Engineering Faculty Document No. 09-19
04/16/2018

TO: The Faculty of the College of Engineering

FROM: The Faculty of the School of Industrial Engineering

RE: New Graduate Course – IE 57800: Applied Ergonomics

IE 57800 APPLIED ERGONOMICS
SEM 1 or 2 or 3, Lecture 3, Cr. 3
JUNIOR, SENIOR, or GRADUATE STANDING

COURSE DESCRIPTION: Analysis, modeling, and design of jobs and systems to be consistent with human factors and ergonomic principles.

REASON: The course is an introductory graduate human factors course, focusing on the engineering tools available to solve human factors and ergonomic problems. It provides a foundation for all human factors graduate students, plus provides a foundation for non-human factors graduate students in an accessible way. It will typically be offered both on-campus and distance, where there is a considerable demand for knowledge of these engineering tools. It provides a starkly different perspective than the other introductory human factors graduate course offered (IE57700), which focuses predominantly on a psychological view of human factors.

Abhijit Deshmukh
Professor and Head
School of Industrial Engineering

Detailed Graduate Course Proposal for Academic Review

Note: The detailed course proposal is intended for academic review by the appropriate area committee of the Graduate Council. It supplements the Form 40G that is intended for administrative review of the Graduate School and Registrar.

To: Purdue University Graduate Council

From: Faculty Member: Steven J. Landry
Department: School of Industrial Engineering
Campus: West Lafayette

Date: March 21, 2018

Subject: Proposal for New Graduate Course

Contact for information if questions arise:
Name: Patrick Brunese
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Course Number: IE 57800
Course Title: Applied Ergonomics
Short Title: Applied Ergonomics

Course Description:

Analysis, modeling, and design of jobs and systems to be consistent with human factors and ergonomic principles.

A. Justification for the Course

Justification of the need for the course

The course is an introductory graduate human factors course, focusing on the engineering tools available to solve human factors and ergonomic problems. It provides a foundation for all human factors graduate students, plus provides a foundation for non-human factors graduate students in an accessible way. It is typically offered both on-campus and distance, where there is a considerable demand for knowledge of these engineering tools. It provides a starkly different perspective than the other human factors graduate course offered (IE57700), which focuses predominantly on a psychological view of human factors.

Justification that course will be taught at a graduate level

The course is designed to meet the four criteria, as follows:

- For (a) the course utilizes readings from both an introductory human factors source (Lehto and Landry, *Human Factors and Ergonomics for Engineers*) and an advanced handbook (Salvendy, ed., *Handbook of Human Factors and Ergonomics, 4th Edition*).
- For (b) the course uses 9 projects as assessments. These projects require the students to consider a poorly formed problem and synthesize what they learned in class to identify a solution.
- For (c) the course is concerned with current needs and methods for conducting human factors and ergonomic assessments in a real-world context.
- For (d) students are asked to read a number of articles on the state-of-the-art in human factors and ergonomics engineering, and in class we discuss the limitations and inaccuracies in the methods. Students have to have this understanding reflected in their project work.

Justification of the demand for the course

- Anticipated enrollment
  - Undergraduate 10-20
  - Graduate 60-80

Justification for online delivery

This course was created and has been offered repeatedly as a distance course (through Engineering Professional Education); until now it has been experimental. Demand for the course from distance learners has been high, and we would like to continue offering it as such.

B. Learning Outcomes and Methods of Assessment

Learning Outcomes	Assessment Methods
Be able to analyze and design work to fit human anthropometric requirements	• Homework, Project, Presentation
Be able to analyze and design work to meet human physiological limitations, including lifting tasks	• Homework, Project, Presentation
Be able to conduct time studies and use predetermined time system modeling	• Homework, Project, Presentation
Be able to perform task analysis and process mapping	• Homework, Project, Presentation
Be able to analyze and design work to meet human cognitive limitations	• Homework, Project, Presentation
Be able to determine function allocation between automation and human tasks	• Homework, Project, Presentation
Be able to model basic human performance at movement, detection, and control tasks	• Homework, Project, Presentation
Identify common human errors and perform human reliability analysis; and	• Homework, Project, Presentation
Be able to design displays that meet basic human-computer interaction principles	• Homework, Project, Presentation
Be able to write technical reports describing the results of human factors analysis	• Homework, Project, Presentation
Be able to present technical material describing the results of human factors analysis	• Homework, Project, Presentation

- Students are required to submit approximately 20 short homework assignments on each of these outcomes
- Students are required to submit project reports on 8 of these topics
- Students are required to submit a video presentation on one of these topics.

Final Grading Criteria

Describing the criteria that will be used to assess students and how the final grade will be determined. Add and delete rows as needed.

Assessment Methods (should match method types in the previous table)	**Weight Toward Final Course Grade**
Papers and Projects	45%
Homework	45%
Presentation	10%

Methods of Instruction

Class Hrs/Week	**Method of Instruction**	**Contribution to Outcomes**
3	Distance	(Lectures are distance-based for this addition; there are also on-campus students)

C. Prerequisite(s)

None: We do not expect distance students to have any background in undergraduate human factors courses; the needed background is covered as part of the lecture-based material.

D. Course Instructor(s)

Name	Rank	Dept.	Graduate Faculty or expected date
Steven Landry	Associate Professor	IE	Yes
Vincent Duffy	Associate Professor	IE	Yes

E. Course Schedule or Outline

Option 1: Schedule Format

Week	Topic(s)
1	• Anthropometrics
2	• Work Physiology • Methods Analysis
3	• Methods Analysis • Lifting Analysis
4	• Lifting Analysis • Learning
5	• Time Studies • Work Sampling
6	• Work Sampling • Task Analysis
7	• Process Mapping • Cognition
8	• Cognition
9	• Decision Making
10	• Judgements • Taskload
11	• Workload • Situation Awareness
12	• Situation Awareness • Function Allocation
13	• Modeling (Fitt's Law, McRuer, GOMS)
14	• Human Error and Error Traps • Human Reliability Analysis

Week	Topic(s)
15	• Human-Computer Interaction • Usability
16	Not applicable

F. Reading List (including course text)

Primary Reading List

- Salvendy, G. (Ed.), Handbook of Human Factors and Ergonomics, 4th Edition. Hoboken, NJ: John Wiley & Sons, Inc. (2012).

Secondary Reading List

- Lehto, M. and Landry, S.J., Introduction to Human Factors and Ergonomics for Engineers, 2nd Ed. CRC Press. (2013).

G. Library Resources

Name of journal, proceedings, book, video, or other acquisition	**Already in Libraries?**
Salvendy, G. (Ed.), Handbook of Human Factors and Ergonomics, 4th Edition. Hoboken, NJ: John Wiley & Sons, Inc. (2012).	Yes
Lehto, M. and Landry, S.J., Introduction to Human Factors and Ergonomics for Engineers, 2nd Ed. CRC Press. (2013).	Yes

H. Course Syllabus (now required)

See Attached.

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IE590: Applied Ergonomics

Fall 2017

Instructor:
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What this course will cover (topic list)

- Anthropometry
- Work physiology
- Methods analysis
- Analysis of lifting tasks
- Learning curves
- Time studies
- Synthetic data systems (human performance modeling)
- Activity sampling
- Sampling methods
- Process mapping
- Basic concepts in cognition
- Decision making models
- Measuring taskload/workload
- Measuring and designing for situation awareness
- Designing for proper function allocation between automation and human
- Modeling human performance
- Categorizing, predicting, and controlling human error
- Principles of human-computer interaction
- Usability analysis

Other/different topics may be covered depending on feedback from enrolled students.

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Course outcomes (1)

- The student will be able to **design work stations and tasks** so that they comply with ergonomic and physiological requirements. (Lecture assignment 1 and 2; Mini project 1)
- The student will be able to **analyze how a task is accomplished using methods analysis** to determine its efficiency. (Lecture assignment 3)
- The student will be able to **analyze a lifting task** to determine its safety and desirability. (Lecture assignment 4; Mini project 2)
- The student will be able to **take data to produce a learning curve** and interpret it correctly. (Lecture assignment 5)
- The student will be able to **conduct a time study**, using either standard time study methods or synthetic data systems, in a manufacturing or service work setting. (Lecture assignment 6 & 7, Mini project 3)
- The student will be able to **conduct work sampling studies** in the workplace to determine the frequency of some effect of interest (Lecture assignment 8)
- The student will be able to **perform task analysis and process mapping** in a manufacturing or service workplace using industry-accepted methods. (Lecture assignment 9, Mini project 4)
- The student will be able to **apply subjective expected utility theory, prospect theory, and heuristics & biases** to identify appropriate decisions in an applied environment. (Lecture assignment 11)

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Course outcomes (2)

- The student will be able to **perform a LENS model analysis** to predict judgments. (Lecture assignment 12, Mini project 5)
- The student will be able to **measure taskload and workload** using industry-accepted methods. (Lecture assignment 13)
- The student will be able to **measure situation awareness** using industry-accepted methods. (Lecture assignment 14 & 15)
- The student will be able to **decompose a task into functions and identify each function's characteristics** in terms of its information processing level and level of automation. (Lecture assignment 16, Mini project 6)
- The student will be able to **model a task** using Fitts' Law, the McRuer Crossover model, and the GOMS framework. (Lecture assignment, 17, 18, & 19, Mini project 7)
- The student will be able to **identify error traps and perform a human reliability analysis** to identify likely human errors and their consequences. (Lecture assignment 20 & 21, Mini project 8)
- The student will be able to **identify where interfaces comply or violate basic human-computer interaction principles**. (Lecture assignment 22)
- The student will be able to **conduct basic usability analyses,** including using the PSSUQ, heuristic analysis, and cognitive walkthrough methods. (Lecture assignment 23, Mini project 9)

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Course outcomes (3)

- The student will be able to **effectively write technical reports** regarding work analysis studies and recommendations.
- The student will be able to **effectively present** work analysis and recommendations.

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What this course will NOT cover

- Economic analysis of human factors interventions
- Team behavior
- Detailed anthropometry and physiology
- Compensation
- Personnel selection
- Tool design
- Protective equipment, hazards

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Layout of the course (1)

- This is a distance course, meaning it is difficult to make the lectures truly interactive. However, we'll do several things to try to make the course as interactive as possible.
  - We'll use Piazza for discussions. I will cover questions/problems posted there at the start of class.
  - You can use Piazza in real-time to post questions during the class period; I will have that open and respond in real-time.
- For each lecture there will be "lecture assignments." There will be 23 of these; one for each topic. They will be short and walk you through an application of the material step-by-step. They are due **before** the associated lecture. However, you can skip (not turn in) up to 4 of these without penalty.

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Layout of the course (2)

- This is "applied" ergonomics, meaning you will be evaluated on your ability to apply the material rather than things verbatim. To that end, there will be 9 mini-projects, one on each topic. For those mini-projects, you will have to submit a technical report.
  - You must submit all 9 mini-projects to complete the course.
  - These mini-projects are designed to be individual projects rather than group projects.
- To ensure you can also present material adequately, I will require one of those technical reports be supplemented with a video presentation of 7 (±1) minutes.

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The book

There is no required textbook. I will provide all readings as .pdf copies on Blackboard. I will pull these from multiple sources, but two in particular:

- Salvendy, G. (Ed.), *Handbook of Human Factors and Ergonomics, 4th Edition*. Hoboken, NJ: John Wiley & Sons, Inc. (2012). The book is quite expensive if purchased, but is an excellent reference. An e-book version is available from Purdue's library, for free, for students with Purdue login credentials. See http://catalog.lib.purdue.edu/Find/Record/3126752.
- Lehto, M., & Landry, S. J. (2012). *Handbook of Human Factors and Ergonomics, 4th Edition*. Wiley.

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Objectives

- In addition to the course objectives, the following objectives are considered pass-fail. You must pass these objectives to attain a passing grade in the course:
  - Submit 19/23 lecture assignments.
  - Submit the 9 mini-project technical reports.
  - Submit 1 video presentation.
  - Work ethically in conducting and reporting on work analyses
- Submission and presentation of satisfactory lab reports and quizzes/tests/homework, without plagiarism, cheating, or other types of unethical behavior, will constitute passing these objectives.
- If you fail even once to show ethical behavior, you will fail the course. Ethical behavior is not negotiable. I cannot overemphasize this. There will be NO SECOND CHANCES. If we detect cheating or unethical behavior of any kind, you will be reported to the Dean of Students office for disciplinary action, and you will get a failing grade for ethics in this course, which will result in me entering a final grade of F at the end of the semester.

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Class preparation

- Each class has a topic and associated slides on Blackboard (Vista).
- It is your responsibility to check the calendar and ensure you are prepared for lecture. This includes reading the assigned chapter, lecture notes, and completing the associated lecture assignment as required.
- I realize that, as a distance class, student's schedules may not be well-aligned with the course calendar. I will therefore have substantial flexibility regarding submission deadlines. If you cannot submit lecture assignments by the due date, let me know. If you cannot submit projects by the deadline, let me know. I will allow late submissions, but will be tracking it to ensure you do not fall too far behind.

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Course calendar - August/September

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	21 Course admin History	22	23 Anthropometrics	24	25 Anthropometrics	26
27	28 Work physiology	29	30 Work physiology	31	1 Methods analysis	2
3	4 **Project 1 due**	5	6 Methods analysis	7	8 Lifting analysis	9
10	11 Lifting analysis	12	13 Learning	14	15 Learning **Project 2 due**	16
17	18 Time study	19	20 Time study – synthetic data	21	22 Work sampling	23
24	25 Work sampling **Project 3 due**	26	27 Task analysis	28	29 Task analysis	30

Lectures in red have a lecture assignment associated with them.

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Course calendar - October

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2 Process mapping	3	4 Process mapping	5	6 Cognition	7
8	9 **Project 4 due**	10	11 Cognition	12	13 Cognition	14 2
15	16 Decision making	17	18 Decision making	19	20 Decision making	21
22	23 Judgments	24	25 Judgments	26	27 Taskload	28
29	30 Workload **Project 5 due**	31				

Lectures in red have a lecture assignment associated with them.

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Course calendar - November

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1 Workload	2	3 Situation awareness	4
5	6 Situation awareness	7	8 Function allocation	9	10 Function allocation	11
12	13 Modeling – Fitt's Law	14	15 Modeling – McRuer **Project 6 due**	16	17 Modeling – GOMS	18
19	20 Human error	21	22	23	24	25
26	27 Error traps **Project 7 due**	28	29 Human reliability analysis	30		

Lectures in red have a lecture assignment associated with them.

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Course calendar - December

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1 HCI	2
3	4 HCI **Project 8 due**	5	6 Usability	7	8 Usability	9
10	11	12	13	14	15	16
	Finals week				**Project 9 due**	
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Additional topic 1

Additional topic 2
Project 4 due

Lectures in red have a lecture assignment associated with them.

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Grading

- Technical reports (based on the mini-projects)
  - Nine assignments
  - Report average worth 45%
  - **You must turn in ALL REPORTS and get a passing grade overall on reports to pass the class**
- Lecture assignments
  - 23 of them
  - Average is worth 45% of your grade
  - **You must turn in 19 out of 23 assignments to pass the class.**
  - If you complete more than 19, then the additional assignments, then each additional (above 19) assignment will be graded and add up to 1 point each to your final grade, weighted by the grade you get on the assignment. (This adds a maximum of 4 points to your final grade, assuming you get a 100% on each assignment.)
- Presentation
  - Submit one video presentation of one of your mini-projects. You can choose whichever one you wish to supplement with a video presentation.
  - The presentation is worth 10% of your grade.
  - **You must turn in a video presentation to pass the class.**

Grading (general)

- I do not curve. You are evaluated against the material, not against each other.
- All work must be submitted through Blackboard/SafeAssign. You are responsible for ensuring that it was successfully uploaded. Please check the submission status when you upload material through SafeAssign.
- I use a completely objective method to grade you, so you should work hard to obtain the grade you wish to have right from the start of the semester. At the end of the semester, I will compute your grade to one decimal point. Grades of 90.0 and above are given an A; grades of 80.0 to 89.9 are given a B, grades of 70.0 to 79.9 are given C, grades of 60.0 to 69.9 are given D, and all others are given an F. Grades within 2.5 points of each cutoff are then examined. If you have (1) completed 24/24 lecture assignments and (2) either your report average or lecture assignment average is at or above the cutoff for the next grade, then you will be given the next highest grade with a "-" modifier. If not, you will be given the same letter grade with a "+" modifier.
- Only factual (incorrectly graded, incorrectly entered) requests will be considered; there will be no subjective adjustment of grades. I will provide grade updates during the semesters, starting when enough grades are obtained to provide a good estimate.