Course number and title: 26-EIH-790 Physical Aspects of the Environment  
Graduate Credits: 3gr. cr  
Instructor(s) in-charge: Amit Bhattacharya, PhD assisted by Sergey Grinshpun, PhD/Thurman Wenzl, ScD  
Course type (underline all that apply): Lecture, Laboratory, Field Projects  
Required or Elective: Required

Course Schedule:
- Lecture: 3 hours per week, 2 meetings  
- Discussion: var hours per week, sessions  
- Field Work: var hours per week, hours per survey/project  
- Outside Study: var hours per week  
- Office Hours: by appt.

Course Assignments:
- Homework: X assignments  
- Exams: 1/1 midterms / finals  
- Reports: required  
- Project: required

Grading Policy:
Mid term Exam: 50%; Final: 50%

Course Prerequisites: None

Catalog Description:
Principles and techniques of recognizing and evaluating health problems of vibration, heat, noise, non-ionizing radiation, ultraviolet, visible, infrared, and microwave.

Textbook and Any Related Course Materials:
Reference:  
Vibration Effects on the Hand and Arm in Industry by Brammer and Taylor, John Wiley and Sons, 1984  
Safety with Laser and Other Optical Sources by Sliney and Wolbarsht, Plenum Publishers company, New York, 1980  
Chapter 11 of Fundamentals of Industrial Hygiene, by B Plog, published by the National Safety Council  

Blackboard:
None
Topics Covered:

HUMAN VIBRATION
Vibration Stress; Biomechanics of Vibration Stress (3 hrs.)
Vibration or Acceleration Physiology; Occupational Injury Related to Vibration Exposure (3 hrs.)
Instrumentation, Measurement and Control Techniques; Recommended Vibration Exposure guidelines (2 hrs.)

HEAT STRESS
Heat stress risk factors, Physiology of temperature stress, workplace exposure, recommended exposure guidelines, measurement and control (3 hr.)

NOISE
Physics of sound (3 hr)
Sound intensity, power, and pressure levels
Decibel addition, Inverse square low
Octave band principles, weighting corrections. “a”-scale

Noise guidelines and standard (2 hrs)
Measurement of sound (2 hrs)
Sound level meters, Dosimeters, type of surveys

Effect of noise on humans (1 hrs).
Noise induced hearing loss, threshold shifts, hearing conservation.
Noise control (2 hrs)
General approaches, absorption, enclosures
Total enclosure noise reduction

NON-IONIZING RADIATION (6 hrs)
Review of Electromagnetic Energy Spectrum
Radio frequency fields, ultraviolet radiation, extremely low frequency magnetic fields
and exposure assessment, methods to evaluate NIR exposures and exposure guidelines

Course Goals (and Program Outcomes):

HUMAN VIBRATION
1. Understand and identify the biomechanics of vibration stresses on biological system (A1, B1, B2)
2. Understand and describe the type of vibration stresses (B1, B2, C1, C2, D1, D3)
3. Understand and describe physiological effects of externally (by tools and heavy equipment) applied acceleration. (B1, B2, C1, C2, D1, D3)
4. Understand and describe the types of injuries that result from vibration (B1, B2, C1, C2, D1, D3)
5. Understand and describe the vibration metrics and its use in measuring vibration exposure (D1, D3, D4)
6. Describe techniques to control vibration exposure (D4, F1, F2)
7. Understand and describe guidelines for limits to vibration exposure (H1, H2, J1, F1)

HEAT STRESS
1. Understand and identify the scope of heat stress risk factors in the workplace (A1, B1, B2)
2. Understand and describe physiology of heat stress (B1, B2, C1, C2, D1, D3)
3. Understand and describe basic heat stress metrics and its application for measuring heat stress exposure in the workplace (D1, D3, D4)
4. Understand and describe techniques to control heat stress exposure (D4, F1, F2)
5. Understand and describe guidelines for limits to heat exposure (H1, H2, J1, F1)

NOISE
1. Understand basics of Physics of sound, sound intensity, power, and pressure levels, decibel addition, inverse square law, octave band principles. Weighting corrections. “A”-scale. (B1, B2)
3. Understand use of equipment to measure of sound: sound level meters, dosimeters. (D3)
4. Understand physiological effect of noise on humans, noise induced hearing loss, threshold shifts. Hearing conservation programs. (C1, C2)
5. Understand basics of noise control: general approaches, absorption, mufflers enclosures, total enclosure. (D4)
6. Calculations of noise reduction, transmission loss. (D4)
NONIONIZING RADIATION

2. Ultraviolet radiation, extremely low frequency magnetic fields and exposure assessment. (B1, B2, C1, C2, D1, D3)
3. Understand and describe methods to evaluate NIR exposures (B1, B2, C1, C2, D1, D4)
4. Understand and describe exposure guidelines (H1, H2, J1, F1)

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

Evaluation Criteria:

**HUMAN VIBRATION:** Theoretical knowledge and comprehension are evaluated through mid term examination. The examination content includes questions dealing with students’ ability to describe and classify vibration stresses, describe physiological effects of vibration created by tools and heavy equipment, describe types of injuries that result from vibration, describe vibration metrics and its use in measuring vibration, describe techniques to control vibration exposure and describe recommendations for limits to vibration exposure.

**NOISE:** Theoretical knowledge and comprehension are evaluated through final examination. The examination content includes questions dealing with students’ ability to describe metrics of sound, sound intensity, power, and pressure levels, decibel addition, inverse square law, octave band principles, weighting corrections, “A”-scale, describe Noise guidelines and standard, OSHA noise standard 29CFR1910.95, noise dose – OSHA and ACGIH, criterion level, Cutoff level, Exchange rate. TWA, describe the use of equipment to measure sound, sound level meters. Dosimeters, type of surveys, describe physiological effect of noise on humans, noise induced hearing loss, threshold shifts. hearing conservation, describe basics of Noise control, general approaches, absorption. Enclosures, total enclosure noise reduction, transmission loss, complex surface, and mufflers.

**NONIONIZING RADIATION:** The final examination is also designed to ask questions dealing with students’ ability to describe Electromagnetic Energy Spectrum, Radio frequency fields, ultraviolet radiation, extremely low frequency magnetic fields and exposure assessment and their health effects, describe methods to evaluate NIR exposures and describe exposure guidelines.

Students also carry out a Heat stress measurement and Noise laboratories in 26-EIH-742.

**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:

- Hypothesis: 60%; Basic Science 20%
- Design Skills: 10%
- Professional Skills: 5%
- 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.

Is there a TA? Yes No

Is computer use expected? Yes No

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.)

**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
- Communicate effectively with a variety of stakeholders (e.g., labor, management, government, peers, safety and health professionals, allied professionals)
- Produce a technical scientific report on research

L. Demonstrate advanced qualitative and quantitative problem-solving skills

- Function effectively as part of a multidisciplinary team to investigate and propose a solution to an exposure hazard in a workplace
### COURSE MATERIAL AND AVAILABILITY

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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.