**ISD 559F Vehicle Crashworthiness and Occupant Protection Fall 2018 Syllabus**

**Professor**

 **Contact Information:** Jingwen Hu, PhD

 Research Associate Professor

 University of Michigan Transportation Research Institute

 Department of Mechanical Engineering

 Tel: (734)763-6398

 Email: jwhu@umich.edu

 Website:[sites.google.com/umich.edu/jingwenhu](http://sites.google.com/umich.edu/jingwenhu)

**GSI:**

 **Contact Information:** TBD

**Office Hours:**

 **On-Campus:** By appointment

 **Online:** By appointment

All office hours for distance students will be held via WebEx (Link to course webex site: TBD). Lecture recordings will be released for viewing within 24 hours after each class.

**Course Description:** This course will teach the basics of vehicle crashworthiness and occupant protection along with finite element modeling for vehicle safety designs. Specifically, upon completion of this course, the students should be able to understand the general procedures and state-of-the-art tools to evaluate vehicle crash safety, apply fundamental principles to interpret injury mechanisms, safety concerns, and design benefits in different types of crashes, and assess safety systems using finite element crash simulations. This course will be featured with three projects, including a modeling project, a literature review project, and a group project on vehicle crash safety designs.

**Prerequisites:** No prerequisite is required for this course. However, basic knowledge of finite element analysis is recommended.

**Learning objectives:** As a result of this course, students will be able to:

* Recall major regulated and consumer-information crash testing procedures
* List common injuries in different types of motor-vehicle crashes
* Name major crash-injury databases and associated contents
* Describe principles of crash energy management and occupant protection
* Interpret principles of occupant protection with restraint systems
* Review injury assessment tools and injury risk estimations for crash tests
* Classify mechanisms of different injuries to the head, neck, chest, and lower extremities
* Examine energy-absorbing capability of simple structures through finite element modeling
* Compare safety concerns for various vulnerable populations
* Assess safety systems that may benefit a wide range of special conditions (e.g. automated vehicles, oblique impacts, and occupant variability) through finite element modeling
* As a student-proposed group design project, formulate potential safety design concepts

**Required Textbook & Materials**

* Accidental Injury: Biomechanics and Prevention, 3rd edition, edited by Narayan Yoganandan, Alan M. Nahum, and John W. Melvin. (digital copy available at UM)
* Vehicle Crashworthiness and Occupant Protection, edited by Priya Prasad and Jamel E. Belwafa. (free download)

**ISD Software Access Policy**

This course requires that you have access to HyperMesh, LS-DYNA, and LS-PREPOST. Historically, access issues are most common for online students and for any non-College of Engineering students. Here are the instructions for accessing the CAEN lab software:

<https://sites.google.com/a/umich.edu/isd-public/remotesoftware/connecting-to-caen-remote-software-with-webclient>

It is critical that you are able to log in to this software successfully PRIOR to your homework submission. As such, we require that all online students submit a screenshot documenting your access to HyperMesh, LS-DYNA, and LS-PREPOST. This assignment will be counted toward your course participation grade and is September 13, 2018.

If you have any issue connecting to the software, please contact isd-instructionalsupport@umich.edu and copy your instructor on the message.

**Grade Distribution**

|  |  |
| --- | --- |
| Participation | 5% |
| Project I | 15% |
| Project II | 20% |
| Project III | 30% |
| Final Exam | 30% |
| Total | 100% |

**Grading Scale**

This course follows a standard ISD grading scale of A, B, C, D, and E.  Grades will be assigned as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| A+ 97-100 | B+ 87-89 | C+ 77-79 | D+ 67-69 | E 59 and below |
| A 93-96 | B 83-86 | C 73-76 | D 63-66 |  |
| A- 90-92 | B- 80-82 | C- 70-72 | D- 60-62 |  |

The minimum grade ranges may be adjusted based on class performance.

**Attendance Policy**

Physical attendance of the course lectures is required for all on-campus students, which will be counted in the grade (5%). Explanation has to be provided in advance for missing a lecture.

**Make-up and Late Work Policy**

I recognize some students are working full time and travel schedules may create difficulties. Notification and proper justification should be provided in advance for missing the due dates.

**Accessibility**

ISD faculty are committed to ensuring equal access to learning for students with disabilities. The University of Michigan SSD Office provides accommodations and services free of charge to students that register. Depending on the type and severity of the disability, the SSD Office makes every effort to provide the appropriate accommodation for academic success. Registered SSD students can arrange to receive services through their disability coordinator.

<https://ssd.umich.edu/topic/our-services>

**The College of Engineering Honor Code**

All students in the class are presumed to be decent and honorable, and all students in the class are bound by the College of Engineering Honor Code. You may not seek to gain an unfair advantage over your fellow students; you may not consult, look at, or possess the unpublished work of another without their permission; and you must appropriately acknowledge your use of another's work. Any violation of the honor policies appropriate to each piece of coursework will be reported to the Honor Council, and if guilt is established penalties may be imposed by the Honor Council and Faculty Committee on Discipline. Such penalties can include, but are not limited to, letter grade deductions or expulsion from the University. As your course instructor, I reserve the right for additional deductions of points for anyone found guilty of an honor code violation.

**Homework Assignments:** You may discuss individual homework/project assignment with your fellow students at the conceptual level, but must complete all calculations and write-up, from scrap to final form, on your own. Verbatim copying of another student's work is forbidden. You may not consult homework solutions from a previous term unless they are made available in a publicly accessible form. All group work is to be completed only within your own group. Your group can receive help **only** from the course instructors. At no time may you receive help from someone who is not a current instructor. You cannot speak with other groups about the problems, conceptually or otherwise, and you may not at any time look at, borrow, or possess another group's work.

**Class Schedule:** Subject to change

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Week** | **Date** | **Topic** | **Assignment** | **Assignment Due** |
| Week 1 | 9/4/2018 | Crash Safety Overview |  |  |
| 9/6/2018 | Crash Simulation Overview |  |  |
| Week 2 | 9/11/2018 | Finite Element Crash Simulations I |  |  |
| 9/13/2018 | Finite Element Crash Simulations II | Project I (modeling) |  |
| Week 3 | 9/18/2018 | UMTRI lab tour – Crash testing facility |  |  |
| 9/20/2018 | Injury definitions - AIS |  |  |
| Week 4 | 9/25/2018 | Vehicle crash field data |  |  |
| 9/27/2018 | Vehicle crash safety regulations |  |  |
| Week 5 | 10/2/2018 | Vehicle structures and crash energy management | Project II (Literature review) | Project I |
| 10/4/2018 | Crash Dummy and Injury Risk Assessment |  |  |
| Week 6 | 10/9/2018 | Occupant restraint system I |  |  |
| 10/11/2018 | Occupant restraint system II |  |  |
| Week 7 | 10/16/2018 | Fall Study Break |  |  |
| 10/18/2018 | Finite Element Crash Simulation III |  |  |
| Week 8 | 10/23/2018 | Rollover crash |  |  |
| 10/25/2018 | Project II presentations | Project III | Project II |
| Week 9 | 10/30/2018 | Basic injury biomechanics - head |  |  |
| 11/1/2018 | Basic injury biomechanics - Neck |  |  |
| Week 10 | 11/6/2018 | Basic injury biomechanics - Chest |  | - |
| 11/8/2018 | Basic injury biomechanics – Lower extremities |  |  |
| Week 11 | 11/13/2018 | Child Passenger Safety |  |  |
| 11/15/2018 | Pedestrian Safety |  |  |
| Thanksgiving | 11/20/2018 | Project III progress with Q&A |  |  |
| 11/22/2018 | --- | --- | --- |
| Week 12 | 11/27/2018 | Rear-seat occupant protection |  |  |
| 11/29/2018 | Parametric human modeling |  |  |
| Week 13 | 12/4/2018 | Oblique frontal impact |  |  |
| 12/6/2018 | Final project presentations |  |  |
| Week 14 | 12/11/2018 | Final project presentations |  | Project III |
| 12/13/2018 | Final Exam |  |  |