

# VME 6071C - Medical 3D Printing

## Fall Semester 2024 – University of Florida

**Instructor:**

Adam H Biedrzycki, DVM, PhD, DACVS

Office location: VH-124

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Class Web site: Canvas at lss.at.ufl.edu

Office hours: 11:45am - 12:35pm W in VH-124

**Class Times:** M/W/F 2nd period (8:30am-9:20am)

- a. M/W classroom based
- b. F computer lab based

**Class schedule:** Three 50-minute classes per week

**Class Location:**

8/23, 8/30, 9/6, 11/22, 12/6, 12/13, 12/20 in Equine Auditorium

8/16, 9/13, 10/4, 10/11, 11/1, 11/8 in VAB Lecture Hall A

9/27, 10/25 V3-114 (3<sup>rd</sup> Floor Conference Room in VAB)

**Course Description:** Medical 3D Printing (3 Credit Hours) This course will cover the application of 3D printing technologies in the field of medicine. It will cover subjects from image acquisition with the correct parameters, image processing, image mask creation, importing to 3D software, manipulation in the 3D environment and exporting the file for successful 3D printing. This will cover a large number of mechanical and biological considerations for repair and replacement of soft and hard tissues and joints. Fracture fixation, orthopaedic implants for hip and knee, orthotic and prosthetic devices are all included in the design portion of the course.

**Course Pre-Requisites (strongly suggested)**

undergraduate mechanics of materials, statics, dynamics, kinematics, MATLAB.

**Course Objectives:**

- Understand the fundamental principles and workflow for additive manufacturing in the medical field, from CT Scans to 3D printing and the processing of a final product
- Acquire the vocabulary necessary to navigate the complex, multivariate landscape of additive manufacturing equipment, materials, and applications used in medicine and surgery.
- Learn to identify how, when, and where 3D printing in medicine can create value to the MD/DVM, from design concepts to end-of-life; and how to select a 3D printing process and material for a specific application.

- Acquire the skills to know how to acquire 3D volumetric images for importation into 3D software
- Acquire the ability to segment, manipulate, alter mask of anatomical regions
- Acquire the skills necessary to design parts for medical 3D devices that combine engineering intuition with computationally-driven design and process-specific constraints.
- Develop a cutting-edge perspective on using 3D models to help patient outcomes.
- The student should gain a detailed understanding of the engineering and technologies used in the study of 3D models for biomechanics *in silico*.
- The student should understand how to apply a spectrum of measurement techniques to provide quantitative assessment of clinically relevant motions, forces and actions.
- The student should understand basic mechanical considerations in the selection or development of surgical procedures and implanted orthopaedic devices.
- The student will gain experience in critical review of the medical/ biomechanical/ 3D printing literature.
- The student will gain experience in the presentation of research findings with critical commentary and extemporaneous discussion.

**Material and Supply Fees:** MIS Student software to be installed on a PC (no cost).

**Textbooks and Software Required:** There are no required texts. All reading materials will be provided online at the class web site. Students will need access to Materialize MIMICS and 3 MATIC software (available at the computer center or online)

**Recommended Reading:** Reading is assigned on a per class basis, and all readings are posted on the Canvas web site.

**Course Schedule:** This is a ROUGH outline of the topical flow of the course. The instructor will, at his sole discretion, modify the schedule and content of the course to complement the research and professional interests of the enrolled students:

- Weeks 1-3 - Introduction to 3D Printing in Medicine
- Weeks 4-6 – CT Image Acquisition and Mask creation
- Weeks 7-8 – Manipulations in the 3D Environment
- Weeks 9-10 – Virtual Surgical Planning
- Week 11 – 3D Printing and Troubleshooting
- Weeks 12-13 Evaluating Model Testing and New Iterations on Design
- Weeks 14-15 Final Project presentation and conclusions

**Attendance Policy, Class Expectations, and Make-Up Policy:** Students are expected to attend class. A substantial part of the student's grade, and the value of the class, will be derived through participation in the class sessions. All written assignments are to be handed in online (in Canvas) before the beginning of class on the date due. **No late**

**assignments will be accepted.**

**Grading**

- Homeworks and in-class quizzes 30%
- Exams (2) 30%
- Class Presentations & Participation 10%
- Term Project 30%

**Grading Policy:** (90-100 A, 88.0-89.99 B+, 80.0-87.99 B, etc.) Grades will not be curved. If you do not agree with the grading of a particular exam or homework problem, presentation grade, or project grade, you will have one week from the date the grade is assigned to submit a written explanation of why you think the grade should be higher. However, the final decision will remain the instructors.

<i>Percent</i>	<i>Grade</i>	<i>Grade Points</i>
90.0 - 100.0	A	4.00
88.0 - 89.9	B+	3.67
80.0 - 87.9	B	3.00
78 - 79.9	C+	2.67
70 - 77.9	C	2.0
60 - 69.9	D	1.67
0 - 59.9	F	0.00

More information on UF grading policy may be found at:

[UF Graduate Catalog](#)  
[Grades and Grading Policies](#)

**Students Requiring Accommodations**

Students Requesting classroom accommodation must first register with the [Disability Resource Center](#). That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

**Make-up Exam Policy**

If the student is unable to take an in-class quiz or complete an assignment due to documented illness, suitable arrangements will be made for the student to complete the work for full credit. If the student is unable to attend class because of planned travel, the student is responsible to make alternate arrangements a minimum of two weeks in advance of his/her absence to complete the assigned work.

**Course web site**

Students will be expected to check it on a regular basis for up-to-date course information. This may include changes to the syllabus, homework assignment due dates, and exam schedules. The course web site will be accessible from the UF E-learning web site at [lss.at.ufl.edu](http://lss.at.ufl.edu).

### **Class E-mail List**

We will use the Canvas course page for communications in the class.

### **Personal responsibility**

You are personally responsible for all information disseminated during the lectures. This means knowing all homework due dates, knowing when exams will be given, where they will be given, what material they will cover, and knowing all material, handouts, and announcements made in the lectures, whether or not you were present. Thus, if you miss a lecture, it is your responsibility to obtain all information presented during that lecture. "I missed that information" or "I was unaware of that information" will not be accepted as valid excuses.

### **Workload**

3D medical printing covers a wide range of engineering techniques and technologies, anatomy, pathology, design and analyses. The goal of this course is for you to be at least conversant and familiar with several key areas within the field. In addition to the intellectual content, this course will strongly emphasize the development of presentation skills and critical review of technical literature. A considerable portion will be working through the tasks using the computer software. Plan to spend at least two hours outside of class for each hour of class time in order to complete the readings, homework and prepare for quizzes and presentations.

### **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. [Click here for guidance on how to give feedback in a professional and respectful manner.](#) 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 [ufl.bluera.com/ufl/](http://ufl.bluera.com/ufl/). [Summaries of course evaluation results are available to students here.](#)

### **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](#) 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. Failure to comply with this commitment will result in disciplinary action. This statement is a

reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others. Violations of the honesty policy will be handled strictly according to U.F. policy. The minimum penalty for an honesty violation will be a one letter-grade reduction for the course.

Ask at any time if you are unclear whether work is to be performed individually or collaboratively.

Failure to properly cite reference material, whether from scientific articles, books, theses, or web sites is plagiarism, which is a violation of academic honesty. Ask at any time if you have any questions on how properly to cite work that is not your own.

**Software Use:** All faculty, staff and student 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 the [Notification to Students of FERPA Rights](#).

### ***Campus Resources:***

#### **Health and Wellness**

**U Matter, We Care:**

If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.

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

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

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or [police.ufl.edu](http://police.ufl.edu).

### Academic Resources

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling.

**Library Support**, Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.

**Writing Studio**, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.

**Student Complaints Campus**

### On-Line Students Complaints

## Tentative Class Schedule

Week	Date	Lecture/Presentation		
		Monday	Wednesday	Friday

1	23 Aug			Syllabus
2	26 Aug -	Historical Background and Applications	Review Material	Overview of Equipment
3	2 Sept -	UF Holiday – No Class	Processing Data	Literature Review
4	9 Sept -	Overview of CT	How to move data	Review CT data (Computer Lab)
5	16 Sept -	Importing Data to Mimics	Creating Masks in Mimics	Exercise 1: Mask Creation (Computer Lab)
6	23 Sept -	Editing Masks	Boolean Functions	Exercise 2: Editing Masks (Computer Lab)
7	30 Sept -	Mask Optimization	Wrap and Smooth Functions	Exercise 3: <b>EXAM 1: Mimics</b> (Computer Lab)
8	7 Oct -	Importing masks to 3-Matic	Working in the Virtual Environment	Exercise 4: Using 3-Matic (Computer Lab)
9	14 Oct -	Analysis Techniques in Mimics	Trim, Cut, Boolean Operations in Mimics	Exercise 5: Advanced 3-Matic Functions (Computer Lab)
10	21 Oct -	Introduction to VSP	VSP 1	Exercise 6: Virtual Surgical Plans (Computer Lab)
11	28 Oct -	Drill Guides	Cutting Guides	Exercise 7: Drill and Cutting Guides (Computer Lab)
12	4 Nov -	Reduction Guides	Clinical	Exercise 8:

			Correlations	<b>Exam 2: 3-Matic (Computer Lab)</b>
13	11 Nov -	UF Holiday -No Class	Optimizing for 3D Printing, Using the Printer, Sending models to the Printer, & Printer Troubleshooting	Exercise 9: Working with Insight and Control Center (Computer Lab)
14	18 Nov -	Exercise 10: Working with the Printer ( 3d Lab)	Evaluating Surgical Models	2 <sup>nd</sup> Iteration Designs & Final Project Compilation
15	25 Nov -	UF Holiday – No Class	UF Holiday – No Class	UF Holiday – No Class
15	2 Dec -	Presentation of Cases	Presentation of Cases	No Class - Reading Day

\*Please note that the instructor reserves the right to alter the syllabus/schedule if it is determined that such a change will benefit the course and the students.

This syllabus is intended to give the student guidance in what may be covered during the semester and will be followed as closely as possible. However, the professor reserves the right to modify, supplement and make changes as the course needs arise. This includes exam dates and lecture topics that may change depending on class progress.