MCEN 4228/5228: 3D Bioprinting & Biofabrication

A. COURSE OBJECTIVES:

This course is of interest for students with a bio/medical, material chemistry or engineering background interested in the application of 3D printing and other 3D fabrication techniques in the field of medicine. It will provide insight in the opportunities of additive manufacturing technologies, micro/nano devices and 3D printing in biomedical applications. It will provide the basics of 3D printing and additive manufacturing and devices used for biofabrication, and the introduction to 3D design. In addition, it will also provide insight in the specific challenges encountered when translating 3D printing to biofabrication, such as the development of specific bioinks and the required control over processing conditions. Finally, it will provide state-of-the-art examples of how currently biofabrication is translated from bench towards the bedside.

B. BASIC INFORMATION

Course instructor: Prof. Wei Tan
Contact information: ECOT 516, Phone: (303)492-0239, Email: wtan@colorado.edu
Class hours & locations: 9 to 11:30am, M/W/F
Office hours: By **appointment ONLY** on Mondays, 12pm-5pm
Prerequisite courses: Undergraduate-level mathematics, materials, college chemistry, fluid mechanics, and biology
Web Page: D2L site: learn.colorado.edu

C. GRADING:

Projects and labs:	30%
In-class Presentations:	10%
Homework:	10%
Quizzes:	20%
Final paper:	30%

D. COURSE SYLLABUS:

1. **WEEK 1: INTRODUCING THE PRINCIPLES, METHODS AND MATERIALS**

Introduction:

(1) Opportunities & Challenges of 3D bioprinting & biofabrication in medical applications
(2) Additive manufacturing and rapid prototyping
(3) 3D Visualization and Imaging Technologies
(4) 3D Modeling and Design Methods
(5) 3D Manufacturing: Materials and Methods
(6) Core Principles and Physical Foundations underlying 3D Bioprinting
(7) Basic process of 3D bioprinting (problem, design, material selection, and object fabrication)
(8) Personalized medicine and clinical needs

Reading assignment:

2. **WEEK 2: BASICS OF 3D BIOPRINTING AND BIOFABRICATION**
   (1) Biofabrication and 3D-Bioprinting Technologies and Tools
   (2) Development of bioinks (bioprintable materials, from metals and ceramics to hydrogels)
   (3) Medical imaging and imaging processing
   (4) Biomodeling
   (5) Blueprints (Digital models of tissues and organs)
   (6) Bioprinters
   (7) Technology platform and emerging trends in bioprinting
   (8) Validating assays applied to printed products
   (9) Case studies
   Reading assignment:

3. **WEEK 3: APPLICATIONS OF 3D BIOPRINTING AND BIOFABRICATION**
   (1) Problem identification
   (2) Applications in Lab-on-chip and Organ-on-chip (Brain-on-chip, Artery-on-a-chip, Lung-on-a-chip, Bone-on-a-chip, Liver-on-a-chip, Gut-on-a-Chip, etc.)
   (3) Applications in prosthetics (e.g. Robohand)
   (4) Applications in implants
   (5) Applications in innovative bioactive research
   (6) Applications in regenerative medicine
   Reading assignment:

4. **WEEK 4: ISSUES RELATED TO 3D BIOPRINTING AND BIOFABRICATION**
   (1) Ethical and regulatory issues
   (2) Intellectual property and patent landscape
   (3) Future perspective in terms of bench research and hospitals
   Reading assignment: