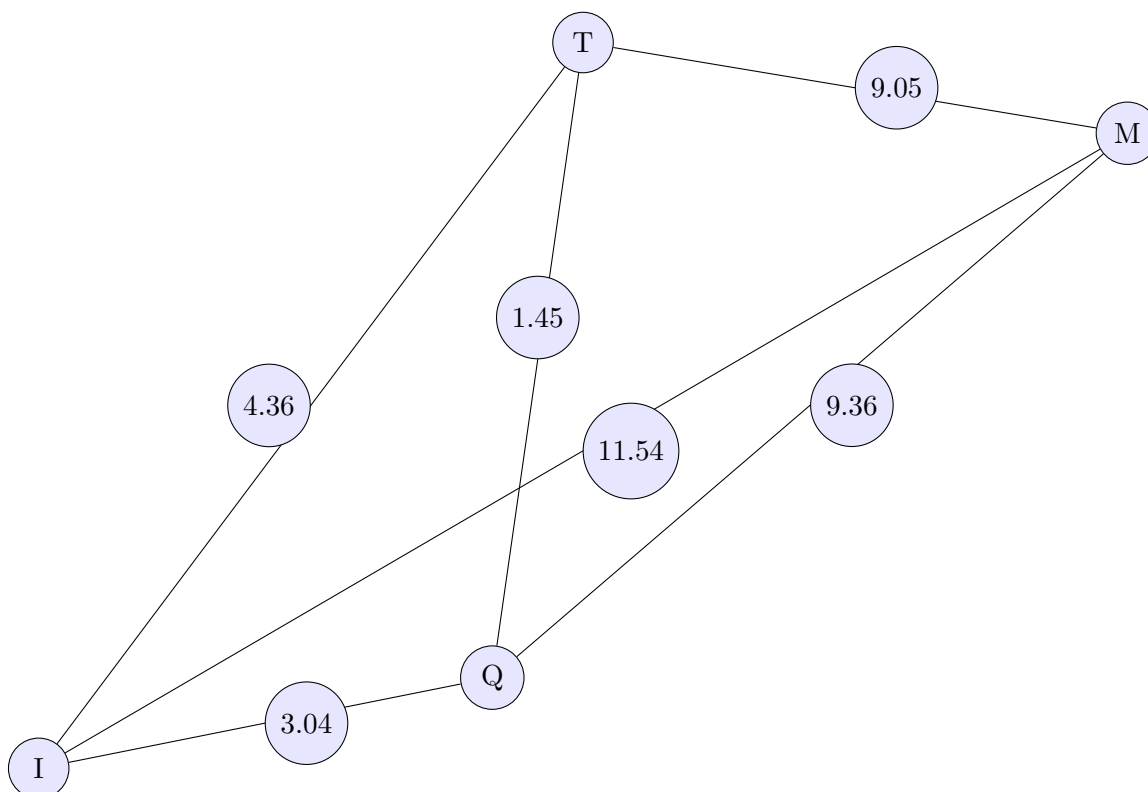
# Problem Set 1

*(Due Date : 1404/08/06)*

## Problems

1. **Traveling Salesman Problem with Constraints**
   A salesman must travel between four cities in Iran: **Tehran (T)**, **Isfahan (I)**, **Mashhad (M)**, and **Qom (Q)**. The distances between the cities are shown in the figure below (in arbitrary units).



   (a) Find the shortest possible route that visits each city exactly once and returns to the starting city (the classical Traveling Salesman Problem). List all possible tours and compute their total distances.

   (b) Now assume that the salesman must **visit Tehran twice** during the journey (he can start and end there, or pass through it in the middle). Find the new optimal route and total distance under this condition.

   (c) Finally, find the shortest tour such that the salesman **visits Esfahan before Mashhad** at least once, while still visiting all cities.