University of Maryland, College Park
Professional Masters/Mechanical Engineering Department

ENPM 636- Applied Additive Manufacturing
Summer 2025

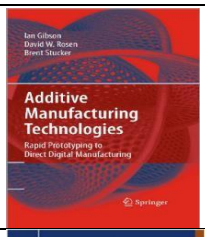
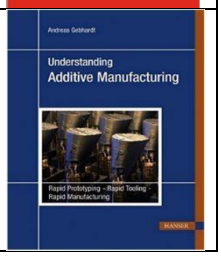
Last Revised Date: May 28, 2025

Course Instructors:
The course will be offered in person and online during the summer of 2025. Dr. Andres Sarmiento (AS) will be the main instructor for the course. Dr. Michael Ohadi will contribute by providing lecture materials and serving a supervisory role for the course, assisting Dr. Sarmiento as needed.

Contact Informaation:
E-mail: apsc@umd.edu; ohadi@umd.edu;
Office Hours: Questions by e-mail at all times are welcome and will be responded to within 24 hrs when possible. One-to-one Zoom meetings are also welcome, but only by appointment, which can be requested through sending an email request.
.

Course Description:
This course introduces students to the fundamentals and practical applications of additive manufacturing (AM), commonly known as 3D printing. Students will explore various AM technologies, materials, and processes, emphasizing practical, hands-on experience. Key topics include CAD modeling for AM, slicing software, print parameter optimization, material selection, quality assurance, and post-processing techniques. Through example case studies and project-based learning, students will develop proficiency in designing and fabricating functional prototypes and parts while evaluating the advantages, limitations, and economic considerations associated with additive manufacturing.

Recommended Books in Lieu of a Formal Textbook:

1. Ian Gibson et al., "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition Springer, 2015, ISBN 9781493921126. **Or** Ian Gibson et al., "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing," 1st Edition Springer, 2010, ISBN 978-1-4419-1119-3; e-ISBN 978-1-4419-1120-9.	
2. Andreas Gebhardt, "Understanding Additive Manufacturing," Hanser, 2011, ISBN 9783446425521	

Course Schedule:
The following is a tentative course schedule. All lectures are pre-recorded and students listen at their own

convenience. Live office hours on Monday and Wednesday evenings are to answer any questions you may have. Consult the course website for updated versions. The course schedule may change during the semester as circumstances arise. Any deviations on Quiz and/or Exam dates will be announced in advance.

WEEK	TOPICS COVERED
1	• **Introduction and Review of Fundamentals of Conventional Manufacturing Methods vs. Additive Manufacturing (AM):** ○ Review of Traditional Manufacturing (TM) Methods ○ History, evolution, and types of AM technologies, and comparison with TM methods. ○ Homework No. 1 assigned
2	• **Additive Manufacturing Processes:** ○ Fused Deposition Modeling (FDM) ○ Stereolithography (SLA) ○ Selective Laser Sintering (SLS) ○ Direct Metal Laser Sintering (DMLS) and other metal AM methods ○ Project 1 assigned ○ HW No 1. Solutions posted
3	• **Materials for AM:** ○ Thermoplastics, photopolymers, and composites ○ Metal powders and ceramics ○ Material properties and selection criteria ○ QUIZ
4	• **Design for Additive Manufacturing (DfAM):** ○ Design constraints and opportunities ○ Topology optimization and generative design ○ Support structures and build orientation ○ Homework No. 2 assigned
4	• **Post-Processing and Quality Assurance:** ○ Surface finishing, heat treatment, and machining ○ Inspection methods and testing standards ○ Project 1 Report ○ Project 2 assigned
5	• **Applications and Case Studies:** ○ Aerospace, automotive, biomedical, and consumer products ○ Prototyping vs. end-use part production ○ MIDTERM ○ HW No 2. Solutions posted
6	• **Economics and Sustainability:** ○ Cost analysis and production planning ○ Environmental impact and material recycling ○ HW No. 3 assigned
7	• **Energy Conversion Applications:** ○ Water recovery heat exchanger enabled by AM. ○ AM heat exchangers for extreme environments. ○ Electronics cooling of high-flux electronics by AM.

	○ HW No. 3. Solutions posted
8	• **Future Trends and Emerging Technologies:** ○ Multi-material printing and 4D printing ○ Smart materials and embedded electronics ○ FINAL PROJECT PRESENTATION

Grading Policy:
Final grades will be based on the following breakdown:

Quiz & Midterm	35% (15% + 20 %, respectively)
Course Project(s)	30%
Final Project	35%

Tentative Grading Scale:
A+: 100-96 A: 95-92 A-: 91-90
B+: 89-87 B: 86-83 B-: 82-80
C+: 79-77 C: 76-73 C-: 72-70
D+: 69-67 D: 66-63 D-: 62-60
F: below 60
Note: The above grading scale is meant to serve as a guideline

Homework:
Homework will be assigned, but not collected or graded. Solutions to homework will be posted on the course website. You are urged to work on the problems yourself before looking at the solutions.

Project(s)
Two projects will be assigned that require submission of a report and a PowerPoint presentation summarizing the report.

Quiz:
Quiz is normally designed for duration of 25 to 30 minutes. They may include both statement type as well as problems to solve. Every quiz might involve some calculations, thus you need to have your calculator with you. You are urged to properly indicate the units of the calculated variables to receive partial credits for your solutions. This is important for all quizzes, exams, projects, and other assignments to avoid losing points that otherwise are deserved. Grading error due to lack of clarity of the paper will be strictly your responsibility.

Midterm Exams:
Midterm exam typically consist of two parts: the first part will focus on statement type questions and the 2nd part on problems to solve. They are typically closed-book and closed-notes. However, you are allowed to have a reference sheet (earlier in the semester one side of 8.5" by 11" sheet and later in the semester both sides of 8.5" by 11" sheet. You need to have your calculator with you. There is no final exam, instead final project will be presented.

Make Up Policy:
No make-up will be given for quizzes. If you miss a Quiz and your excuse is accepted then the weight of that Quiz will be distributed on the remaining Quizzes. Make up for midterm or final examinations will only be given in the exceptional cases when the individual can demonstrate with proper documentations that the emergency involved was beyond his/her control. In case of any religious observance, the student must personally hand over a written notification of the projected

absence in the first week of the semester.

Academic Honesty:

All students are expected to uphold the highest ethical and professional of academic honesty (see the University of Maryland Code of Academic Integrity). A violation of the UMD Code of Academic Integrity includes (but is not limited to) intentionally using or attempting to use unauthorized materials, information, or study aids in any academic exercise. Please be advised that a failure to accept and exhibit the fundamental value of academic honesty may result in a course grade of 'XF'

Course Website:

We will use ELMS (https://elms.umd.edu) as the primary site to archive lecture notes and course related materials and share information. If you are unfamiliar with ELMS Learning System, it would be a good idea to familiarize yourself with its features now. In case of any technical difficulty, please send an email to elms@umd.edu. Should you prefer assistance over the phone, you can call the OIT Help Desk at 301-405-1400. You are required to check the course website on a regular basis.

Path to Success in ENPM636:

The key factors for success in this course are to stay focused and fulfill your responsibilities. The course material is inherently cumulative such that the material learned in one session will be used in the following sessions. If you lose your focus for a day or two, it will be extremely hard for you to come back to the track. Please feel free to send your questions by e-mail any time. We will be happy to assist you as necessary.