Instructor: Mark M. Levy, M.D., D.Sc.  
Orthopedic Surgeon  
Assistant: Majd Machour

Scope: 2-hours lecture per week  
1-hour frontal exercise per week

Credit: 2.5 Points

Course Topics:

1. Introduction: course overview, terminology, bone repair, implants for fractures, joint replacement and spine disorders
2. Bone and joint characteristics: biology, structure and biomechanics, main pathologies and treatment strategies
3. Fracture implants for internal fixation: materials, IM nails, plates, screws, sliding screws for hip fractures, biomechanics of implant bone system, overview of ASTM tests
4. Fracture implants for external fixation: simple fixators, Ilizarov and Taylor systems
5. Total joint replacement: materials, engineering principles of fixation and bearing surfaces, joint stability, failure and complications, partial Vs total replacement, overview of ASTM tests.
6. Main total joint replacement: total hip arthroplasty, total knee arthroplasty, shoulders and other joints, use of FEA
7. Spine anatomy and biomechanics: overview
8. Spine implants for: scoliosis, fractures, disc space (cages, disc replacement), vertebral bone. Biomechanics of fixation systems and overview of ASTM tests
9. New trends in Orthopedics: Additive manufacturing (3D printing) of implants, use of surgical robotics, computer assisted and navigation, VR and AI in orthopedic surgery
11. Introduction to Biocompatibility concepts of orthopedic implants
12. Regulation basics: FDA, CE mark; application to orthopedic implants
13. Introduction to R&D of orthopedic implants, market and commercialization

Bibliography and complementary material:

1. Lecture notes (lecture slides and cited references)  
2. Anatomy: Gray’s Anatomy 3rd Ed, others  
3. Orthopedic Surgery: Campbell’s Operative Orthopaedic 12th Ed, others
4. Strength or Mechanics of Materials: (Beer, Popov, Timoshenko, others)
5. Basics biomechanics of the musculoskeletal system, Nordin 4th Ed
6. The Medical device R&D handbook, Kucklick 2nd Ed
7. Biomedical Engineering textbooks
8. Literature publications: throughout the lecture slides
9. Websites: FDA, USPTO, CE, AAOS, WHO, Medical device companies, etc.

Grades:
Final Exam (on orthopedic implants principles and exercise materials)
Homework assignments: mandatory submission
Optional: Final project (done and presented in groups)