MFGE 4399 : Polymer Nanocomposites

Course Description

Instructors: Dr. Jitendra Tate, Texas State-San Marcos, RFM 2218, Email:jt31@txstate.edu

Prereqs: Basic undergraduate level of materials science and mechanics of materials background (ENGR 2300 and ENGR 3311)

Textbook: J.H. Koo, *Polymer Nanocomposites: Processing, Characterization, and Applications*, McGraw-Hill, New York (2006) (available from bookstore).

Reference: M.J. Schulz, A.D. Kelkar, and M.J. Sundaresan (eds.), *Nanoengineering of Structural, Functional, and Smart Materials*, CRC Press, Boca Raton, FL (2006).

T.J. Pinnavia and G.W. Beall (eds.), *Polymer-Clay Nanocomposites*, Wiley, New York (2000).

A.B. Morgan and C.A. Wilkie (eds.), *Flame Retardant Polymer Nanocomposites*, Wiley, New York (2007).

C.A. Harper and E.M. Petrie, *Plastics Materials and Processes: A Concise Encyclopedia*, Wiley, New York (2003).

Selective technical papers

Catalog Description:

This is introductory course in polymer nanocomposites that would focus materials, manufacturing methods, characterization, and applications. It will include different types of nanomaterials that are commonly used in modifying the polymer matrix composites. The major thrust would be the challenges in manufacturing low-cost real-life components in industrial applications, commercial success stories, its impact on current established material market, and future directions.

Course Objectives:

Composites materials have made miracles since last four decades in aerospace and aircraft industry. Nanomodified composites are newer materials and are under investigation in many fields including electronics, bio-medical, aerospace, sports, auto, and construction. Today's manufacturing engineer should be aware of these new materials and it is going to open new market for future employment. This interactive course with little lab component will give students an insight of manufacturing challenges.

- To gain an understanding of materials commonly used for nano-modification such as nanoclays, Holloysite nanotubes (HNT™), polyhederal oligomeric silsesquioxane (POSS™), carbon nanotubes, nano-graphene, etc.
- To understand advantages and disadvantages of different thermoplastics and thermoset polymers as matrix materials.

- To study different manufacturing techniques of dispersion of nanoparticles such as sonication, high shear mixing, centrifugal mixer, twin-screw extrusion.
- To study different manufacturing techniques to produce real-life components such as vacuum infusion and injection molding
- To understand characterization techniques of these materials under mechanical (static, fatigue, and impact) and thermal (glass transition temperature) loadings and exposure to fire environments.

Topics Covered:

Week	Topic	Reading Assignment	Instructor
1	Introduction of Polymer Nanocomposites (PNCs)	Chap. 1	Koo
2	An Overview of Nanoparticles	Chap. 1 and 2	Koo
3	Themoplastics, Thermosets, and Elastomers	Notes	Tate
4	Processing of Nanomaterials	Chap. 4	Koo
5	PNCs Characterization-Morphological	Chap. 4	Koo
6	PNCs Characterization-Mechanical	Chap. 4	Tate
7	PNCs Characterization-Thermal (DMA, TMA, TGA, DSC) Project Work Begin in 8th Week	Notes	Londa/Guest
8	PNCs Characterization-Flammability Mid-term Exam	Chap.6	Koo
9	Properties of Polymer Nanostructured Materials	Chap.6	Koo
10	Applications of Polymer Nanostructured Materials-I	Chap.7	Koo
11	Applications of Polymer Nanostructured Materials-II	Chap. 7	Koo
12	Environmental and Safety Issues	Notes	Trybula/Guest
13	Current Status, Trends, & Future Directions	Chap. 8	Tate
14	Research Project Discussions		Koo/Tate

Grading Policy:

- Test#1 25%
- Test#2 20%
- Final 50%
- Class participation 5%

Grading Scale: 90-100 (A), 80-89.9 (B), 70-79.9 (C), 60-69.9 (D), 59.9 or less (F)):

Exams: Mid-term exam will be take home open book and open notes; and final exam will be a comprehensive research term paper.

Dishonesty: Texas State University policy with respect to academic dishonesty will be followed in this course.

Absences:

Absences are not recommended in general. All departmental and University policies on academic integrity and absences apply and should be taken very seriously.

General Policies and Procedures:

1) NO food or drinks are permitted in the classroom.
2) NO smoking or tobacco use of any kind in the lab or classrooms per state law.
3) NO cell phone use during appointed class times.
4) Instructor DOESN'T accept late homework/assignment/project unless there exists legitimate excuses (illness, death in the family, etc.) and adequate documentation is furnished.
5) Instructor DOESN'T give make-up quiz or, test or, project or, homework unless there exists legitimate excuses (illness, death in the family, etc.) and adequate documentation is furnished.
6) Instructor DOESN'T curve grade under any circumstances.

TRACS

7) You must check your emails regularly and also need to visit 'TRACS' for important announcements, due dates, course documents, and assignments.
8) All important presentations will be uploaded on 'TRACS'. These presentations are copyrighted and are only for your convenience. These presentations should not be shared/e-mailed to any students/faculties/staff not related to this course outside or, at Texas State University - San Marcos.
9) It is the student's responsibility to obtain class notes, handout materials, if any, etc. when a scheduled lecture is missed. Most of the course material will be uploaded on TRACS.

Special Needs:

Students with special needs (as documented by the Office for Disability Services) should identify themselves to the instructor at the beginning of the semester so that provisions for accommodation can be made.