53:235 **APPLIED OPTIMAL DESIGN**

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Purpose: The purpose of this course is to present modern concepts of optimal design of systems. Basic ideas from optimization theory are developed with simple design examples. Analytical and numerical methods are developed and their applications discussed. Use of numerical simulation methods in the design process is described. Prerequisite: 53(58):113

Textbook: Arora, J.S., *Introduction to Optimum Design*, McGraw Hill, 1989

Reference: Haug, E.J. and Arora, J.S., *Applied Optimal Design*, Wiley Interscience, 1979.

Other Optimization Books

1. Kirsch, U., *Structural Optimization: Fundamentals and Applications*, Springer-Verlag, New York, 1993.
2. Haftka, R.T. and Gurdal, Z., *Elements of Structural Optimization*, Third Revised Edition, Kluwer Academic Publishers, 101 Philip Dr., Norwell, MA 02061, 1992.
3. Vanderplaats, G.N., *Numerical Optimization Techniques for Engineering Design: With Applications*, McGraw-Hill Book Co., New York, New York, 1984.
4. Reklaitis, G.V., Ravindaran, A. and Ragsdell, K.M., *Engineering Optimization: Methods and Applications*, Wiley-Interscience, John Wiley and Sons, Inc., New York, NY, 1983.
5. Morris, A.J. (Ed.), *Foundations of Optimization: A Unified Approach*, Wiley-Interscience, John Wiley and Sons, New York, New York, 1982.
6. Kirsch, U., *Optimum Structural Design*, McGraw-Hill Book Co., Inc., New York, New York, 1981.
7. Gill, P.E., Murray, W., and Wright, M.H., *Practical Optimization*, Academic Press, New York, New York, 1981.
8. Luenberger, D.G., *Linear and Nonlinear Programming*, Addison-Wesley, 1983.
9. Fletcher, R., *Practical Methods of Optimizations*, Second Edition, Wiley-Interscience, John Wiley and Sons, Inc., New York, New York, 1987.
10. Bazarra, M.S. and Shetty, C.M., *Nonlinear Programming: Theory and Algorithms*, John Wiley, New York, New York, 1979.
11. Papalambros, P.Y. and Wilde, D.J., Principles of Optimal Design: Modeling and Computation, Cambridge University Press, 2000.
12. Arora, J.S., Editor, *Guide to Structural Optimization*, ASCE Manuals and Reports on Engineering Practice No. 90, American Society of Civil Engineers, Reston, VA 20191, 1997.
13. Avriel, M. and Golany, B., *Mathematical Programming for Industrial Engineers*, Marcel and Dekker, New York, 1996.
14. Berteskas, D.P., *Nonlinear Programming*, Athena Scientific, Belmont, MA 1995.
15. Fang, Shu-Cherng and Puthenpura, S., *Linear Optimization and Extensions*, Prentice Hall, Englewood Cliffs, NJ, 1993.
16. Hertog, D. den, *Interior Point Approach to Linear, Quadratic and Convex Programming*, Kluwer Academic Publishers, Dordrecht 1994.
17. Hestenes, M., *Conjugate Directions Methods in Optimization*, Springer-Verlag, Berlin, 1980.

18. Jeter, Melvyn W., *Mathematical Programming: An Introduction to Optimization*, Marcel Dekker, New York, NY 1986.
19. Nash, S.G. and Sofer, A., *Linear and Nonlinear Programming*, McGraw Hill, New York, NY 1996.
20. Padberg, M., *Linear Optimization and Extensions*, Springer-Verlag, Berlin 1995.
21. Pierre, D.A. and Lowe, M.J., *Mathematical Programming via Augmented Lagrangian: An Introduction with Computer Programs*, Addison-Wesley, Reading MA 1975.
22. Pshenichnyi, B.N., *The Linearization Method for Constrained Optimization*, Springer-Verlag, Berlin, 1994.
23. Schittkowski, K., *More Examples for Nonlinear Programming Codes*, Springer_Verlag, Berlin, 1987.
24. Wright, S.J., *Primal-Dual Interior Point Methods*, SIAM, Philadelphia, 1997

Topical Outline

1. Introduction; notation; Design process
2. Optimal design problem formulation
3. Unconstrained optimal design theory; applications
4. Constrained optimal design theory; applications
5. Numerical methods; Linear and quadratic programming
6. Numerical methods; unconstrained problems
7. Numerical methods; constrained problems
8. Optimal design with numerical simulation method; design sensitivity analysis
9. Applications; Use of IDESIGN