IIT Mandi
Proposal for a New Course

Course number : **EE 543**
Course Name : **Vision and Learning Based Control**
Credit Distribution : *3-0-0-3*
Intended for : **3rd/4th year B.Tech. EE, CS, and M.Tech/Ph.D.**
Prerequisite : **None**
Mutual Exclusion : **None**

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1. **Preamble:** This course provides exposure to vision and learning-based control techniques. The course covers a wide range of related topics. The objective is to impart knowledge related to visual servoing, and robot learning along with various applications. By the end of the course, the student will be able to-

   • Understand the role of visual sensors to control different real-time systems
   • Understand the fundamental components of visual servoing
   • Understand the key concept for robot learning by demonstration
   • Understand the utility of imitation learning for practical systems
   • Utilize visual feedback to control the given system of interest

2. **Course Modules:** The modules to be covered in this course are-

   Introduction [1L]: Overview, motivation, and real-world practical applications.

   Visual Sensor Model and Calibration [10L]: Camera model, Coordinate Frames and Transforms, Intrinsic camera calibration, and extrinsic camera calibration.

   Visual Servoing [14L]: Image Jacobian, Robot Jacobian, Image Based Visual Servoing, Position Based Visual Servoing, Eye-in-hand and Eye-to-hand Configurations, Comparison among different class of visual servoing.

   Robot Learning [14L]: Basic concepts of reinforcement learning, reinforcement learning algorithms. Robot learning by demonstration.

   Hybrid Method Design [3L]: Comparative analysis for various methods. Explore, understand and identify different ways to design a hybrid scheme to control the given system of interest. Case study and course projects.

3. Text books:

- Corke, Peter I., and Oussama Khatib. Robotics, vision and control: fundamental algorithms in MATLAB. Vol. 73. Berlin: Springer, 2011.
- Vakanski, Aleksandar, and Farrokh Janabi-Sharifi. Robot learning by visual observation. John Wiley & Sons, 2017.

4. References:

• Ijspeert, Auke Jan, et al. "Dynamical movement primitives: learning attractor models for motor behaviors." Neural computation 25.2 (2013): 328-373.
• Chaumette, François, and Seth Hutchinson. "Visual servo control. I. Basic approaches." IEEE Robotics & Automation Magazine 13.4 (2006): 82-90.
• Chaumette, François, and Seth Hutchinson. "Visual servo control. II. Advanced approaches [Tutorial]." IEEE Robotics & Automation Magazine 14.1 (2007): 109-118.

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.				

6. Justification of new course proposal if cumulative similarity content is >30%: