Design Course for Ph.D.

L: Lecture, **T**: Tutorial, **P**: Laboratory / **S**: Studio, **CH**: Contact Hours, **CR**: Credit

Course Number:	**DD:702**	**L**	**T**	**P**	**S**	**CH**	**CR**
Course Name:	**Human Factors and Ergonomics in Product design**	**2**	**1**	**0**	**2**	**7**	**5**

Course Objectives

- The course aims to provide a comprehensive overview on the five specialized methods in human factors and ergonomics.
- The physical methods, Psychophysiological Methods, Behavioral and cognitive methods, Environmental methods, and Macro ergonomic methods will be discussed in detail.
- A structural approach in analyzing and evaluating Human factors and ergonomics aspects in product design will be outlined.

Course Outcomes/Learnings

- **CO1:** To Analyze and evaluate musculoskeletal disorder and work postures.
- **CO2:** To observe and understand cognitive process, perception, and response of individuals.
- **CO3:** To understand, indoor lighting, noise and acoustic measures, vibration exposure, and habitability.
- **CO4:** To understand organizational and behavioral research methods.
- **CO5:** To understand ergonomics and human factors integration to product design.

Syllabus

- **Physical Methods**
  Introduction to Ergonomics and its history, analysis and evaluation techniques of work-related musculoskeletal disorder, observation and analysis of postures, measurement of discomfort, analysis of workplace and its layout, measurement of work effort and fatigue, assessing lower back disorder, and predicting upper-extremity injury risks through REBA RULA method.

- **Psychophysiological Methods**
  Analysis and evaluation of human psychophysiology: estimating mental load through heart rate and heart rate variability (EDA, EMG, EEG, ERP etc.), monitoring alertness through eyelid movements, muscle activity and its rest period.

- **Behavioral and cognitive methods**
  Analysis and evaluation of people, events, artefacts, and tasks: observation and application of interviews for usability, cognitive task analysis methods, systematic human error reduction and prediction, workload analysis and prediction, and situational awareness

- **Environmental methods**
  Analysis and evaluation of environmental factors: thermal conditions and comfort, indoor air quality, indoor lighting, illumination and luminous level, noise and acoustic measurement, and vibration exposure

- **Macro ergonomic methods**
  Analysis and evaluation of work systems: organizational and behavioural research methods, participatory ergonomics, macro ergonomics analysis: structure and design (MAS, MEAD) evaluations of work system intervention, and analysis of the structure and processes of work systems

- **Human Factors / Ergonomics in Product design**
  Integrating and addressing ergonomics in product design: design process, product life cycle, and innovation. Framework for integrating environmental issues in ergonomics to product design. Cultural ergonomics issue in product design. Design, usability, and maintainability aspects in products.

Textbooks:

- Salvendy G. *Handbook of human factors and ergonomics*. (John Wiley and Sons, 2012)
- Karwowski W. Soares M. M. and Stanton N. A. *Human factors and ergonomics in consumer product design: Uses and Applications*. (CRC Press, 2011)

Reference Books:

- Sanders M. and Mccormick E. *Human Factors In Engineering and Design*. (McGraw-Hill Education, 1992)
- Bridger R. *Introduction to ergonomics*. (CRC Press, 2008)
- Tilley A. R. and Dreyfuss H. *The Measure of Man and Woman: Human Factors in Design*. (John Wiley and Sons, 2001)
- Nemeth C.P. *Human Factors Methods for Design: Making systems user centric* (CRC Press, 2004)
- Proctor R. W. and Zandt T. V. *Human factors in simple and complex systems*. (CRC press, 2017)
- Cacha C. A. *Ergonomics and safety in hand tool design*. (CRC Press,1999)
- Kroemer K.H. *Fitting the human: Introduction to ergonomics/human factors engineering*. (CRC Press, 2017)
- Freivalds A. *Niebel's methods, standards, and work design.* (Mcgraw-Hill higher education, 2009)

Approach:

- Lecture, tutorial and Studio sessions to train students in the aspects of human factors and ergonomics in product design.

Evaluation Criteria:

- Students will be evaluated based upon their performance in assignments (group /individual), sessional tests, final project outcomes (e.g., problem areas, the scope of improvements and design concepts, report, and presentation), and mid / end-semester examinations.

Program Outcomes

PO1 – An ability to independently carry out research /investigation and development work to solve practical problems.

PO2 – An ability to present the outcomes/deliverables in the form of a design portfolio or write and present a substantial technical report/document.

PO3 – Students will gain the knowledge and skillset to create innovative solutions to the emerging problems of society while working at the intersection of Design, Technology, and People.

PO4 – Students will develop the skillset in creative problem solving and critical thinking.

PO5 – The skill set and in-depth knowledge to demonstrate mastery in creating innovative design solutions in following specialized areas:

1. Technology-based Design
2. Life-centered Design
3. Inclusive Design
4. Integrated Design
5. Community-based Design
6. Sustainable Design

Mapping of Course Outcomes (CO's) with Program Outcomes (PO's)

Course Outcomes/Learnings	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2	1	-	1
CO2	1	-	1	1	-
CO3	2	1	1	1	-
CO4	2	2	-	-	-
CO5	2	2	1	1	1

3 = Strong mapping

2 = Moderate mapping

1 = Gentle mapping

0 = Negligible/Very weak mapping