**Asian Institute of Technology**
School of Engineering and Technology

**AT74.11 Haptics 3(2-3)** **Semester: January**

**Course Objective:** Haptics is becoming popular with the evolution of the Mechatronics approach, especially in biomedical applications. Tele-operation applications now demand haptic feedback to be embedded. Creation of virtual objects using virtual forces/impedances has become common in many industry applications. The main objective of this course is to impart the knowledge and experiences of haptics so that students will be able to apply it on haptics related applications.

**Learning Outcomes:**
Upon completion of this course, the students would be able to:

- Design haptic devices using the human haptics sensing mechanisms
- Design and program haptic tele-operation systems
- Analyze different types of haptic interfaces in terms of their functionality
- Identify the current developments and research gaps in haptics

Prerequisites: None

**Course Outline:**

I. Introduction to Haptics
   1. Human sensory organs and motor control
   2. Human kinesthetic and cutaneous sensing
   3. Applications of haptics

II. Haptic Devices and Applications
   1. Kinematics and dynamics of haptic devices
   2. Design, control and simulation of haptic devices
   3. Tactile and vibrotactile devices

III. Haptic Rendering
   1. Virtual walls, virtual shapes and creation of virtual effects
   2. Haptic impedance and admittance
   3. Virtual forces and effects

IV. Tele-operation
   1. Evolution of tele-operation
   2. Bilateral tele-operation and control strategies
   3. Transparency stability and operationality of tele-operation systems
   4. Force sensors and Reaction Force Observer
   5. Advances of research in tele-operation

**Laboratory Sessions:**

- Vibrotactile Sensor Performance
- Introduction to Phanthom Omni Device and programming
- Virtual walls
- Virtual Impedances
- Tele-operation
- Programming Tele-operation devices
- Bilateral tele-rehabilitation

**Learning Resources**

Textbooks: No designated text book, but class notes and handouts will be provided

Reference Books:


1. A. Sears, J.A. Jacko(eds), Human-Computer Interaction Fundamentals, CRC press, 2009
2. M. Mihelj, J. Podobnik, Haptics for Virtual Reality and Teleoperation, ,Springer, 2014
3. C. Hatzfeld, T.A. Kern(eds), Engineering Haptic Devices: A Beginner's Guide 2nd edition, Springer,2014


Journals and Magazines:


1. Sprectrum, IEEE
2. IEEE Transactions on Haptics, IEEE
3. Automatica, Elsevier


**Teaching and Learning Methods**: Methods used are lectures and assignments which include presentations

**Time Distribution and Study Load:**
Lectures: 42 hours
Presentations: 6 hours
Self study and assignments: 135 hours

**Evaluation Scheme:** Mid semester (30%) examination, final examination(40%) (both are closed book) and assignments (30%).

In the evaluation, an "A" will be awarded if a student demonstrates an excellent level of understanding of the principles and demonstrates excellent capabilities in haptics related applications. "B" will be awarded if a student demonstrates an average level of understanding of the principles and demonstrates average capabilities in haptics related applications. "C" will be given if a student

demonstrates below average level of understanding of the principles and demonstrates below average level of capabilities in haptics related applications.

**Instructor(s):** Dr. A.M. Harsha S. Abeykoon