# Homework III (due: 03/21/2017)

# CIS 9590 Ad Hoc Networks

Name _____ Student Number _____

1. (Connected Dominating Set)
For a given connected graph with edge set $E = \{12, 25, 27, 28, 34, 36, 38, 45, 58, 67, 78\}$, where 25 represents an undirected link between nodes 2 and 5, find out the CDS using replacement path rule. Consider two cases: 2-hop and 3-hop neighborhood information.

2. (Topology Control)
Consider a geometric graph: A: (0, 10), B (5, 20), C: (0, 30), D: (8, 38), E: (15, 32), F: (20, 18), G: (13, 15), H: (15, 0). Here $u$ : ($u_x$, $u_y$) represents the coordinates of node $u$ at axes $x$ and $y$. Show geometric graphs: (1) unit disk graph with radius 15, (2) Gabriel graph (GG), (3) relative neighborhood graph (RNG), (4) Euclidean minimum spanning tree (EMS), and (5) nearest neighbor graph. Show details of deriving the neighbor set for node F for GG, node C for RNG, node G for NNG.

3. (Topology Control: Local MST)
Repeat question 2 using local MST with 1-hop neighborhood of radius 20 (the work by N. Li and H. Hou on Design and Analysis of an MST-based Topology Control Algorithm). Show details for node G and then the final topology. Pay attention to orientation of each link. Unidirectional link (u, v) means u selects v, but not v selects u. Show the topology after removing all unidirectional links.

4. (Topology Control: Yao's graph and Cone-based)
Repeat question 3 for Yao graph (k=6 with one cone line is aligned with the X axis). Show details for node G only. Repeat question 3 for L. Li et al's cone-based approach where $\alpha = 5\pi/6$. Show details for node G only.

5. (Energy-Efficient Broadcasting)
Given a geometric graph: A: (12, 28), B: (34, 49), C: (8, 6), D: (2, 45), E: (40, 12), F: (30, 20), G: (25, 13), H: (25, 30), I: (1, 23), J: (20, 26). We assume node J is the source. Find energy-efficient broadcast using (a) Least-Unicast-Cost (BLU), (b) Broadcast Link-based MST (BLiMST), (c) Broadcast Incremental Power (BLP) without sweep, and (d) BLP with sweep. It is assumed that the transmission cost is based on $P(dis) = dis^2$. (Ref: J. Wieselthier, G. Nguyen, and A. Ephremides, INFOCOM 2000 and INFOCOM 2002.)