List of Questions

1. Enumeration: permutations, variations, combinations (without and with repetition). Simple relations between binomial coefficients**, binomial theorem**, Pascal's triangle.
2. Basic notions of graph theory: graph, simple graph, degree, isomorphism, complement, subgraph, walk, trail, circuit, path, cycle, connectedness, components. Trees: basic properties**, spanning trees, their existence**.
3. Euler trail and circuit, necessary and sufficient conditions for their existence**. Hamilton path and cycle, necessary conditions**, sufficient conditions: Dirac's** and Ore's** theorem.
4. Vertex coloring: the notion of $\chi(G)$ and its relationship to $\omega(G)$** and $\Delta(G)$**. Zykov's construction**. Greedy coloring**. Interval graphs, their coloring**.
5. Bipartite graphs, relationship with odd cycles**. Covering and independent vertices and edges. Gallai's theorems* Tutte's theorem*.
6. Matchings. Augmenting paths. Theorems of König**, Hall** and Frobenius**. Edge-chromatic number, its relationship to $\Delta(G)$**.Vizing's theorem, Shannon's theorem. König's theorem** (edge-chromatic number of bipartite graphs).
7. Network, flow, value of a flow, s-t cut, capacity of a cut, augmenting paths. Ford-Fulkerson theorem**, Edmonds-Karp theorem. Integrality lemma**.
8. Generalizations of flows. Menger's theorems about paths between pairs of points*. Higher connectivity and edge-connectivity in graphs. Menger's related theorems*.
9. BFS algorithm, it's usage for determining connectedness and distances. Minimum weight spanning tree, Kruskal's theorem.
10. Algorithms for finding shortest paths: Dijkstra's algorithm*, Ford's algorithm*.
11. DFS algorithm, DFS tree, classification of the edges*. DAG, topological ordering**. Shortest and longest paths in acyclic graphs.

Theorems and statements with an * were partially proved in the lecture.
Theorems and statements with a ** were completely proved in the lecture.