Computer Aided Design of Thermal Systems (ME648)

PG/Open Elective

Credits: 3-0-0-9


Lecture-by-Lecture Break-up (Three 50 min Lectures per Week)


Lec #10: Example Problem. Curve Fitting: Exact Fit and Best Fit: Applications. Exact Fit: (a) General form of a polynomial. To be continued.

Lec # 11: Exact Fit (Contd): (b) Newton’s Divided-Difference Interpolating Polynomial. (c) Lagrange Interpolation.


Lec #13: Best fit with a Polynomial. Nonpolynomial form. Linearisation: Exponential, Power law and other functions. Function of two or more independent variables: Exact Fit: \( y = f(x_1, x_2) \)-demonstration of the method using a second order polynomial.


Lec # 17: Relaxation Method: Successive Over-relaxation and Under-relaxation. Concept of Relaxation Factor. Optimum Relaxation Factor. Finite-Difference Method: Derivation of Central, Forward and Backward difference expressions for \( y_i^{'} \) and \( y_i^{''} \) using Taylor series approach. Concept of truncation error. Finite-difference expressions of higher order accuracy.


**Lec # 21:** Definition of Stability. von Neumann Stability Analysis for each scheme.


**Lec # 23:** Problems in Cylindrical Geometry: (a) Axisymmetric Problems (b) Non-Axisymmetric Problems.

**Lec # 24:** Non-linear GDE: Variable Thermal Conductivity. Non-linear Boundary Condition: Radiation boundary Condition.


**Lec # 26:** Commonly used methods for obtaining an initial design. Example Problem: Initial design of a Refrigerator.


**Lec # 28** Example Problem (Completed). Heat Exchanger Design Problem: Given quantities, Requirements, Constraints, Design variables and Operating Conditions of a typical heat exchanger design problem.
**Lec # 29:** Example Problem: Design of a Counterflow Double-Pipe Heat Exchanger: Statement of the Problem.


**Lec # 31:** Visualization of Lagrange Multiplier Method in Two Dimensions. Unconstrained Optimization: Application of Lagrange Multiplier Method when there is no constraint. Example Problems (Conversion of a Constrained Optimization Problem into an Unconstrained Optimization Problem).


**Lec # 33:** Eliminating a section based on two tests. Dichotomous Search: The basic method. The expression for the Final Interval of Uncertainty. Fibonacci Search: Fibonacci Series. The Steps in a Fibonacci Search. Example Problem: Demonstration of the application of Fibonacci Search method to obtain the maxima of a function. Comparison of Effectiveness of Three Search Methods in terms of Reduction Ratio (RR).

**Lec # 34:** Multivariable, Unconstrained Optimization: (a) Lattice Search; (b) Univariate Search. Example Problem (Demonstration of Univariate Search for a Two-variable Problem).


**Lec # 37:** Mathematical Proof of Geometric Programming for Single Variable Unconstrained Optimization (with zero degree of difficulty). Example Problem. Example of a Difficult Expression of $y^*$ (containing a negative number raised to a negative non-integer): How to get around the problem?


**Lec #39:** Genetic Algorithm: Fundamentals.

**Lec # 40-41:** Special Topics (Suggested): 1. Optimization of Performance of a Power Cycle based on Exergy Analysis. 2. Any other topic of the instructor’s choice.

**Textbooks**