DSE-5(v): Optimization

Week 1: Problem statement of a nonlinear optimization problem, Example of production-inventory, Location facilities, Stochastic resource allocation, Convex sets.
[1]: Chapter 1 (Sections 1.1, and 1.2 [Examples A, and F]), and Chapter 2 (Section 2.1.1).

Week 2: Convex functions, Epigraph and hypograph of a function.
[1]: Chapter 3 (Sections 3.1.1, 3.1.2, 3.1.3 [only statement with example], 3.2.1, and 3.2.2).
[2]: Chapter 7 (Examples [7.2.1(i) to 7.2.1(v)]).

Week 3: Differentiable convex function, Twice differentiable convex function.
[1]: Chapter 3 (Sections 3.3.1, 3.3.3 [only statement], 3.3.4, 3.3.5, 3.3.6, 3.3.7 [only statement], and 3.3.8 [only statement]).

Weeks 4 and 5: Minima of convex function, Quasiconvex functions, Pseudoconvex functions.
[1]: Chapter 3 (Sections 3.4.1, 3.4.2, 3.5.1, 3.5.2, 3.5.4 [only statement with example], 3.5.10, and 3.5.11 [only part of statement relating quasiconvexity and pseudoconvexity]).

Week 6: Unconstrained problems: Necessary optimality conditions, Sufficient optimality conditions.
[1]: Chapter 4 (Sections 4.1.1, 4.1.2, 4.1.3, 4.1.4 [only statement], 4.1.5, and 4.1.7).

Week 7: Problems having inequality constraints: Fritz John optimality conditions, Karush-Kuhn-Tucker (KKT) necessary optimality conditions.
[1]: Chapter 4 (Sections 4.2.8 [only statement], 4.2.9, 4.2.10, 4.2.11, and 4.2.13).

Week 8: Fritz John necessary conditions for inequality and equality constraints with examples.
[1]: Chapter 4 (Sections 4.3.2 [only statement], 4.3.3, 4.3.4, and 4.3.5).

Week 9: KKT necessary and sufficient conditions for inequality and equality constraints.
[1]: Chapter 4 (Sections 4.3.7, and 4.3.8).
[2]: Chapter 8 (Examples 8.5.1, and 8.5.2).

Weeks 10 and 11: Lagrangian dual problem, Weak duality theorem, Duality gap, Strong duality theorem.
[1]: Chapter 6 (Sections 6.1 [without geometrical interpretation], and 6.1.1).
[1]: Chapter 6 (Sections 6.2 [6.2.1, 6.2.2, 6.2.3 (only statement), and 6.2.4 (only statement)]).

Week 12: Wolfe's method for quadratic programming problem.
[2]: Chapter 7 (Section 7.7).

Weeks 13 and 14: Descent property, Order of convergence, Global convergence, Steepest descent method, Newton's method.
[2]: Chapter 9 (Sections 9.2.2, 9.2.4, 9.2.5, 9.4, and 9.5).

Week 15: Linear fractional programming problem and simplex algorithm.
[2]: Chapter 12 (Sections 12.4, and 12.5 [simplex algorithm]).

Essential Readings

1. Bazaraa, Mokhtar S., Sherali, Hanif D. & Shetty, C. M. (2006). Nonlinear Programming: Theory and Algorithms (3rd ed.). John Wiley & Sons. Wiley India (2017).
2. Chandra, Suresh, Jayadeva and Mehra, Aparna (2009). Numerical Optimization with Applications. Narosa Publishing House Pvt. Ltd. Delhi. Second Reprint 2016.