

BME MATH-M1 List of Questions for the Oral Exam, 2022 December.

(A) Graph Theory

1. Basic notions: directed and undirected graphs, isomorphism, subgraph, adjacency matrices, degree, the sum of degrees is equal with the double of the number of edges.
2. Paths, cycles, connectedness, connected components, forest, tree .
3. Eulerian paths and cycles and a sufficient and necessary condition for their existence.
4. Hamiltonian paths and cycles and a necessary condition for their existence.
5. Sufficient conditions for the existence of a Hamiltonian cycle (the Theorems of Ore and Dirac).
6. Finding shortest paths: the basic techniques and Dijkstra's algorithm. The number of its steps in the worst case.
7. Ford's and Floyd's algorithms, the numbers of their required steps.
8. Transportation networks and the maximal flow problems. Cuts and the Ford-Fulkerson theorem.
9. The integer value theorem, and some generalizations of the transportation network problem.
10. Multiple connectivity, multiple edge connectivity, Menger's theorems.
11. Chromatic numbers of graphs. Bipartite graphs and their chromatic numbers.
12. The marriage problem. Matchings. The König-Hall Theorem.

(B) Probability Theorem

13. Event algebras, probability measures.
14. Conditional probabilities and independence. The complete event system theorem.
15. Random variables. Probability distributions, density and distribution functions.
16. Expected value, variance and their basic properties.
17. The Markov and the Chebyshev inequality.
18. Indicator variables, binomial distributions and their basic properties.
19. The Law of Large Numbers.
20. The Central Limit Theorem.
21. Bernoulli proceses, N_k, T_n and their probability distributions.
22. Poisson processes and the probability distribution of N_k .

2022 fall.