

### Topics covered in Math 312

- (1) Bipartite graphs. A characterization of bipartite graphs.
- (2) Isomorphism of graphs.
- (3) Self-complementary graphs.
- (4) Eulerian circuits. Euler Theorem.
- (5) De Bruijn graphs.
- (6) Extremal problems on graphs. Turan's Theorem.
- (7) Graphic sequences. A theorem on such sequences.
- (8) Trees, characterizations of trees.
- (9) Centers of trees.
- (10) Prufer codes, Cayley's formula.
- (11) Counting spanning trees in graphs.
- (12) Minimum spanning trees. Algorithms of Kruskal and Prim.
- (13) Shortest Path Problem. Dijkstra's Algorithm.
- (14) Kings in tournaments.
- (15) Matchings in bipartite graphs. Hall's Theorem.
- (16) Matchings and covers. Konig-Egervary Theorem.
- (17) Gallai's Theorem ( edge covers and matchings).
- (18) Algorithm for finding maximum matchings in bipartite graphs.
- (19) Stable matchings.
- (20) Matchings in general graphs. Tutte's Theorem.
- (21) Connectivity and edge connectivity.
- (22) A characterization of 2-connected graphs.
- (23) Ear decomposition.
- (24) Menger's Theorems(!).
- (25) Fan Lemma.
- (26) Flows in networks. Decomposition of every flow into flows along cycles and  $s, t$ -paths.
- (27) Ford-Fulkerson Algorithm. Max Flow–Min Cut Theorem.
- (28) Integral flows (matchings in bipartite graphs, edge connectivity).
- (29) Colorings. Colorings of Cartesian products of graphs.
- (30) Greedy algorithm for coloring.
- (31) Coloring of interval graphs.
- (32) Color-critical graphs and their properties ( $(k - 1)$ -edge-connected etc.).
- (33) Brooks' Theorem.
- (34) Mycielski's Construction.
- (35) Planar and plane graphs. Dual graphs.
- (36) Bipartite planar graphs versus Eulerian dual graphs.
- (37) Euler's Formula.
- (38) Outerplanar graphs.
- (39) Kuratowski's Theorem.
- (40) 5-Color Theorem for planar graphs.
- (41) Edge colorings. Shannon's Theorem. Edge colorings of bipartite graphs.
- (42) Hamiltonian circuits. Necessary conditions. Theorems of Dirac and Chvátal-Erdős (sufficient conditions).