

# AUTOMOTIVE SYSTEMS AND MOBILITY

The Doctor of Engineering (D.Eng.) in Automotive Systems and Mobility (ASM), centers on engineering practice and application, problem-solving skills, and innovation to prepare graduates for technical leadership roles in the automotive and mobility industry.

The D.Eng. encourages doctoral students to conduct cutting edge research using emerging technologies in the broad areas of automotive engineering and mobility. It is a multidisciplinary program with core research areas in Automotive Cybersecurity; Advanced Simulation; Human Factors & Transportation Systems Safety; Connected and Autonomous Vehicles; Dynamics, Control & Vehicle Safety; Electrified Vehicles; Materials, Manufacturing, & Design; Shared Mobility; Thermal-Fluid & Combustion; and Data Analytics in Automotive & Mobility.

GRE is not required for admission.

## Program Details

The D.Eng. degree requirements require a minimum of 36 credits hours including 6 credit hours of coursework, 6 credit hours of directed study and pre-candidate research courses, and 24 credit hours of dissertation research.

## Program Policies

In addition to the UM-Dearborn Graduate School policies for doctoral students, as a doctoral student in ASM program, you need to know the requirements, timeline, and processes for Pre-candidacy, Candidacy, Proposal Exam, and eventually your Dissertation Defense.

Also, an Annual Progress Report completed by you and your faculty advisor must be submitted for review to the ASM Doctoral Committee in May of each year.

The ASM Doctoral Committee and your Faculty Advisor are the main resources for information and guidance throughout your program.

## Curriculum Requirements

A student must complete a minimum of 36 credit hours including:

- 6 credit hours of coursework
- 6 credit hours of directed study and pre-candidate research courses
- 24 credit hours of dissertation research.

## Pre-Candidacy Coursework Requirement

The program requires completion of:

- Two curricular qualifying courses with a combined GPA of 3.5/4.0 and 3.3/4.0 or better in each course
  - The two graduate courses should be chosen to support the student's academic and research development, as recommended by the advisor.
- ASM 791 Doctoral Directed Study
- ASM 980 Pre-Candidate Dissertation Research

## Core Research Areas and Suggested Courses

**Note: The following course list is provided as guidance and is not comprehensive.**

### Automotive Cybersecurity

Code	Title	Credit Hours
CIS 540	Foundation of Information Security	3
CIS 544	Computer and Network Security	3
CIS 545	Data Security and Privacy	3
CIS 546	Security and Privacy in Wireless Networks	3
CIS 548	Security and Privacy in Cloud Computing	3
CIS 549	Software Security	3
CIS 584	Advanced Computer and Network Security	3
CIS 624	Research Advances in Computer and Network Security	3
ECE 527	Multimedia Secur & Forensics	3
ECE 528	Cloud Computing	3
ECE 554	Embedded Systems	3

### Advanced Simulation, Human Factors and Transportation Systems Safety

Code	Title	Credit Hours
CIS 552	Information Visualization with Parallel Computing	3
CIS 652	Advanced Information Visualization and Virtualization	3
HCDE 510	Foundation of HCDE	3
HCDE 520	Research Methods in HCDE	3
HCDE 530	Information Visualization	3
IMSE 501	Human Factors & Ergonomics	3
IMSE 514	Multivariate Statistics	3
IMSE 545	Vehicle Ergonomics I	3
IMSE 546	Safety Engineering	3
IMSE 569	Sys Simulation in Auto Engin	3
IMSE 577	Human-Computer Interaction	3
IMSE 593	Vehicle Package Engineering	3
IMSE 659	Advanced System Simulation	3

### Connected and Autonomous Vehicles

Code	Title	Credit Hours
AENG 564	Autonomous Vehicle Perception	3
CIS 527	Computer Networks	3
CIS 535	Wireless Technologies and Pervasive Computing	3
CIS 537	Advanced Networking and Distributed Systems	3
CIS 579	Artificial Intelligence	3
CIS 585	Advanced Artificial Intelligence	3
CIS 647	Research Advances in Networking and Distributed Systems	3
CIS 685	Research Advances in Artificial Intelligence	3
ECE 527	Multimedia Secur & Forensics	3
ECE 531	Intelligent Vehicle Systems	3
ECE 536	All Weather Automotive Vision	3
ECE 543	Kinem, Dynam Control Robots	3
ECE 544	Mobile Robots	3
ECE 560	Modern Control Theory	3

ECE 5702	High-Speed and Adv Networks	3	IMSE 519	Quan Meth in Quality Engin	3
ECE 577	Engineering in Virtual World	3	IMSE 538	Intelligent Manufacturing	3
ECE 586	Digital Image Processing	3	IMSE 561	Tot Qual Mgmt and Six Sigma	3
ECE 612	Wireless Sensor Networks	3	IMSE 5655	Supply Chain Management	3
ECE 642	Robotic Embed Sys	3	IMSE 567	Reliability Analysis	3
ECE 644	Advanced Robotics	3	IMSE 580	Prod & Oper Engineering I	3
ECE 645	Coop Robots	3	IMSE 581	Prod & Oper Engineering II	3
ECE 650	Info Theory in Elec Comm	3	IMSE 593	Vehicle Package Engineering	3
ECE 661	Sys Ident and Adaptive Control	3	ME 514	Advanced Mechanics of Materials	3
ECE 679	Adv Intelligent Sys	3	ME 558	Fracture and Fatigue Considerations in Design	3

## Dynamics, Control and Vehicle Safety

Code	Title	Credit Hours
AENG 502	Modeling of Automotive Systems	3
AENG 547	Automotive Powertrains I	3
AENG 555	Vehicle Stability & Control	3
ECE 515	Vehicle Electronics II	3
ECE 532	Auto Sensors and Actuators	3
ECE 552	Fuzzy Systems	3
ECE 560	Modern Control Theory	3
ECE 565	Digital Control Systems	3
ECE 567	Nonlinear Control Systems	3
ME 540	Mechanical Vibrations	3
ME 542	Advanced Dynamics	3
ME 543	Vehicle Dynamics	3
ME 548	Automotive Powertrains II	3

## Electrified Vehicles

Code	Title	Credit Hours
AENG 598	Energy Sys for Auto Vehicles	3
ECE 515	Vehicle Electronics II	3
ECE 517	Adv Pwr Electrncs&Motor Drvs	3
ECE 519	Adv Topics in EMC	3
ECE 532	Auto Sensors and Actuators	3
ECE 5462	Elec Aspects of Hybrid Vehicle	3
ECE 5791	Vehicle Power Management	3
ECE 646	Adv Elec Drive Transportation	3
ESE 502	Energy Storage Systems	3

## Materials, Manufacturing, and Design

Code	Title	Credit Hours
AENG 545	Vehicle Ergonomics I	3
AENG 550	Design of Automotive Chassis	3
AENG 586	Design & Mfg: Ltwt Auto Mat	3
AENG 589	Auto Assembly Systems	3
AENG 650	Analysis and Design for Vehicle Crashworthiness	3
ECE 539	Production of Elec Prods	3
IMSE 502	Computer-Integrated Mfg	3
IMSE 504	Metal Forming Processes	3

ME 582	Injection Molding	3
ME 583	Mechanical Behavior of Materials	3
ME 584	Mechanical Behavior of Polymer	3
ME 587	Automotive Composites	3
ME 589	Composite Materials	3

## Shared Mobility

Code	Title	Credit Hours
IMSE 500	Models of Oper Research	3
IMSE 505	Optimization	3
IMSE 514	Multivariate Statistics	3
IMSE 559	System Simulation	3
IMSE 5655	Supply Chain Management	3
IMSE 567	Reliability Analysis	3
IMSE 584	Logistical Systems	3
IMSE 605	Advanced Optimization	3
IMSE 606	Advanced Stochastic Processes	3

## Thermal-Fluid Combustion

Code	Title	Credit Hours
ME 522	Advanced Fluid Mechanics	3
ME 525	Computational Fluid Mechanics and Heat Transfer	3
ME 532	Combustion Processes	3
ME 535	Advanced Thermodynamics	3
ME 537	Automotive Air Conditioning	3
ME 538	Vehicle Thermal Management	3
ME 545	Acoustics and Noise Control	3
ME 571	Conduction Heat Transfer	3
ME 572	Convection Heat Transfer	3
ME 596	Internal Combustion Engines I	3
ME 597	Internal Combustion Engines II	3
ME 598	Engine Emissions	3
ME 622	Advanced Topics in Fluid Mechanics	3

## Data Analytics in Automotive Mobility

Code	Title	Credit Hours
CIS 511	Introduction to Natural Language Processing	3
CIS 536	Text Mining and Information Retrieval	3
CIS 556	Database Systems	3

CIS 5570	Introduction to Big Data	3
CIS 568	Data Mining	3
CIS 5700	Advanced Data Mining	3
CIS 571	Web Services	3
CIS 580	Data Analytics in Software Engineering	3
CIS 586	Advanced Data Management	3
ECE 537	Data Mining	3
ECE 576	Information Engineering	3
IMSE 586	Big Data Aanal & Visuliztn	3
ECE 579	Intelligent Systems	3

## Early Start Requirements

The students are expected to engage in research work from the first year of the program. To facilitate that, each student should have a faculty research advisor at the beginning of the first semester and develop the dissertation research topic with the faculty advisor by the end of the second semester in the program. There is an additional requirement that at least 6 credit hours of faculty-guided research (ASM 791 or ASM 980) be completed within the first year of enrollment in the program. In the first semester, all students need to take the ASM 791 (Doctoral Direct Study) and the second semester the ASM 980 (Pre-candidate Dissertation Research).

## Research Maintenance Requirements

- ASM 990 (Dissertation for candidates) can be taken only after a student achieves candidacy. A minimum of 24 credit hours in ASM 990 is required.
- During the candidacy, a student enrolls in ASM 990 every semester. The outcomes of ASM 990 include a written dissertation research progress report, a presentation of research results to the dissertation committee. A "S" or "U" grade will be given by the adviser based on the student's performances in research. Any "U" grade will be reviewed by the committee and a written plan will be provided to the student about what is needed to improve dissertation research. The metric to measure a student's progress includes, but not limited to, regular meetings with the adviser, good quality research progress reports, publications, patent applications, prototype system demos, and well-recognized open-source programs. The faculty advisor notifies ASM committee about the student's progress in each semester.
- A Student must register to ASM 791, ASM 980 or ASM 990 must arrange meetings with the faculty advisors at least twice per month for mentoring by the advisor.

## Dissertation Committee

The dissertation committee is formed when a student takes ASM 980. As a rule, the dissertation committee continues overseeing the student's work to the stage of the final dissertation defense.

- The faculty advisor serves as the chair of the Dissertation Committee.
- The dissertation committee will consist of a minimum of three members in addition to the committee chair. The committee members will include two faculty members (at least one member from the CECS) and one industry member.
- The composition of the dissertation committee must be approved by the D. Eng. program committee. The industry member's curriculum vitae must be submitted to the Program Committee for approval.
- Depending on the dissertation topic, a faculty member outside the CECS may be included in the dissertation committee.

- A committee may have a sole chair or two co-chairs. Persons who may serve as co-chair, but not the sole chair, include:
  - tenure or tenure-track members of the University's instructional faculty;
  - research faculty;
  - instructors and lecturers;
  - similarly qualified University faculty or staff, or person from outside the University; and
  - former University faculty members who have moved to a faculty position at another university

## Candidacy Requirements

Achieving candidacy for the D. Eng. in ASM requires:

- Completion of two curricular qualification courses and maintain a combined GPA of 3.5/4.0 and 3.3/4.0 or better for each course
- Completion of all the required outcomes of ASM 980
- Submission of the candidacy application form
- Approved Doctoral Dissertation Committee

## Dissertation

After passing ASM 980, the student may proceed with the dissertation research and the writing of the dissertation. The dissertation should document the original contributions made by the candidate as a result of independent research. This research work should be of archival quality. In advance of graduation, all members of the student's dissertation committee must approve the dissertation. To obtain this approval a student must submit a written copy of the dissertation to the dissertation committee and defend the research work at a final oral examination open to other faculty, students, and the interested public. Students defending the dissertation must be registered in ASM 990.

Upon completion of the dissertation work, the student initiates the last step toward the degree—the dissertation defense process. The process follows the official guidelines and consists of the following main stages:

- Preparation of a written dissertation formatted in accordance with the guidelines,
- Pre-Defense meetings with the members of the program committee,
- Written evaluations of the dissertation by the dissertation committee members
- The Oral Defense of the dissertation consisting of two parts:
  - Public seminar and open question session held by the student
  - Private deliberations by the committee,
- Final oral examination report and certificate of approval prepared by the dissertation committee
- Post-Defense meeting with the CECS Graduate Education Office

## Timeline Requirements

The D. Eng. ASM program has a time limit of 3 years for completion. Students are expected to complete the degree within 2 years after achieving candidacy, but no more than 3 years from the date of the first enrollment in the program.

All D. Eng. ASM students are required to register for either the program's coursework or dissertation credits every fall and winter semester unless they are on an approved leave of absence. Students may request a leave of absence when certain life events prevent continued active participation in their degree program. Students may request a leave of absence as early as six months prior to the term the leave is to start. A leave will

be granted to students for illness (either physical or mental) or injury, to enable them to provide care or assistance for family or dependents, to allow them to meet military service obligations, or for other personal reasons. The student's request for a leave of absence will need the approval by the CECS Doctoral Program Committee.

A student is considered to have completed the D. Eng. ASM program only if the student has completed the two required courses with satisfactory grades and the required research credit hours, passed the dissertation defense and got a satisfactory grade on the written dissertation. A petition for an extension of study time may be submitted by the student with the endorsement of student's dissertation advisor to the committee of D. Eng. in ASM for approval. The time extension will be no more than 2 years. Table 2.2 is an example of curriculum.

**ASM 791 Doctoral Directed Study 1 to 6 Credit Hours**

Independent study and research work on the material related to the doctoral research project under the guidance of the faculty advisor. A report and an oral presentation are required. Required outcomes include well-defined research topic/objective/technical approach and in-depth literature review. (F, S, W).

**Restriction(s):**

Can enroll if Level is Doctorate

Can enroll if College is Engineering and Computer Science

Can enroll if Major is

**ASM 980 Pre-Candidate Dissertation Research 1 to 9 Credit Hours**

Dissertation work by a pre-candidate student in the Automotive Systems and Mobility program conducted under guidance of the faculty advisor. (F, S, W).

**Restriction(s):**

Can enroll if Level is Doctorate

Can enroll if College is Engineering and Computer Science

Can enroll if Major is

**ASM 990 Doctoral Dissertation 1 to 12 Credit Hours**

Dissertation work by a student of the D.Eng. program in Automotive Systems and Mobility conducted under guidance of the faculty advisor. The student must be admitted to D.Eng. candidacy status. (F, S, W).

**Restriction(s):**

Can enroll if Level is Doctorate

Can enroll if College is Engineering and Computer Science

Can enroll if Major is