

## Indian Institute of Technology Kanpur

### Proposal for a New Course

1. **Course No: DES638A**
2. **Course Title: Human Machine Interaction (HMI)**
3. Per week Lectures: **3(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: Department of Design**  
Other Departments/IDPs which may be interested in the proposed course: **Cognitive Science**  
Other faculty members interested in teaching the proposed course: **None**
5. **Proposing Instructor(s): Dr. Gowdham Prabhakar**
6. **Course Description:**

This course will introduce candidates to Human Machine Interaction (HMI) and focus on designing interaction technologies for different environments from physical world to virtual world. It will walk through different modalities of interacting with machines(HMI)/computers(HCI) from history to state-of-the-art. It will emphasise on the methods of designing and evaluating different user interfaces (UI) to enhance user experience (UX). The candidates will get exposed to existing state-of-the-art technologies like eye-gaze tracking, hand-movement tracking, full-body motion tracking and have a hands-on experience working with these systems to build and develop new technologies for present and future. They will also get exposed to different programming languages like Visual C#, Python and multiple hardware platforms like Arduino, Raspberry Pi, NodeMCU/Seeduino (IoT module). This course will also help them in extending their careers in HCI for automotive, aviation, music, robotics (HRI), Severe Speech and Motor Impairment (SSMI) community.

#### a. Course Objectives:

- Introduce candidates to HMI and its applications
- Train them in software programming for GUI development
- Get hands-on in building hardware prototypes and integrate with GUI
- Train them in conducting user studies and carry out research
- Learn the concepts by doing projects

#### b. Course Content:

S.No.	Topic	Details	Lectures
1	Introduction to Human Machine Interaction (HMI)	<ul style="list-style-type: none"><li>• Machines, senses, and perception</li><li>• Waves of HCI</li><li>• Human Centred Design</li><li>• Affordances, conceptual model, and signifiers</li><li>• Fitts Law</li></ul>	5
2	Interaction Modalities	<ul style="list-style-type: none"><li>• GUIs, Gaze, and Gesture-based Interaction</li><li>• Hand Interactions</li><li>• Pointing and Icons</li><li>• Haptic and sensing devices</li><li>• Data Visualisation/Sonification/Physicalisation</li><li>• Voice Interaction / Smart Assistants</li><li>• Multimodal Interaction</li></ul>	6

3	HMI Applications	<ul style="list-style-type: none"> <li>• Wearables and Materials</li> <li>• Accessibility and Inclusive Design</li> <li>• Human AI Collaboration</li> <li>• Human-Robot Interaction</li> <li>• Human Music Interaction</li> <li>• Immersive &amp; Ubiquitous Interaction</li> <li>• Metaverse Interaction (AR/VR/MR/XR)</li> </ul>	7
4	Interaction Technologies Design - Software	<ul style="list-style-type: none"> <li>• Design Thinking</li> <li>• Practice on Python Programming</li> <li>• Develop Graphical user Interface (GUI) in Python and Visual Studio (C#)</li> <li>• Communicate between python and C# using socket programming</li> <li>• Wireless Communication (IoT Modules)</li> <li>• Multithreading for GUI</li> </ul>	6
5	Interaction Technologies Design - Hardware	<ul style="list-style-type: none"> <li>• Introduction to Arduino, Sensors and Actuators</li> <li>• Integrate sensors and actuators signals with the developed GUI</li> <li>• Deploy the entire system on Raspberry Pi or any single board computer (SBC)</li> <li>• Hands on training with Hand tracker, eye-gaze tracker, full body motion tracker</li> </ul>	4
6	HMI Research	<ul style="list-style-type: none"> <li>• Quantitative Research</li> <li>• Qualitative Research</li> <li>• Problem Definition</li> <li>• Experiment Design</li> <li>• User Study</li> <li>• Data collection</li> <li>• Data analysis</li> <li>• Inferencing</li> </ul>	8
7	HMI Design Project	<ul style="list-style-type: none"> <li>• Pick up a problem statement</li> <li>• Identify pain points of human users</li> <li>• Design a product which could provide the best experience with your proposed interface</li> <li>• Project review meetings</li> </ul>	2
8	Additional Exercises based on project requirement	<p>Based on students' interest and project requirements, they will be guided in learning and practicing the following in their projects.</p> <ul style="list-style-type: none"> <li>• Applied Digital Signal Processing</li> <li>• Computer/Machine Vision</li> <li>• Applied Machine Learning</li> <li>• Applied Deep Learning</li> </ul>	2
		Total Lectures	40

c. **Pre-requisites, if any:** None. Prior knowledge/experience in Arduino and python programming may be helpful but not mandatory.

**d. Short Summary:**

This is an interdisciplinary course that trains students in designing and developing interaction technologies in physical as well as virtual world. It gives a foundation of programming the front-end as well as back-end of a GUI and integrate with the hardware system developed using Arduino or Raspberry pi. This course is structured in such a way that the candidates will learn the concepts by practice (design projects).

**e. Recommended Books:**

- Shneiderman B. "Designing The User Interface - Strategies for Effective Human-Computer Interaction." Pearson Education
- Johnson P. "Human Computer Interaction: psychology, task analysis and software engineering." McGraw Hill Book Company, 1992.
- Buxton B., Sketching User Experiences: Getting the Design Right and the Right Design, Morgan Kaufmann
- Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, "Human-Computer Interaction", third edition
- Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA.

Dated: 18-5-2023

Proposers: Dr. Gowdham Prabhakar

Dated:

DPGC Convener: