

Indian Institute of Technology Kanpur
Proposal for a New Course

1. Course No: CHE 6XX
2. Course Title: Foundation of Deep learning for Chemical Engineers
3. Per Week Lectures: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional Hours[0-2]: 0 (A), Credits (3-0-0-0) Duration of Course: Full semester
4. Proposing Department: Department of Chemical Engineering

Other Departments/IDPs which may be interested in the proposed course: ME, AE, MSE

Other faculty members interested in teaching the proposed course: Harshwardhan H. Katkar

5. Proposing Instructor(s): Indranil Saha Dalal

6. Course Description:

A) Objectives: The course will build up from a basic Machine learning course and introduce the concepts of Deep learning. The students are expected to have a basic exposure of Machine learning and computer programming. The problems and examples relevant to engineering, especially chemical engineering, will be selected, whenever possible.

B) Contents (preferably in the form of 5 to 10 broad titles):

Lecture-wise break-up (considering the duration of each lecture is 50 minutes)

S. No.	Broad Title	Topics	No. of Lectures
1.	Introduction	Introduction to Deep learning and examples	2
2.	Probabilities and distributions	Probability, Probability density, Information theory, Bayesian probabilities, Discrete variables, Multivariate Gaussian	6
3.	Single Layer Networks: Regression	Linear regression, Basis functions, Likelihood function, Geometry of least squares, Multiple outputs	4
4.	Single Layer Networks: Classification	Discriminant functions, Decision Theory, Generative Classifiers, Discriminative Classifiers	6
5.	Deep Neural Networks	Limitations of fixed basis functions, multilayer networks, deep networks, error functions	6
6.	Gradient Descent	Gradient Descent optimization, convergence, normalization	3
7.	Backpropagation	Evaluation of gradients, automatic differentiation	2
8.	Convolutional Networks	Computer vision and convolutional filters, visualizing trained CNNs and object detection	3
9.	Graph Neural Networks	Machine learning on graphs, Neural message-passing, General graph networks	4
10.	Sampling	Sampling algorithms, Markov Chains Monte Carlo, Langevin Sampling	4

C) Recommended pre-requisites, if any (examples: a- PSO201A, or b- PSO201A or equivalent): Basic UG-level programming and any first level course on Machine learning.

D) Short summary for including in the Courses of Study Booklet:

Probability, Distributions, Single layer networks for regression and classification, Deep neural networks, Gradient descent, Convolutional networks, Graph neural networks, Sampling

7. Recommended text/reference books:

A) Christopher M. Bishop, Hugh Bishop; Deep Learning, Springer, 2024.

8. Any other remarks:

A) Most of the homework assignments will involve computer programming by the students. Assignments will be given every week.

Dated: 12/7/2024

Proposer: Indranil Saha Dalal

Dated:

DPGC Convener:

The course is approved / not approved

Chairman, SUGC

Dated: 27/09/2022