Automation in Production
EIN 4905 or EML4905

Class Periods: 2 days a week, 1hr + 2hrs
Monday 9:50am – 10:40am, + Lab Time (scheduled by group)

Credits: 3

Locations:
Lecture: MAE-C Room 010
Lab: MAE-C Room 010A / 002

Academic Term: Spring 2023

Instructor:
Dr. Sean Niemi      Dr. Katie Basinger-Ellis
Email Address: srn@mae.ufl.edu   Email Address: katie.basinger@ufl.edu
Office Phone: (352) 294-3381    Office Phone: (352) 294-7730
Office Hours: TBD            Office Hours: TBD

Teaching Assistants/Peer Mentors/Supervised Teaching Students:
Please contact through the Canvas website
- Andrea Camacho-Betancourt
  o andreacamachobet@ufl.edu
- James Sanchez
  o jsanchez2@ufl.edu

Course Description
Students will learn how to design for and program parts using CNC machining. Students will be able to design a part to meet specifications using Fusion 360, program the code for machining (Computer Aided Manufacturing), and operate a CNC machine to make the part. This course includes 1 hour of lecture, and 2 hours of lab time each week. Lab times are individual to the lab team and will have an instructor present.

Course Pre-Requisites / Co-Requisites
Due to the low course enrollment size, Drs. Basinger-Ellis and Niemi will be selecting a cohort of students from applicants.
MAE Students: EML2023, a grade of A- or better in EML2322L, 4EG classification
ISE Students: CAD with Solidworks or Fusion360 (no exceptions), co-req EIN4451 or EIN4360

Course Objectives
- Understand and apply fundamentals of component design for subtractive and additive manufacturing with a focus on multi-axis CNC manufacturing
- Apply tooling/tool/toolpath selection to program G-Code for designed parts
- Learn the fundamentals of operation for 3, 4, and 5-axis CNC machines
- Summarize additive manufacturing methods and its comparability with traditional manufacturing

Materials and Supply Fees
All supplies will be provided through funding from the IACMI – The Composites Institute and a generous donation from Autodesk Inc.
### Relation to Program Outcomes (ABET):

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Coverage*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics</td>
<td>Medium</td>
</tr>
<tr>
<td>2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors</td>
<td>High</td>
</tr>
<tr>
<td>3. An ability to communicate effectively with a range of audiences</td>
<td></td>
</tr>
<tr>
<td>4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts</td>
<td></td>
</tr>
<tr>
<td>5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives</td>
<td>High</td>
</tr>
<tr>
<td>6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions</td>
<td></td>
</tr>
<tr>
<td>7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies</td>
<td>Medium</td>
</tr>
</tbody>
</table>

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

### Required Textbooks and Software
- **Autodesk Fusion360** will be the primary CAD/CAM software used. Fusion360 is free for students with a "*.edu" email address. It is compatible on Mac or PC and has a web-browser version.
- **Microsoft Teams** will be used as the primary communication tool for this course. Use of GroupMe or text messaging is highly discouraged.

### Recommended Materials
- **Cutting Tool Applications** by George Schneider Jr., CMfgE (available for free via download)
## Course Schedule

<table>
<thead>
<tr>
<th>Lab #</th>
<th>Week</th>
<th>Lecture Topic</th>
<th>Lab Activity</th>
<th>Assignments (Due on Fri of the week)</th>
</tr>
</thead>
</table>
| 1     | 1/9   | **Course Intro Safety**  
Introduce Air Engine                                                                 | NO LABS - SCHEDULE  
TBA                                                                                  | ACE Online Course                     |
| 2     | 1/16  | **HOLIDAY VIDEO LECTURE: INTRO TO MACHINING**                                  | Machine interface overview:  
Hand jogging  
Tool probing  
Part probing  
Running a program                                  | CAM Base Component                     |
| 3     | 1/23  | **G-Code**                                                                      | Simulate Base Component  
Machine Base Component                                                                 | CAM Piston Block                       |
| 4     | 1/30  | **Work Holding, Datums, and Work Coordinate Systems (G54, etc.)**              | Simulate Piston Block  
Piston Block                                                                 | CAM Piston Cross Hole                  |
| 5     | 2/6   | **Tools and Tool Holding**                                                      | Simulate Valve Block  
Simulate Piston Cross Hole  
Machine Valve Block  
Machine Piston Cross Hole                                                                 | CAM Wheel                             |
| 6     | 2/13  | **Speeds and Feeds**                                                            | Simulate Wheel  
Machine Wheel & Logo                                                                 | Full Air Engine Assembly               |
| 7     | 2/20  | **Tool Paths & Surface Finish**                                                 | Live Assessment                                                                 | Live Machine Assessment                |
| 8     | 2/27  | **Machining Dynamics**                                                          | Chatter Demonstration  
Work on Maze CAM/Design                                                                 |                                       |
| 9     | 3/6   | **Z-Depth Activity**                                                            | Maze CAM / Z-Depth                                                               |                                       |
| 10    | 3/13  | **SPRING BREAK!!!!**                                                            | Maze CAM / Z-Depth                                                               |                                       |
| 11    | 3/20  | **Metrology & Tolerances**                                                      | Maze CAM / Z-Depth                                                               |                                       |
| 12    | 3/27  | **Machining Costs**                                                             | Maze CAM / Z-Depth                                                               | Part: Maze                            |
| 13    | 4/3   | **Job Scheduling / Lean MFG**                                                   | 5 Axis (Demonstration)                                                          | Project Idea                          |
| 14    | 4/10  | **Job Scheduling / Lean MFG**                                                   | Project                                                                         | CAM of Project Parts                  |
| 15    | 4/17  | Project Work                                                                    | Project                                                                         |                                       |
| Exam  | 4/24  | Project Work                                                                    | Project                                                                         | Part(s): Project                      |
| Weeks | 4/28  | Project Work                                                                    | Project                                                                         |                                       |

*Schedule subject to change due to instructor whims and/or chaos levels*
**Attendance Policy, Class Expectations, and Make-Up Policy**

Attendance for lecture and lab sections is required. Students are expected to have all necessary CAD/CAM work completed prior to their arranged lab period. There will not be time in labs for anything more than a brief review for safety and operational parameters.

Do not use your cell phones as anything other than a camera or calculator when in lab. Cell phones are a major distraction and inhibit safe operation of the equipment.

If you are ill, or have a university approved excused absence, please bring it to the attention of the course instructors in a timely manner so we can schedule a suitable make-up period.

Excused absences must be consistent with university policies in the undergraduate catalog (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx) and require appropriate documentation.

**Evaluation of Grades**

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Total Points</th>
<th>Percentage of Final Grade</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Engine</td>
<td>100</td>
<td>25%</td>
<td>Five components; 20 pts each</td>
</tr>
<tr>
<td>Z-Depth Activity</td>
<td>25</td>
<td>6.25%</td>
<td>Please don’t machine more vise jaws</td>
</tr>
<tr>
<td>G-Code Quiz</td>
<td>25</td>
<td>6.25%</td>
<td></td>
</tr>
<tr>
<td>Live Assessment</td>
<td>50</td>
<td>12.5%</td>
<td>Freedom!</td>
</tr>
<tr>
<td>Maze</td>
<td>100</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>Project 1</td>
<td>100</td>
<td>25%</td>
<td>Individual or group</td>
</tr>
<tr>
<td>Project 2 (Bonus)</td>
<td></td>
<td>Bonus</td>
<td>Individual</td>
</tr>
</tbody>
</table>

**Grading Policy**

- A: 93-100
- A-: 90-92.99
- B+: 88-89.99
- B: 83-87.99
- B-: 80-82.99
- C+: 78-79.99
- C: 73-77.99
- C-: 70-72.99
- D+: 68-69.99
- D: 63-67.99
- D-: 60-62.99
- E: 0-59.99

More information on UF grading policy may be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

**Students Requiring Accommodations**

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

**Course Evaluation**

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

**University Honesty Policy**

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/) specifies a number of
behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

**Commitment to a Safe and Inclusive Learning Environment**
The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:
- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

**Software Use**
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

**Student Privacy**
There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: [https://registrar.ufl.edu/ferpa.html](https://registrar.ufl.edu/ferpa.html)

**Campus Resources:**

**Health and Wellness**

<table>
<thead>
<tr>
<th>U Matter, We Care:</th>
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</thead>
<tbody>
<tr>
<td>Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact <a href="mailto:umatter@ufl.edu">umatter@ufl.edu</a> so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.</td>
</tr>
</tbody>
</table>

**Counseling and Wellness Center:** [http://www.counseling.ufl.edu/cwc](http://www.counseling.ufl.edu/cwc) and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

**Sexual Discrimination, Harassment, Assault, or Violence**
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](http://www.police.ufl.edu/), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

**Sexual Assault Recovery Services (SARS)**
Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or [http://www.police.ufl.edu/](http://www.police.ufl.edu/).
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<tr>
<td><strong>E-learning technical support</strong>, 352-392-4357 (select option 2) or e-mail to <a href="mailto:Learning-support@ufl.edu">Learning-support@ufl.edu</a>. <a href="https://lss.at.ufl.edu/help.shtml">https://lss.at.ufl.edu/help.shtml</a>.</td>
</tr>
<tr>
<td><strong>Career Resource Center</strong>, Reitz Union, 392-1601. Career assistance and counseling. <a href="https://www.crc.ufl.edu/">https://www.crc.ufl.edu/</a>.</td>
</tr>
<tr>
<td><strong>Library Support</strong>, <a href="http://cms.uflib.ufl.edu/ask">http://cms.uflib.ufl.edu/ask</a>. Various ways to receive assistance with respect to using the libraries or finding resources.</td>
</tr>
<tr>
<td><strong>Teaching Center</strong>, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <a href="https://teachingcenter.ufl.edu/">https://teachingcenter.ufl.edu/</a>.</td>
</tr>
<tr>
<td><strong>Writing Studio, 302 Tigert Hall</strong>, 846-1138. Help brainstorming, formatting, and writing papers. <a href="https://writing.ufl.edu/writing-studio/">https://writing.ufl.edu/writing-studio/</a>.</td>
</tr>
<tr>
<td><strong>Student Complaints Campus</strong>: <a href="https://care.dso.ufl.edu">https://care.dso.ufl.edu</a>.</td>
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</table>