Course number and title: 26-OSE-744 Biomechanical and Physiological Aspects of Muscular Activity
Graduate Credits: 3 gr. cr
Instructor(s) in-charge: Amit Bhattacharya, PhD
Course type (underline all that apply): Lecture, Laboratory, Field Projects
Required or Elective: Required

Course Schedule:
- Lecture: 3 hours per week, 1 meetings
- Discussion: ______ hours per week, ______ sessions
- __var__ hours for informal discussion
- Field Work: ______ hours per week, ______ hours per survey/project
- Outside Study: ______ hours per week
- Office Hours: ___by appt.___

Course Assignments:
- Homework: _____ assignments
- Exams: ___2___ class presentations and Final project report
- Reports: __X__ required
- Project: __X__ required

Grading Policy:
Exam: 90%; Lab: 10%

Course Prerequisites:
Bachelors level background in engineering and/or biology and/or psychology

Catalog Description:
Biomechanics of human static posture and dynamic motion, cardiovascular and metabolic cost of muscular activity, biomechanics of trauma, spinal mechanics, and biomechanical modelling.

Textbook and Any Related Course Materials:
Human Physiology by Guyton; Exercise Physiology, Katz & Katz; Motor Control by Shumway-Cook & Wollacott; Basic Orthopaedic Biomechanics by Mow and Hayes

Blackboard:
No

Topics Covered:
Overview of background materials
Energy Liberation and Transfer; Muscle Mechanics; Circulatory, Respiratory, CNS/PNS and Metabolic Responses to Muscular Activity; (2 hrs.)
Basic Concepts and Definitions Related to Biomechanics of Occupational Related Physical Activity (2 hrs.)
Static/dynamic Equilibrium and Application to Occupational Biomechanics (3 hrs.)
Dynamics of Human Movement and impact of environmental physical and chemical risk factors (neurotoxic chemical exposure): Gait/Postural Stability (4 hrs.)
Spinal Mechanics Low Back Pain Analysis from Biomechanics Viewpoint (3 hrs.)
Knee Mechanics  Occupational Knee Injuries (2 hrs.)
Computer Simulation/Modeling Studies (3 hrs.)

Advanced applied topics-Research to Practice

Early (or subclinical) non-invasive markers of degenerative disorders of skeletal system and neurological systems
Laboratory demonstration of Quantitative posturography and measurement of bone quality noninvasively for early screening of neurotoxicity and osteoporosis and osteoarthritis, respectively.

Note: Above is a list of topics but the actual depth of the contents under each topic change from year to year to encompass new literature in the subject matter.

Lab Projects:
Demonstration of postural balance measurement system and bone shock absorption system (2 hrs)

Course Goals (and Program Outcomes):

Overview
Understand Functional units of locomotion/human equilibrium (A1, B1, B2, C1 and C2)

Understand planning and performance of human movements by the brain (A1, B1, B2, C1,C2, D1,D2,D3)

Understand Energy Liberation and Transfer; Muscle Mechanics; Circulatory, Respiratory, CNS/PNS Responses (A1, B1, B2, C1 and C2)

Understand Fundamental Concepts Related to Biomechanics of Occupational Physical Activity (A1, B1, B2, C, C2, K1)

Understand Static/dynamic Equilibrium and Application to Occupational Biomechanics (A1, B1, B2, C, C2, K1)

Understand Spinal Mechanics  Low Back Pain Analysis from Biomechanics Viewpoint(A1, B1, B2, C, C2, K1)

Understand Computer Simulation/Modeling Studies (A1, B1, B2, C1 and C2)

Research to Practice
Understanding the role of environmental physical risk factors and chemical risk factors (due to neurotoxic chemicals) on the mechanism of impairment of CNS/PNS and muscle mechanics and their impact on human locomotion (A1, B1, B2, C, C2, K1)

Understanding Bone physiology/mechanics and application to degenerative disorders of skeletal system (A1, B1, B2, C, C2, K1)

Understanding the use of foundation of physiology and biomechanics for the development of non-invasive tools for early (subclinical) detection of degenerative disorders of skeletal system and neurological systems (A1, B1, B2, C, C2, K1)

NOTE: The ABET Program outcome is shown as a capital letter; the number designates the program specific outcome.

Evaluation Criteria:
Students are evaluated based on 1) Critical review of current peer-reviewed articles on the subject matter relevant to at least two of the above mentioned topics is evaluated during a presentation in the classroom using the attached evaluation form 2) written term paper describing a research proposal dealing with new research areas related to at least one of the above mentioned topics is evaluated using the attached evaluation sheet. The term paper/research proposal may be submitted by the PhD students (with permission and supporting letter from their advisor) for potential funding through NIOSH sponsored Pilot Research Training Grant program. Grading forms for each of these elements are provided to students at the first class.

Relation to Program Educational Objectives:
This is a required course for all Comprehensive Practice majors. The course contributes to the following Program Educational Objectives, as shown:

_X_ Fundamental Knowledge
Hygiene Science 60 %; Basic Science 20 %
_X_ Design Skills 10 %
_X_ Professional Skills 5 %
_X_ Life-long Learning 5 %

NOTE: EOH faculty define Hygiene Science as all the Knowledge Elements other than the Basic Sciences; Design skills are those necessary to solve real world problems. Professional skills are those that involve teams, management, leadership, written and oral communication, approach to stakeholders and ethics; life-long learning is demonstration of the need for continuing professional development.
Program outcomes and how they are covered in this course

For each ABET IH Program Outcome (A through L), the EOH Educational Outcomes are shown below. Upon completion of this course, students will have had the opportunity to acquire knowledge (K), skills (S) and attitudes (A) associated with each of the Educational Outcomes, as noted by underlining. Where the educational measurable outcome contributes strongly to the ABET Program Outcome, the K/S/A is shown in upper case; where the contribution is average, the k/s/a is shown in lower case letters. (Note, use the Contribution to Knowledge and Professional Skills estimates above to guide your decision.)

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A. Identify agents, factors and stressors generated by and/or associated with defined sources, unit operations and/or processes:

Identify potential health hazards of workplace processes and operations

B. Describe qualitative and quantitative aspects of generation of agents, factors and stressors:

Describe the underlying processes of the generation of hazards in occupational and environmental settings

Describe qualitative and quantitative aspects of hazards associated with specific occupational or environmental sources

C. Understand physiological and/or toxicological interactions of physical, chemical, biological and ergonomic agents, factors and/or stressors with the human body:

Understand the relation between exposures and health outcomes

Compare and contrast the potential for differences in response to hazards due to personal factors among some subjects at risk of exposure and the subsequent need to modify programs and practices

D. Assess qualitative and quantitative aspects of exposure assessment, dose-response, and risk characterization based on applicable pathways and modes of entry:

Describe how to evaluate potential adverse outcomes of chemical or physical exposures, based on similarity of the exposure to documented hazards

Describe occupational hygiene aspects of emerging technologies

Describe the basic principles of conducting sampling and analysis for exposure assessment

Describe the basic principles of evaluating engineering and non-engineering controls to reduce exposure

Develop and implement an exposure assessment plan to evaluate potential hazards and existing controls
Gather, manage and analyze quantitative (e.g., measurements of exposure or system performance) and qualitative (e.g., written programs) data to evaluate potential hazards and existing controls in order to reduce risk

E. Calculate, interpret and apply statistical and epidemiological data:

   Apply epidemiologic and/or statistical concepts to the interpretation of exposure data

F. Recommend and evaluate engineering, administrative and personal protective equipment controls and/or other interventions to reduce or eliminate hazards:

   Identify and recommend appropriate methods to reduce exposure (using engineering controls, personal protective equipment or administrative controls), or deficiencies in written programs and policies
   Design work process/practice interventions

G. Demonstrate an understanding of applicable business and managerial practices:

   Produce accurate oral and written reports, including descriptions of occupational processes and activities, exposure assessment plans and evaluation of occupational and environmental work settings
   Describe approaches to interact with higher-level decision makers in various management structures
   Manage resources effectively
   Display effective leadership

H. Interpret and apply applicable occupational and environmental regulations:

   Understand, interpret and apply occupational and environmental regulations
   Apply guidelines, standards and laws in interpreting qualitative and quantitative data for exposure assessment for risk characterization

I. Understand fundamental aspects of safety and environmental health

   Apply the professional code of ethics to a scenario

J. Attain recognized professional certification

   Explain the importance of ethics in the practice of occupational and environmental hygiene
   Understand the need for and resources available for continuing professional development after graduation
   Describe the requirements to obtain professional certification

K. Conduct a research activity resulting in a report that demonstrates mastery of the subject and high level of professional and public communication skills
Design a research question, develop a plan and conduct research  K  S  A  k  s  a

Communicate effectively with a variety of stakeholders (e.g., labor, management, government, peers, safety and health professionals, allied professionals)  K  S  A  k  s  a

Produce a technical scientific report on research  K  S  A  k  s  a

L. Demonstrate advanced qualitative and quantitative problem-solving Skills  K  S  A  k  s  a

Function effectively as part of a multidisciplinary team to investigate and propose a solution to an exposure hazard in a workplace  K  S  A  k  s  a

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NOTE: Students provide feedback on individual courses through the end-of-class Department and Division evaluation survey instrument. This instrument provides feedback on the course material, organization and presentation, and perceived contribution of the course to the achievement of Program Outcomes. In addition, feedback is received from the continuing, semi-annual Question-feedback process during which students identify Best Learning Experience, Session/presentation that was an endurance test, What would make life as a student better?, If I could do it over, I would…. Opportunities I would like to have but don't seem to be available, Opportunities I would like more of, Aspects of the program the faculty should consider eliminating, Worst part of the UC program, Best part of the UC program, Other comments. A Ph.D. and M.S. student participate in Division faculty meetings. Exit surveys are conducted by the University and the Division as part of the requirements for graduation. All students are urged to participate fully in each of these activities in order to improve the educational experience.