

ENFP 671: MATERIAL FLAMMABILITY (3 credits)
SYLLABUS

Class Time & Location: Tuesdays and Thursdays, 12:30 – 1:45 PM, CSI 2118

Instructor: Dr. Stanislav I. Stoliarov, stolia@umd.edu, (301)405-0928

Office Hours: Tuesdays, 10:00 AM – 12:00 PM, JMP 3104C

Objectives: This course introduces students to the science and technology of polymeric materials. Standard methods for assessment of fire hazards associated with these materials are reviewed. Fundamental mechanisms defining polymer combustion in various scenarios are elucidated. Students successfully completed this course will be able to perform a quantitative determination of the impact of selection of a given material on a scenario-specific rate of fire development and use this knowledge to carry out analysis of fire accidents or to make optimum fire protection design decisions.

Prerequisites: Primary courses in calculus, chemistry, thermodynamics, and heat transfer. Fire Dynamics (ENFP 415) and Fire Assessment Methods (ENFP 320) are not required but highly desirable.

Textbooks: There is no textbook for this course. A basic text on polymer science will be helpful but not required.

Format: A block of lectures will be followed by a quiz or a project assignment. Two quizzes and 4 projects are planned. The project assignments will require students to perform research of a given topic or to conduct engineering analysis of a material flammability problem. For each project assignment, the students will submit a written report or make an oral presentation of her/his findings.

Grading: The quizzes will be graded on 5 point scale. The projects will be graded on either 5 or 10 point scale depending on the level of complexity. Active participation in the class discussions will be rewarded with up to 3 additional points.

Attendance and Communications: Regular attendance and participation in lectures and discussions is paramount. Lecture slides and project assignments will be posted online. The project reports should be submitted on paper and be typed. While team studying and brainstorming is highly encouraged, all papers must be prepared individually. It is unacceptable to submit any work that is copied. The papers will be graded and returned to the student.

Special Needs: Anyone having special needs regarding disabilities, schedules, and religious conflicts, please see the instructor in private.

ENFP 629M: MATERIAL FLAMMABILITY COURSE OUTLINE

1. Introduction to Polymers: chemical structure, classification, molar mass, principles of polymerization and processing, ubiquitous polymers.

2. Thermo-mechanical Behavior: glass transition and melting, elastic deformation and viscoelasticity, yield, crazing and fracture, environmental exposure and aging.

3. Introduction to Composite Materials: matrix materials and types of reinforcement, fiber packing and arrangement, nanocomposites.

4. Standard Flammability Tests: from UL-94 to Room Corner, classification, purpose, relation between test outcomes.

5. Chemistry of Polymer Decomposition: typical mechanisms, gaseous products, char formation, kinetics and product yield assessment, condensed-phase-active flame retardant additives, the role of oxygen.

6. Physics of Pyrolysis: modes of heat transfer inside a pyrolyzing solid, energy conservation and mass transport equations, state-of-the-art pyrolysis models, model parameterization and validation.

7. Chemistry of Gas-phase Combustion: kinetics and thermodynamics of combustion, smoke and hazardous species generation, gas-phase-active flame retardant additives.

8. Understanding Flame-Solid Interaction: criteria for surface flame ignition, empirical and CFD-based methodologies for prediction of the flame-to-solid heat transfer, flame spread.