

The Ohio State University
College of Engineering
Department of Mechanical and Aerospace Engineering
Robotics and Autonomous Systems (ROBOTAS-MN)

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Robotics and Autonomous Systems (RAS) is believed to be one of the transformative technologies for several key fields including healthcare, manufacturing and public safety in the United States. As we know, restructuring of U.S. manufacturing is essential to the future of economic growth and the creation of new jobs and ensuring competitiveness of U.S. industries. Resurgence of RAS has been fueled by recent advances in fast, mobile, computing, artificial intelligence, and machine learning. However, due to a shortfall of investment in robotics research in the past decades, the US is losing leadership in this area. As a result, industry has found difficulty in hiring high quality employees in the robotics and automation field.

The main objectives of the RAS minor program are: (1) exposing students to RAS engineering subjects ranging from design, analysis, control, interaction and operation; (2) equipping students with an understanding of the RAS engineering fundamentals and basic research skills needed to succeed in R&D for the automation, healthcare and manufacturing industries; (3) promoting student interest in a career path in automation, manufacturing and healthcare in which RAS technologies play a central role; (4) producing a high quality work force that is essential to revitalize manufacturing in the United States.

Required Prerequisites (5-8 courses; 20-31 CH) The RAS minor requires prerequisite coursework in calculus, advanced mathematics (linear algebra and differential equations), physics, and engineering:

1. Complete **one** of the following calculus sequences:
 - a) MATH 1151 (~~-or-~~ 1156 ~~-or-~~ 1140 & 1141) and 1172
 - b) MATH 1151 (~~-or-~~ 1156 ~~-or-~~ 1140 & 1141), 1152 and 2153
 - c) MATH 1161.xx and 2162.xx
 - d) MATH 1181H and 2182H
 - e) MATH 4181H and 4182H
2. Complete **one** of the following advanced mathematics options:
 - a) MATH 2174
 - b) MATH 2177
 - c) MATH 2415 ~~-and-~~ 2568(H)
3. Complete **one** of the following physics courses:
 - a) PHYSICS 1250(H)
 - b) PHYSICS 1260
4. Complete **one** of the following engineering courses:
 - a) ENGR 1221
 - b) CSE 1222
 - c) ENGR 1281.01H

Required course (1 course; 3 CH)

MECHENG/ECE 5463 - Introduction to Real Time Robotics Systems

Elective courses (3 courses; 9 CH)

Choose 3 courses (9 CH) from the list below. Many of the courses listed have prerequisites beyond those required for the minor; please consult the Course Catalog before enrolling.

AEROENG 5620 - Stability and Control of Flight Vehicles
AEROENG 5621 - Guidance, Navigation and Control of Aerospace Vehicles
CSE 3521 - Survey of Artificial Intelligence I: Basic Techniques
CSE 5052 - Survey of Artificial Intelligence for Non-Majors
CSE 5524 - Computer Vision for Human-Computer Interaction
ECE 3551 - Introduction to Feedback Control Systems
ECE 4194.02 - Group study in machine learning
ECE 5200 - Introduction to Digital Signal Processing
ECE 5553 - Autonomy in Vehicles
ISE 5520 - Industrial Automation
ISE 5525 - Industrial Robotics

ISE 5740 - Cognitive Engineering Systems: Human-Centered Automation
ISE 5760 - Visual Analytics for Sensemaking
MECHENG 5194 - Smart Product Design
MECHENG 5372 - Design and Control of Mechatronics Systems
MECHENG 5751 - Design & Manufacturing of Compliant Mechanisms & Robots
MECHENG 5775 - Machine Learning for Engineers

Please Note: With the permission of the Department of Mechanical and Aerospace Engineering, up to six hours of research credit with tangible components of robot and automation systems from selected units (AEROENG, CSE, ECE, ISE and MECHENG 4998(.xx)(H) and/or 4999(.xx)(H)) may be applied to the minor's elective requirements. Please fill out the RAS Minor Research Project form, available on the [Robotics and Autonomous Systems minor website](#), to request permission.

Robotics and Autonomous Systems minor program guidelines:

Credit Hours Required A minimum of 12 credit hrs. 1000 level courses shall not be counted in the minor. At least 6 CH must be upper-level courses as defined by the College of Engineering

Transfer and EM Credit Hours Allowed A student is permitted to count up to 6 total hours of transfer credit and/or credit by examination toward the minor.

Overlap with the GE A student is permitted to overlap up to 6 credit hours between the GE and the minor

Overlap with the Major and Additional Minor(s)

- The minor must be in a different subject than the major.
- The minor must contain a minimum of 12 hours distinct from the major and/or additional minors.

Grades Required

- Minimum C- for a course to be listed on the minor.
- Minimum 2.00 cumulative point-hour ratio required for the minor.
- Course work graded Pass/Non-Pass cannot count on the minor.
- No more than 3 credit hours of course work graded Satisfactory/Unsatisfactory may count towards the minor.

Declaring the minor

Students should see their assigned academic advisor to declare the minor prior to the filing of the graduation application. Students do not need the approval of the Department of Mechanical and Aerospace Engineering to declare the minor.

Approval of Coursework

Initial approval of the minor coursework:

Students who complete the minor following the guidelines on this sheet need only verify with their academic advisor that the minor appears complete on the degree auditing system. No approval from the Department of Mechanical and Aerospace Engineering is required.

Approval for courses not listed on this form to apply to the minor program:

Students must obtain the approval of the Department of Mechanical and Aerospace Engineering to apply courses not listed on this form toward the Robotics and Autonomous Systems minor. Please email Dr. Haijun Su (su.298@osu.edu) to request approval.

College of Arts and Sciences Curriculum and Assessment Services
306 Dulles Hall, 230 Annie and John Glenn Ave
<http://artsandsciences.osu.edu>

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