

**Indian Institute of Technology, Kanpur**

**Proposal for a New Course**

1. Course No: DESxxx

2. Name of the Course: Cognitive Ergonomics in Hybrid Physical-Digital Interfaces

3. Per Week Lectures: 03 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional Hours[0-2]: 0 (A)

Credits (3\*L+2\*T+P+A): 9

Duration of Course: Full Semester

4. Proposing Department/IDP: Design

Other Departments/IDPs which may be interested in the proposed course:

Other faculty members interested in teaching the proposed course:

5. Proposing Instructor(s): Ashish Kumar Singh

6. Course Description:

**Relevance:** Equips designers to create usable, safe, and cognitively appropriate interfaces - crucial for product interface design.

**Objectives:** To provide students with a conceptual grounding in human information processing, perception, and attention, along with hands-on experience in display/control design and usability evaluation methods, enabling them to design and evaluate interactive systems effectively.

**Course Content:** This course teaches how human factors and human information-processing principles apply to the design and evaluation of usable and safe interfaces, from perceptual limits and mental models to concrete display and control design decisions. The course culminates in an applied project in which students redesign a real interface and conduct a formative usability test.

Sl. No.	Topic Description*	Session (Lecture/ exercise (on field))
1	Module 1 - Understanding Humans: Foundations of cognitive ergonomics Scope of HFE, what cognitive ergonomics covers in physical-digital interfaces - Approx. 02 sessions Understanding ourselves – basics of senses, human nervous system, visual ergonomics - vision focus (visual acuity, vision angle, colour discrimination, sizing text, contrast sensitivity), designing across senses - multimodal interaction across visual, auditory, and haptic channels (and perception) - Approx. 08 sessions Human information-processing models, perception, attention, memory, and mental workload, and their implications for interface design - Approx. 05 sessions Initial Mid-Module Assignment Brief On field practical exercise (field familiarization visit, problem statement and initial user-needs brief)**	15
2	Module 2 - Understanding Interaction: mental models, affordances, and human error Mental models and conceptual models, situation awareness model (Endsley model (Level 1–3)), Norman’s model, affordances, signifiers, mapping, constraints, feedback, and error types On field practical exercise**	5
3	Module 3 - Designing Interfaces: displays, controls, and cognitive principles Types of display and control interfaces - Approx. 02 sessions Principles for effective display and control design (linked with attention, perceptual, memory, mental model principles) - Approx. 08 sessions End-Module Assignment Brief On field practical exercise**	10
4	Module 4 - Understanding Work: Task analysis and cognitive work analysis Understanding users, context and tasks - Approx. 01 sessions Hierarchical task analysis, Usability evaluation techniques (Cognitive walkthrough, Norman’s model of interaction, heuristic evaluation, SUS, etc.) - Approx. 04 sessions On field practical exercise**	5
5	Module 5 - Evaluating Cognitive Performance: workload, measurement, and design prioritisation	5

What is mental workload, objective vs subjective measures, NASA-TLX, subjective assessment tools for measuring perceived mental workload, and prioritisation frameworks (severity × frequency × impact), Subjective Workload Assessment Technique On field practical exercise (prototyping/mock-ups/testing)** Final Presentation and Discussion	
Total	40

\*sequencing of modules/topics may be adaptively reorganized to align with ongoing studio briefs, field opportunities, or invited expert sessions

\*\*studio sessions also include site visits, user research, usability assessment, data analysis, and prototype development. Additional independent studio/workshop hours are expected for design iteration and validation.

**Pre-requisites, if any:** None.

**Learning Outcome:** By the end of the course students will be able to:

- Explain basic human information processing and how it constrains interface design.
- Apply usability evaluation techniques to identify usability problems.
- Produce a low-fidelity (physical/digital) prototype and run a short formative test, synthesizing findings into prioritized design changes.
- Design displays/controls that reduce cognitive load and support decision making.

**Assessment Criteria and Weightage:**

- Module-wise exercises
- Mid-Module practical exercise: Individual/ Group: Cognitive task analysis report and usability testing + user formative test report and reflection journal (short) (studio deliverable)
- End-Semester practical exercise: Individual/group applied redesign/proto + presentation (studio deliverable)
- End-Semester examination
- Short quiz / theory test (closed-book)
- Participation and in-class critiques

**Any other remarks:**

Classroom lectures will be complemented by on-field exercises and interface prototyping activities. These activities may include field familiarization visits, user research, task and usability analysis, interface mock-ups, and formative usability testing of prototypes. Additional independent studio/workshop hours are expected for iterative design refinement and validation.

**References (suggested readings):**

John D Lee, Christopher D. Wickens, Yili Liu, Linda Ng Boyle. *Designing for People: An Introduction to Human Factors Engineering* (2017)

Salvendy, Gavriel, ed. *Handbook of human factors and ergonomics*. John Wiley & Sons, 2012.

Mark S. Sanders, Ernest James McCormick. *Human Factors in Engineering and Design* (McGraw-Hill)

Norman, D. A. *The Design of Everyday Things*.

Park, C. W., & Alderman, J. (2018). *Designing across senses: a multimodal approach to product design*. " O'Reilly Media, Inc."

Research papers and other reference materials (based on assignments)

Dated: 06.04.2026

Proposer: Ashish Kumar Singh

Dated: \_\_\_\_\_

DUGC/DPGC Convener: \_\_\_\_\_

The course is approved / not approved

Chairman, SUGC/SPGC

Dated: \_\_\_\_\_