

Introduction to Computer-Aided Tissue Engineering

(MEM478/800: 3 Credits)

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(Wednesdays: 6:00 ~ 8:50 pm)

Course Outline

Introduction to Computer-Aided Tissue Engineering (CATE) is designed for graduate and senior undergraduate students in engineering and bioengineering major who are interested in acquiring the knowledge and skill in utilizing computer-aided technologies for tissue engineering application. The course will introduce: 1) the engineering and bioengineering aspect of tissue regeneration; 2) basics of computer-aided design, computer-aided engineering, and computer-aided manufacturing (CAD/CAM/CAE); 3) knowledge on the use of integrated CAD/CAE/CAM technology in tissue engineering application; and 4) a hand-on experience on using enabling CAD, medical imaging processing and three-dimensional reconstruction software, and solid freeform fabrication system for tissue scaffold design, modeling, simulation, and freeform fabrication. The course will be conducted in a joint lecture, laboratory and project style with following tentative topics:

Lectures:

1. Introduction to cellular biology, tissue engineering and computer-aided tissue engineering;
2. Enabling CAD/CAM in Design and Manufacturing;
3. Computer-Aided Tissue Engineering;
4. Non-invasive Imaging (CT/MRI) Based 3D Reconstruction and Biomodeling
5. Hierarchy Modeling and Biomimetic Design of 3D Bone Tissue Scaffolds
6. Freeform Fabrication of Biomedical implants and 3D tissue scaffolds;
7. Cell and organ printing and its application for pharmacokinetic models

Laboratories:

1. 3D CAD and Solid Modeling;
2. CT/MRI image-based 3D Reconstruction;
3. CAD modeling of tissue anatomy;
4. Tissue scaffold design and analysis;
5. Tissue scaffold fabrication
6. Basic cell-scaffold biological study

Software/Hardware:

CAD – Pro/Engineer, AutoCAD, SolidWorks
3DR – Materialise, GeoMagic
FEA – ANSYS, ABAQUS, and Pro/Mechanica
SFF – Z420 3D Printing

References: “Principles of CAD/CAM/CAE Systems”, by Kunwoo Lee, Addison-Wesley, 1999
“Principle of Tissue Engineering”, R. Lanza, R. Langer, and W. Chick, R.G. Landes Company and Academic Press, Inc., Latest edition
“Biomechanics: Mechanical Properties of Living Tissue”, Y.C. Fung, Springer, New York, 1993
“Pro/Engineer Tutorial, Wildfire 3.0”, by Roger Toogood, SDC Publication, www.SDCpro.com
Lecture handouts, Lab tutorials, and Research papers

Homework (2 wk), Research Paper (3 wk), and Term Project (4 wk): topics related to CATE

Grading Policy: Homework 1 & 2: (25%), Lab (10%), Research Paper (25%), Project (40%)

Lecture/Lab: 4-174, MEM UG Laboratory

Lab Administrator: George Ciarrocchi: Room 2-115; Tel: 895-1397; george@coe.drexel.edu

Laboratory for Computer-Aided Tissue Engineering, Room 1-005;