

New Jersey Institute of Technology

Department of Biomedical Engineering

10452: BME 678 - 102 - Design of Orthopedic Implants

Thursday: 6:00 PM to 9:05 PM **Room:** Fenster Hall 640
Instructor: Mr. George Makris, 973-432-3660, gmakris@njit.edu;
Office Hours: By Appointment

Reference Materials:

Journal of Applied Biomaterials, Journal of Orthopaedic Research, JBJS

Prerequisites: BME 677 and working knowledge of Creo 3 Parametric. First of a two part course on design of orthopedic implants using Pro Engineer (Creo 3). Develop 3D models of a typical Total Hip Replacement and Tibial Component for the Knee. Use of anatomic guidelines to establish the design envelop Design Input and design output. Additional topics include mechanical properties of implant materials, material selection and introduction to FEA using Creo3 Simulate on Tibial Knee component . Methods for prototype development with the use of 3D printing will also be discussed. A critical objective of this course is the preparation of design reports and project presentations.

LECTURE SCHEDULE:

Week	Topics	Assignments/Due Date
1: Jan 19	Review of syllabus and reference materials Review mechanical properties of metallic, ceramic, and polymeric implant materials; corrosion, degradation, wear and failure modes. Design Input for a total Hip System Lab: Design Envelop Layout	Review: Commercially available Hip Systems to be used as a base for 1st project.
2: Jan 26	Lecture: Design Input, Design goals. Lab: CAD modeling techniques , Modeling of a Hip Stem	
3: Feb 2	Lecture: CAD modeling techniques components Lab: Modeling of a Hip Stem Femoral Head	
4: Feb 9	Lecture: CAD modeling techniques assemblies Lab: Modeling of Acetabular cup assembly	S1: Femoral Stem Model
5: Feb 16	Lecture: CAD modeling techniques components , Design Output, ROM Lab: Model refinements, System presentation, Design Outputs	
6: Feb 23	Lecture: Design Input, Design goals Trauma Systems. Lab: CAD modeling techniques (long bone models)	R1: Paper Project I HIP System
7: Mar 2	Lecture: Trauma Plates, Design Cancellous Locking screw Lab: CAD modeling techniques (helical cuts , patterns)	
8: Mar 9	Lecture: Design Input, Design goals. CAD modeling Lab: Modeling Proximal Tibial Bone	R2: Paper Project II Plate system
9: Mar 16	No Class Spring Recess	Spring recess
10: Mar 23	Lecture: CAD modeling Assembly mode Lab: Modeling / bone, tools , components Lecture: CAD modeling Lab: Modeling / Tibial Implant Designs / Implant Fit.	
11: Mar. 30	Lecture: FEA / Assembly, Loads, constraints, materials Lab: FEA Analysis of Tibial component.	
12: Apr 6	Lecture: FEA / Design optimization Lab: FEA Analysis of Tibial component.	S2: Proximal Tibia Bone Model and Tibial component
13: Apr 13	Lecture: FEA / Critical stress, acceptance criteria. Lab: FEA Results., singularities, sectional views, stress distribution	
14: Apr 20	Lecture: Prototype, 3D Printing Design Transfer. Lab: Design Outputs, File formats, Drawings	R3: Paper Project III Tibial FEA ANALYSIS

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Week	Topics	Assignments/Due Date
15: Apr 27	Project Presentations	CP: Class Presentations
16	NO FINAL EXAM (Final grade is a result of grade points accumulated from Assignments)	

Grading:

S1: Progress Report, Stem Design	5
R1: Paper Report Project I	25
R2: Paper Report Project II	25
S2: Progress Report, Tibia Bone & Component	5
R3: Paper Report Project III	25
CP: Class Presentations	15

Assignments:

1. Assignments (S, R, CP) must be submitted prior to 6:00 PM of the day they are indicated as due.
2. Assignments (S, R) should be written using MSWord and may be submitted in paper or emailed to the instructor in .doc or .pdf format.
3. Assignment and CAD files should contain student name identifiers such as: Makris_hip_stem.prt, Makris_S1.pdf, Makris_R2.pdf
4. After the due date, reports will be accepted for 75% credit. Assignments more than two weeks late will not be accepted.

Project Progress reports (S) should contain the following:

- 1) INPUT / design goals (list)
- 2) Status to Date (list and screen capture images)

Paper Project reports (R) should contain the following:

- 1) Abstract
- 2) Short Background on Subject Material
- 3) Design input/project goals
- 4) Methods and Materials
- 5) Results
- 6) Discussion and Conclusion
- 7) References

Class Presentations (CP)

Group Presentation (Groups and projects to be assigned)

Presentations should contain the following:

- 1) Scope
- 2) Short Background on Subject Material
- 3) Design input/project goals
- 4) Summary of Methods and Materials
- 5) Individual Design highlights
- 6) Comparative Discussion of group work.
- 7) Conclusions

Grade distribution: Group 70%, individual 30%)

Notes: 1. Any change in this outline will be discussed beforehand in class.

2. Please note that the NJIT Honor Code will be strictly followed.

3. Discussion and Exchange of ideas is encouraged but ALL work shall be based on individual effort.