Course 14: Human-Centric Design for Operator 4.0 (1-4-0)

Course Objective: Human-centric design is a unique approach to solve problems of products, process, environments, and other human operations challenging with incompatibilities of human needs, abilities and limitations. The objective of this course is to understand the interactions among humans and other elements of a system, evaluate and design tasks, equipment, products, processes, jobs, environments and other elements in working systems including work organization in order to optimize human well-being and overall system performance.

Learning Outcomes:

The students on the completion of this course would be able to:

CLO1.   Apply human abilities, limitations, needs and other important human characteristics for designing tasks, jobs, equipment, products, environments, processes and other element in working systems.
CLO2.   Evaluate occupational health and safety (OHS) risks to accidents, injuries, and ill health in a working system.
CLO3.   Create solutions and opportunities for reducing OHS risks, enhancing operators' performance and preference.
CLO4.   Design tasks, equipment, workstation, workspace, environment, and other elements in working systems compatible with needs, abilities and limitations of operators for better well-being and performance.
CLO5.   Analyze work organization affecting on human behavior and performance, e.g. policy, work schedule, motivation, satisfaction, communication and participatory.

Prerequisite: None

Course Outline:

Module 1: Basic of Human Factors Knowledge for Human-Centric Design

1. Introduction to Human-Centric Design (HCD)

o Meaning, scope and applications of human-centric design

o Basic concepts of HCD for engineering

o Professional in HCD

2. Human characteristics: Limitation, Ability, and Fatigue

o Physical / Physiological / Psychological and Cognitive /Behavioral Characteristics

o Stress and strain in human

o Human fatigue and human errors and their effect to health, accident and efficiency

3. Human System Interaction: Manual working system, Semi-automation working system, and Automation

o HCD for product design

o HCD for process and physical environmental design

o HCD for work organization design

4. Human System Interaction: Situation Awareness and Usability Testing

o HCD for product design

o HCD for process and physical environmental design

o HCD for work organization design

Module II: Problem Identification for Human-Centric Design

1. Human factors evaluation tools for identifying risk factors effecting on health,

incident, accident and efficiency such as Posture Evaluation, Task Analysis, Usability

Testing, Human Error Risk Assessment et.al.

2. Each student selects a problem of interest related to HCD

3. Identify human factors elements related to the selected problem

4. Analysis the problem of Human-Centric Design

Module III: Intervention and Design

1. Workstation and Workspace Design

o Measurement of human dimensions and motion.

o Application of human anthropometry for workstation and workspace designs

o International standards related to HCD

2. Design for Human Control/System Interaction (HCI/HSI)

o Visual/Display Control Design

o HCD for control centers

o Accessible design for special people

o Physical environment design for HCI/HIS

3. Man-machine system and interaction and cognitive designs

o Human perception, information and sensory receptors

o Human fallibility: human information processing / memory

o Visual display of static and dynamic information /designs

o Human decision

4. Design of physical environment: Light, Temperature, Pressure, Noise/Auditory, and Vibration

Module IV: Evaluation, Test, and Recommendation

1. Evaluation of manual work

o Size and dimension evaluation

o Posture and strength evaluation

o Space and movement evaluation

2. Evaluation of physical environment in design: Light, Temperature, Pressure, Noise/Auditory, and Vibration

3. Evaluation of HCI/HIS and Cognitive

o Usability testing of human compatibility

o Spatial compatibility evaluation

o capacity and limitation

o Usability testing of human performance

o Usability testing of human error in controlling system

Workshop Sessions:

1. HCD showcase on usability test and discussion ….

2. Human characteristics measurement…..

3. Human system interaction and response

4. Situation Awareness and human error in decision

5. Human factors evaluation tools for identifying risk factors I: Practice

6. Human factors evaluation tools for identifying risk factors II: Practice

7. Human factors problem identifications: Presentation & Discussion

8. Workstation and workspace design

9. Design for human control/system interaction

10. Human decisions and cognitive designs

11. Design of physical environment

12. Evaluation of manual work

13. Evaluation of physical environment

14. Evaluation of HCI/HIS and cognitive

15. User experience design: usability, accessibility, and desirability

Laboratory Sessions:

None

Learning Resources:

Textbooks: No designated textbook, but class notes and handouts will be provided.

Reference Books:

1. Sanders, M. S. and McCormick, E. J. Human Factors in Engineering and Design, 7th Edition, McGraw Hill, 1993

2. Kroemer, K. H. E., and Grandjean, E. Fitting the Task to the Human. CRC Press, 1997

3. Stanton, N., Hedge, A, Brookhuis, K, Salas, E., and Hendrick, H. Handbook of Human Factors and Ergonomics Methods. CRC Press, 2005

4. Karwowski W., and W. S. Marras. Occupational Ergonomics: Principles of Work Design. CRC Press, 2003

5. Willson, J. R., and Corlett, E. Evaluation of Human Work: A practical ergonomics methodology, 3rd Ed. Taylor & Francis, 1995

6. Marras, S. M., and Karwowski, W. The Occupational Ergonomics Handbook: Fundamentals and assessment tools for occupational ergonomics, 2nd Ed. Taylor & Francis, 2006

Journals and Magazines:

Not declared

Teaching and Learning Methods: This course is problem-based learning. It is designed for more practical by dividing into 4 modules (1) Basic, (2) Problem Identification, (3) Design and Intervention, and (4) Evaluation. Students will be educated all the basic knowledge of human factors related to work elements and human interaction system designs via lectures and case study discussions at the first module. During the second module, they will learn how to identify the problems related to human in several work systems by practical workshops and case studies. Individual assignments will be assigned to the students to gain their understanding. The third module will provide more skill of human-centric design in practice via workshop, laboratories and self-learning based on a project of interest. To complete the project, the students will be able to discuss and get recommendations from instructors and share their learning with other students in the class during the workshops in the third module. At the last module, the students will learn and practice more and more in evaluation tools of human-centric design techniques to increase their skill for optimizing human well-begin and system performance in their project.

Time Distribution and Study Load:

Lectures: 15 hours

Workshop: 60 hours (includes 9 hours of lab session)

Project and Self-study: 60 hours

Evaluation Scheme: The final grade will be computed according to the following weight distribution: Paper examination of basic knowledge (20%), Peer assessment in class activities (10%), Individual assignments and presentations (20%), Group project progress presentation (20%), Group project final report and presentation (30%)

"A" would be awarded if a student shows a deep understanding of the basic knowledge based on exam results and home assignments, and an excellent in applying the knowledge to project works.

"B+" would be awarded if a student shows a mature understanding of the knowledge learned through home assignments, project works, and exam results.

"B" would be awarded if a student shows an overall understanding of all topics.

"C+" would be given if a student meets above average expectation in understanding and application of basic knowledge.

"C" would be given if a student meets average expectation in understanding and application of basic knowledge.

"D+" would be given if a student meets below average expectation in understanding and application of basic knowledge.

"D" would be given if a student does not meet expectations in both understanding and application of the given knowledge.

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