EE904 – Deep Learning for Communications

Department of Electrical Engineering
Indian Institute of Technology Kanpur

1. **Course No.**: EE904

2. **Course title**: Deep Learning for Communications

3. **Pre-requisites**: Basic knowledge of Probability theory and Linear algebra, Python or Matlab programming background.
   If students do not have above background, then they should be motivated to learn basics of above during the progress of the course and instructor will give enough time as well as discussion sessions will be conducted to clear doubts of the students.

4. **Course duration**: Full semester

5. **Instructor**: Dr. Tushar Sandhan, sandhan@iitk.ac.in

6. **Proposing Department**: Electrical Engineering

   Other Departments where the course content will be overlapping: Computer Science and Engineering

7. **Course type**: PG

8. **Course description:**

   Recently the deep learning techniques have become popular and widely used in industrial applications, autonomous driving, robotics and automation. It is also being used in healthcare, disease diagnosis and finding its applications in communication engineering. Its impressive image generation ability has found application in art, paintings and ancient image recoveries.

   This course will cover the deep learning, machine learning methods and their applications in communications. Deep learning for communications is a novel field that offers many attractive interdisciplinary research areas at the interface between information theory, machine learning and communications engineering.

9. Course contents:

1. Introduction and applications of AI, ML and DL
2. DL applications and concepts in communications
3. Mathematical basics for ML
4. Regression and Classification
5. Neural networks and optimization algorithms
6. Convolutional neural networks
7. State of the art CNN architectures
8. Feature representation and learning
9. Programming demo application (python)
10. Ground penetrating radars and applications
11. Input signals representation and classification (audio, image)
12. Millimeter-waves and object detection
13. Load balancing and optimal resource allocation
14. Optical communication and pattern recognition
15. Wi-Fi and indoor localization
16. AI for satellite communication

17. Course evaluation scheme:

There will be online quizzes (objective or brief answer based) – total 2 or 3
Programming assignment – total 1 or 2
Final end exam – total 1
Total number of programming assignments or quizzes will be decided via discussion with students during online virtual conference/meeting sessions.

10. Reference books:

1. Goodfellow, Y. Bengio, and A. Courville, Deep Learning, MIT Press, 2016
2. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006
3. R.-S. He and Z.-G. Ding, Applications of Machine Learning in Wireless Communications, IET, 2019