

**CHE 415 – Introduction to 3D Printing
Fall 2023**

Otto H. York Department of Chemical and Materials Engineering - NJIT

Instructor: Prof. Murat Guvendiren

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Office Hours: **TBD** (*Schedule an appointment via email*)

Class Time: Thursday 6:00pm-10:00pm

Class Location: Tier 109

Teaching Assistant: TBD

Course Description: This course introduces 3D printing technologies including history and basics of 3D printing, currently available 3D printing methods and printable materials as well as current and emerging applications of 3D printing. Students will get a general idea on the major players in 3D printing industry and global effects of 3D printing. The course will be composed of a lecture and a hands on laboratory session, during which students will create a 3D design and print a functional prototype.

Prerequisites: Junior standing or higher (contact Dr. Guvendiren for exceptions)

Course Administration: Administration of this course will be done through Canvas.

Student Learning Outcomes

1. Identify key 3D printing technologies, and corresponding major industry segments
2. Identify key material properties for 3D printability for each printing technique
3. Develop the ability to assess printing methods and materials (inks) for specific applications
4. Develop ability to design and 3D print devices/tools to meet desired needs with realistic constraints for 3D printing
5. Manufacture devices and tools using 3D printing
6. Identify future applications and opportunities of 3D printing
7. Assess the 3D printing industry and the global effects of 3D printing particularly on engineering manufacturing
8. Develop presentation skills and foster team work
9. Ability to communicate effectively through written reports and oral presentations
10. Develop ability to search literature for peer-reviewed articles, and learn critical reading
11. Identify economic, environmental and societal issues related to Additive Manufacturing.

12. Effectively present technical and engineering problems to a “lay audience”

Learning Materials/Tools

Reference Text Books:

- Additive Manufacturing Technologies – 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, by Ian Gibson, David Rosen, and Brent Stucker, Second Edition, Springer, New York.
- 3D Printing and Additive Manufacturing – Principles and Applications, by Chee Kai Chua and Kah Fai Leong, The 4th Edition, World Scientific.

Required CAD Software: Autodesk Fusion 360 (cloud-based CAD Design software). Fusion 360 is free for students. You are required to download this software in your OWN laptop. If you don't have a laptop, please contact Dr. Guvendiren.

System requirements: <https://goo.gl/gUWyqi>

Download page: <https://www.autodesk.com/products/fusion-360/students-teachers-educators>

Required Slicing Software: Flashprint software will be used for silicing the digital images for 3D printing. Our lab is equipped with Flashforge Inventor Dual Extrusion 3D Printer.

Link: <https://flashforge-usa.com/pages/download>

When to Download: These software are not required in the first week of the class. So please wait to download them. More detailed information will be provided in the first day of class.

Other Learning Material: PowerPoint presentations for each lecture will be posted on the Canvas. Students are strongly encouraged to take notes during the lectures and integrate their notes into the provided documentation after each lecture.

Calculator: A scientific calculator is required.

Laboratory Materials/Supplies: All the materials and supplies needed for the laboratory section of the course will be provided by the Department. Students may be expected to SHARE some of the items.

Rules and Expectations during the Lectures/Labs

- **ABSOLUTELY No cell phones, no video/audio recording, and NO FOOD allowed any time during the lecture and laboratory.** Laptops will be used when instructed for the lectures (to be announced).
- Please come to the class before the lecture starts or at least ON TIME. Under no circumstances, you should distract your peers and the instructor.
- Students are expected to come to class having read the assigned material, completed the assignment, and well prepared to engage in dialogue regarding the assigned material. All reading and other preparatory assignments must be completed by their due date(s).

- There will be **NO MAKE-UP**. If your absence is justified by a letter from Dean of Students Office, the missed activity may be forfeited.

Academic Integrity: Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: <http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf>.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu”

Disability Support Services: NJIT provides disability support services in the campus. If you need accommodations due to a disability please contact Chantonette Lyles, Associate Director of Disability Support Services, Fenster Hall Room 260 to discuss your specific needs. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.

Course Format: The course will consist of a lecture and a hands-on laboratory session with extensive participation between students and the instructor. The following is the tentative Course Schedule.

Detailed Course Schedule

Course schedule is tentative and may change throughout the term. **Dates** are also tentative and may be subjected to change. **The instructor will communicate any changes.**

Month	Day	Topics
Spt.	7	Introduction to 3D Printing
Spt.	14	Software and Data Formats for 3D Printing Lab: Fusion360 Workshop #1
Spt.	21	Software and Data Formats for 3D Printing Lab: Fusion360 Software Workshop #2 – Design Project 1
Spt.	28	Vat-photopolymerization printing / Quiz #1 Lab: Design Project 1
Oct.	5	Final Project Workshop
Oct.	12	Extrusion-based printing / Quiz #2 Lab: Design Project 2
Oct.	19	Droplet-based printing / Quiz #3 Lab: Design Project 2
Oct.	26	Powder-based printing / Quiz #4 Lab: Design Project 3
Nov.	2	Bioprinting and Applications / Quiz #5 Lab: Design Project 3
Nov.	9	Bioprinting Workshop Lab: Design Project 4
Nov.	16	3D Printing Industry and Its Impact - Group Presentations Lab: Design Project 4
Nov.	23	Thanks Giving RECESS
Nov.	30	Final Project Workshop
Dec.	9	Final Project Design Demonstration & Presentations

Quizzes: Pop quizzes will focus on the previously covered chapter. Quizzes will be held at the beginning of the class. Please be on time. There will be no make up for Quizzes.

Design Challenges: Students will work individually or will be grouped into teams (rotating for every challenge) to develop functional digital designs and 3D print these designs (and show their functionality). Usually you will have two weeks to return your design (determined by the Instructor and announced before the assignment of the project). Late designs (up to a week) will be accepted but you will receive half the credit. A rubric will be provided for each design challenge!

Final Project: Each team will be given a Final Design Project, and will be required to come up with a simple but creative design (a tool or a device, TBD). Each team will be required to prepare a written report and present their design process by the end of the course. No late returns will be accepted. A separate rubric will be provided!

Grading Criteria

- Quizzes 15%
- Group Presentation 20%
- Design Challenges 30%
- Final Project 35%
 - Printed Device 10%
 - Written Report 10%
 - Presentation 15%

Grading will be based on:

A:	90 – 100%
B+:	85 – 89%
B:	80 – 84%
C+:	70 – 79%
C:	60 – 69%
D:	50 – 59%
F:	0 – 49%