

Materials Selection and Design

1. The Design Process

- The Role of the Materials Engineer in Design
- Overview of the Design Process
- Conceptual and Configuration Design of Products and Assemblies
- Conceptual and Configuration Design of Parts
- Creative Concept Development
- Cross-Functional Design Teams

2. Criteria and Concepts in Design

- Concurrent Engineering
- Designing to Codes and Standards
- Statistical Aspects of Design
- Reliability in Design
- Life-Cycle Engineering and Design
- Design for Quality
- Robust Design
- Risk and Hazard Analysis in Design
- Human Factors in Design
- Environmental Aspects of Design
- Safety in Design
- Products Liability and Design

3. Design Tools

- Computer-Aided Design
- Mechanism Dynamics and Simulation
- Finite Element Analysis
- Computational Fluid Dynamics
- Computer-Aided Electrical/Electronic Design
- Design Optimization
- Dimensional Management and Tolerance Analysis
- Documenting and Communicating the Design
- Rapid Prototyping

4. The Materials Selection Process

- Overview of the Materials Selection Process
- Techno-Economic Issues in Materials Selection
- Material Property Charts
- Performance Indices

Decision Matrices in Materials Selection
Relationship between Materials Selection and Processing
Computer-Aided Materials Selection
Value Analysis in Materials Selection and Design
Use of Failure Analysis in Materials Selection

5. Effects of Composition, Processing, and Structure

On Materials Properties

Introduction to the Effects of Composition, Processing, and Structure on Materials Properties
Fundamental Structure-Property Relationships in Engineering Materials
Effects of Composition, Processing, and Structure on Properties of Irons and Steels
Effects of Composition, Processing, and Structure on Properties of Nonferrous Alloys
Effects of Composition, Processing, and Structure on Properties of Ceramics and Glasses
Effects of Composition, Processing, and Structure on Properties of Engineering Plastics
Effects of Composition, Processing, and Structure on Properties of Composites
Effects of Surface Treatments on Materials Performance
Sources of Materials Property Data and Information

6. Properties versus Performance of Materials

Properties Needed for the Design of Static Structures
Design for Fatigue Resistance
Design for Fracture Toughness
Design for Corrosion Resistance
Design for High-Temperature Applications
Design for Oxidation Resistance
Design for Wear Resistance
Properties Needed for Electronic and Magnetic Applications
Design with Brittle Materials
Design with Plastics
Design with Composites

7. Manufacturing Aspects of Design

Introduction to Manufacturing and Design
Design for Manufacture and Assembly
Manufacturing Processes and Their Selection
Modeling of Manufacturing Processes

Manufacturing Cost Estimating
Design for Casting
Design for Deformation Processes
Design for Powder Metallurgy
Design for Machining
Design for Joining
Design for Heat Treatment
Design for Ceramic Processing
Design for Plastics Processing
Design for Composite Manufacture
Control of Residual Stresses
Design for Surface Finishing