SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of Chemical Engineering	LP: CL22016 Rev. No: 00
B.E/B.Tech/M.E/M.Tech : M.Tech Regulation: 2022 PG Specialisation : Chemical Engineering Sub. Code / Sub. Name : CL22016 Artificial Intelligence for Chemical Engineering Unit : I Introduction to AI	Date: 8.7.2024

Unit Syllabus: What is Artificial Intelligence? Types of problems AI addresses like Computer Vision, Natural Language Processing, Robotics, Expert Systems, Object detection and Image segmentation. Applications of AI in chemical engineering areas like fault diagnosis, Process control, Process design, Planning and operations, Modeling and simulation and Product design, development and selection like Separation Design, Heat-Exchanger Network Synthesis.

Objective: To understand the application of Artificial Intelligence in chemical engineering areas

Session No *	Topics to be covered	Ref	Teaching Aids
1	Introduction to Artificial Intelligence	T1: pp 1- 5 T2: pp 197	PPT & BB
2	Types of problems AI can solve	T2: pp 198 - 202	PPT & BB
3	AI applications for computer vision and Natural Language processing	Web resources	PPT & BB
4	AI applications in Robotics, Expert systems	Web resources	PPT & BB
5	AI applications in image segmentation and Object detection	Web resources	PPT & BB
6	AI in chemical engineering – Fault diagnosis, planning and operation	T2: pp 401-409	PPT & BB
7	AI in process control, Process design	T2: pp 412 - 419	PPT & BB
8	AI in separation design and heat exchanger Network synthesis	T2: pp 420 - 421	PPT & BB
9	AI in planning and operations/ Modeling and Simulation	T2: pp 427 - 438	PPT & BB

Content beyond syllabus covered (if any):

* Session duration: 50 minutes

SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Sub. Code / Sub. Name: CL22016 Artificial Intelligence for Chemical Engineering

Unit : II Deep Artificial Neural Networks (DNNs)

Unit Syllabus: The working of the Rosenblatt perceptron, multilayer perceptrons. Activation functions and their importance in incorporating nonlinearities into the predictive models. The feed forward process in ANN layers with dense fully connected layers. The error (loss) functions as a measure of the ANN performance. Backpropagation algorithm for neuron learning.

Objective: To familiarize with the construction and working of Deep Neural Networks

Session No *	Topics to be covered	Ref	Teaching Aids
10	Introduction to Deep Neural Networks	R1: pp 96 - 101	PPT & BB
11	Working of Rosenblatt perceptron	Web resources	PPT & BB
12	Multilayer perceptron	Web resources	PPT & BB
13	Activation functions – Predictive models	T2: pp 457-458	PPT & BB
14	Feed forward process in ANN layers	Web resources	PPT & BB
15	Measurement of ANN performance	R1: pp 101 - 106	PPT & BB
16	Loss functions/Error functions as a measure of ANN performance	R1: pp 108 - 114	PPT & BB
17	Backpropagation algorithm for neuron learning	T2:pp 449 - 450	PPT & BB
18	Example problems in back propagation algorithms	T2: pp 453- 464	PPT & BB
Content beyond syllabus covered (if any):			

* Session duration: 50 mins

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COURSE DELIVERY PLAN - THEORY

Sub. Code / Sub. Name: CL22016 Artificial Intelligence for Chemical Engineering

Unit : III Convolutional Neural Networks (CNNs)

Unit Syllabus: The drawbacks of Deep ANN. How CNN take into account the spatial patterns. The working of the CNN in pattern recognition. The role of kernels, pooling, padding and stride in CNN learning. How the kernels help in reducing the learning parameters (weight sharing). One, two and three dimensional convolutions.

Objective: To study the construction and working of Convolutional Neural Networks (CNNs)

Session No *	Topics to be covered	Ref	Teaching Aids
19	Introduction to Convolutional Neural Networks	R1: pp 326	PPT & BB
20	Comparison between Deep Neural networks and Convolutional Neural Networks	R1: pp 329	PPT & BB
21	Convolutional Neural Networks application in Pattern recognition	R1: pp 330	PPT & BB
22	Role of kernels and pooling in CNN learning	R1: pp 335 - 341	PPT & BB
23	Role of padding and stride in CNN learning	R1: pp 342 - 352	PPT & BB
24	Reducing learning parameters by weight sharing	R1: pp 331 - 334	PPT & BB
25	Examples and case studies in CNN applications	Web resources	PPT & BB
26	Examples and case studies in CNN applications	Web resources	PPT & BB
27	1,2,3 dimensional convolutions	R1: pp 365	PPT & BB
Content beyond syllabus covered (if any):			

* Session duration: 50 mins

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COURSE DELIVERY PLAN - THEORY

Sub. Code / Sub. Name: CL22016 Artificial Intelligence for Chemical Engineering

Unit : IV Transfer Learning

Unit Syllabus: Some outstanding deep networks proposed like AlexNet, VGGNet, Inception, GoogleNet and ResNets. The problems they faced and how they resolved the problems. The concept of Transfer Learning and how one can use these proposed networks to solve other relevant problems.

Objective: To understand transfer learning and examples of deep networks.

Session No *	Topics to be covered	Ref	Teaching Aids
28	Introduction to Transfer learning	T1: Ch 13	PPT & BB
29	AlexNet architecture	Web resources	PPT & BB
30	VGGNet architecture	Web resources	PPT & BB
31	Inception architecture	Web resources	PPT & BB
32	GoogleNet and ResNets architecture	Web resources	PPT & BB
33	Challenges in Transfer learning	T1: Ch 13	PPT & BB
34	Examples in Transfer learning	Web resources	PPT & BB
35	Case studies in Transfer learning	Web resources	PPT & BB
36	Using Transfer learning to solve engineering problems	Web resources	PPT & BB
Content beyond syllabus covered (if any):			

* Session duration: 50 mins

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COURSE DELIVERY PLAN - THEORY

Sub. Code / Sub. Name: CL22016 Artificial Intelligence for Chemical Engineering

Unit : V Sequence modelling using Recurrent Neural Networks

Unit Syllabus: The application of this architecture in predictions based on sequential data. Various RNN architectures proposed like many to one, One to many and Many to many. The variants of RNN like Gated Recurrent Units (GRU) and the Long Short Term Memory (LSTM) architectures.

Objective: To understand the various architectures of RNNs.

Session No *	Topics to be covered	Ref	Teaching Aids
37	Introduction to Recurrent Neural Networks	R1: pp 367	PPT & BB
38	Sequence modelling using Recurrent Neural Networks	R1: pp 372	PPT & BB
39	RNN architecture in predictions based on sequential data	R1: pp 373 - 376	PPT & BB
40	Many to one RNN architecture	R1: pp 377 - 378	PPT & BB
41	One to many RNN architecture	R1: pp 380 - 382	PPT & BB
42	Many to Many RNN architecture	R1: pp 383 - 385	PPT & BB
43	Gated Recurrent Units	Web resources	PPT & BB
44	Long Short Term Memory architectures	Web resources	PPT & BB
45	Applications and Examples of Recurrent Neural Networks	Web resources	PPT & BB

Content beyond syllabus covered (if any):

* Session duration: 50 mins

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Sub Code / Sub Name: CL22016 Artificial Intelligence for Chemical Engineering

TEXTBOOKS:

1. Raff, Edward. Inside Deep Learning: Math, Algorithms and Models. Manning Publications, 2022.

2. Quantrile, Thomas, Liu, Y. A, Artificial Intelligence in Chemical Engineering, Academic Press, 1991.

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville. Deep Learning. (Adaptive Computation and Machine Learning series). 2015.

	Prepared by	Approved by
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Designation	Assistant Professor	Professor and HoD
Date	8.7.2024	8/07/24.
Remarks*		
Remarks*		

* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD