

**Automotive Product Design/Development using Engineering Plastics**

CME 3098 (1.6 CEUs)

**Objective**

The objective of this course is to introduce the students various aspect of technology that is required for successful plastics product development for automotive and other industrial applications that require structural integrity.

**Description**

The course prepares automotive engineers practical knowledge for successful design/development of automotive components maximizing potential benefits of high performance engineering plastics. It starts with fundamentals on plastics materials and its properties under various thermal, mechanical and service environments. Basic concept of plastics design principles will be covered, based mostly on mechanics of material. It continues to prepared students with basic understanding of various plastic processing methods, with major emphasis on injection molding. Non-uniform, anisotropic properties induced during injection molding process will be discussed and also the implications to design engineers explored. The course will also cover joining technology such as various welding process, mechanical fasteners, snap fits and adhesives. Finally, some practical design tips based on product development experience will be shared. Throughout the course the students will learn various principles and theories through practical applications examples, such as powertrain components, interior components and exterior components using engineering plastics.

**Topics**

1. Plastics Material
  - a. Plastics materials in the market
  - b. Design Considerations of Plastics as compared to Metals
  - c. Chemical and Physical Elements of Plastics (Poly-mer, Morphology of polymeric solids)
  - e. Classification of Plastics Materials
2. Properties of Engineering Plastics
  - a. Standard Properties- Single Point Datasheet
  - b. Multi-Point Properties:
    - Impact, Fracture Toughness
    - Creep, Stress Relaxation
    - Fatigue
    - Long-Term Strength
    - Temperature Dependence
    - Aging
    - Environment: Chemical, Moisture, Radiation
    - Miscellaneous: Complex modulus, damping, Friction and Wear, NVH
3. Structural Consideration of Materials
  - a. Basic Concepts on mechanics of materials
  - b. Stress Concentration
  - c. Stiffness Design, Rib Design
  - d. Dynamic Stress, Impact Loading
  - e. Vibration, resonance
  - f. Application of CAE for design
4. Processing of Plastics Material
  - a. Various Polymer Processing: Rotation Molding, Compression Molding, Rotation Molding, Injection molding, co-injection molding, in-mold compounding, die-slide molding , Thermoforming, Extrusion, co-extrusion , Blow Molding, suction-blow molding
  - b. Injection Molding

- Injection Molding Process Parameter
  - Injection Molding Tools
  - Injection Molding Issues: Knit line, Flash, Fiber orientation, Regrind, Warpage, Surface Quality, Sink Marks and ‘Ghost’ marks, Thickness variation, Flow balancing, melt flipper
  - CAE Correlations
  - Machine Size selection
  - Variations of Injection Molding Process: Gas-Assisted, Water Injection, Mucell, In-mold paint, die-slide, injection compression
5. Joining Plastics Materials
- a. Frictional Heat Welding: Vibration, IR-Assisted Vibration Welding, Ultrasonic, Spinwelding
  - b. Laser Welding, IR-Assisted Laserwelding
  - c. Infra-Red (IR) welding, Infra-Stake<sup>®</sup> Welding
  - d. EMABOND
  - e. Snap Fit
  - f. Mechanical Assembly
  - g. Adhesives
6. Miscellaneous topics:
- a. Rapid Prototype
  - b. NDT
  - c. Failure Analysis
  - d. Chrome Plating (adhesion) and Painting (Surface Treatment, Charge Buildup, Moisture of molded parts)
  - f. Static Charge Buildup: Gas pipe
  - g. Strategy of managing Warpage
  - h. Thermal Expansion failure- License plate frame failure
  - g. Part Cost Estimate
7. Design Validation Testing

**Prerequisite**

Basic knowledge of material science and mechanics of material recommended.

**Course Material**

Provided by instructor

**Instructor**

Dr. Chul S. Lee, Application Technology Leader, BASF

Adjunct Instructor, Engineering Professional Development, College of Engineering & Computer Science, University of Michigan-Dearborn

**Target Audience**

This course is intended mainly for automotive engineers, but open to all engineers and scientists who are involved in plastics product development activities.

**Continuing Education Units**

A total of 1.6 CEUs will be awarded to each participant who completes the program. The CEU is a nationally recognized means of tracking non-credit continuing education development. It confirms participation in a structured professional development activity or course work. One CEU is awarded for 10 hours of completed activity or course work. A permanent record of each attendee’s participation is maintained in the Office of the Registrar at the University of Michigan-Dearborn.

**Register**

Engineering Professional Development



Phone: 313-593-0938

Fax: 313-593-4070

URL: <http://www.engin.umd.umich.edu/EPD/seminars.php>

Email: [tceccare@umich.edu](mailto:tceccare@umich.edu)