THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Biomedical Device Additive Manufacturing

MATSCEN 5655

Credit Hours:
3.00 - 3.00

Course Levels:
Undergraduate (1000-5000 level)
Graduate

Course Components:
Lecture

Course Description:
Survey of Additive Manufacturing (AM) patient data acquisition and medical device Computer Aided Design (CAD), medical research and clinical grade AM materials and AM fabrication methods, quality assurance/management systems and regulatory (FDA) approval process.

Prerequisites and Co-requisites:
Prereq: 3141, or Grad standing in MGEL, MatScEn, WeldEng, BiomedE, CBE, MechEng, AeroEng, or ISE, or permission of instructor.

Course Goals / Objectives:
- Understand the requirements of 3D patient data acquisition, patient-specific CAD and mechanical modeling (i.e., Virtual Surgical Planning), and intra-operative guidance.
- Understand how 3D fabrication technologies are used in biomedical research.
- Understand how 3D fabrication technologies are used in the clinic.
- Understand range of criteria used to design, validate, and use biocompatible, 3D printable, materials.
- Understand basics of the regulatory process including Quality Assurance (QA) and/or Quality Management Systems, GLP assessment, and GMP production.

Course Topics:

- Block I: Data Acquisition and Design (5 lectures) Lectures 1-2: Overview; 3D image acquisition and processing (slice and surface scanning); medical and industrial imaging
- Block I Lectures 3-4: 3D image preparation for 3D printing (CAD); Mechanical Modeling for biological applications
- Block I Lecture 5: file set up for 3D printing
- Block II: AM Processes for Biomedical Devices (7 lectures) Lectures 6-8: Polymer: Fused Deposition Modeling, Binder Jetting, Selective Laser Sintering, and Powderbed Fusion for Medical Applications.
- Block II Lectures 9-10: Electrospinning, Melt Electrowriting, vat photocrosslinking: stereolithography and projection (mask) printing; Hydrogel bioprinting and bioassembly
- Block III: Fabrication and Applications of AM Biomedical Devices (9 lectures) Lectures 13-15: FDM, Binderjetting, and SLS Applications
- Block III Lectures 16-19: Electrospinning, Melt Electrowriting, Vat Photocrosslinking, Hydrogels for Bioprinting and Bioassembly, Cells, Spheroids, and Organoids.
- Block III Lectures 20-21: Powderbed Fusion Ceramics and Metals
- Block IV: Regulator of AM Biomedical Devices (7 lectures) Lectures 22: biocompatibility in vitro (cytotoxicity) and in vivo (small animal models)
- Block IV Lectures 23: large animal models
- Block IV Lectures 24: FDA (Presubmission, IDE, IND, 510k, PMA)
- Block IV Lecture 25: Translation to the Clinic

Designation:
Elective