COURSE PLAN

V Trimester (2024-25)

SECTION I

Class	5MCA	**Semester**	V
Course title	Neural Networks and Deep Learning	**Course Code**	MCA572
Hours	60	**Hours per week**	6 (4+2)
Credits	4	**Course Type**	Theory & Practical
Faculty name	Dr. NISHA VARGHESE	**Contact details**	nisha.varghese@christuniversity.in 9497796443
Class policies and guidelines	• Please ensure strict compliance with the class policies of the University/Department as outlined in the following link: https://christuniversity.in/general-regulations. • Students must adhere to the timetable and be present in their designated classrooms. • Attendance will be taken within the first 5 minutes, and latecomers will not be permitted for attendance. • Active and voluntary participation is expected during discussions • All the information will be communicated in the class and the same will be posted in Google Classroom. • All the programs must be uploaded to the GitHub account, and the GitHub account must be associated with your official Christ ID. • Cell phones, iPods/MP3 players should be kept in your bag and turned off, as these items cause disruptions during valuable class time. • All students are required to bring their laptops with necessary software installed. Laptops should only be used when instructed in class. • It is expected that students will employ genuine, sincere, and fair methods to complete tests, tasks, or projects, which will be used to		

	evaluate their progress. Any instances of plagiarism, copying, or cheating will result in automatic zeros.
Teaching methodologies	**Peer Learning** Promotes collaborative knowledge exchange and critical thinking by enabling students to teach and learn from one another **Experiential Learning** Assessment components are designed to work in a team to ensure experiential learning with a real-world scenario. Students are allowed to form a team based on the concepts of their interest. **Problem Solving** The students are also asked to solve some real time problems on ANN's, CNN's, RNN's etc **Concept Visualization** The simulation tools and play are used to visualise CNN/ANN working to have better understanding. **Expert Interaction** The students will be given extra training on the trends in industry with Deep learning.
Course Description	Understand the concepts and models of the neural networks and deep learning and its applications.
Course Objectives	The main aim of this course is to provide fundamental knowledge of neural networks and deep learning. On successful completion of the course, students will acquire fundamental knowledge of neural networks and deep learning, such as Basics of neural networks, shallow neural networks, deep neural networks, forward & backward propagation process and build various research projects**.**
Course Outcomes	**CO1:** Understand the major technology trends in neural networks and deep learning **CO2:** Build, train and apply neural networks and fully connected deep neural networks **CO3:** Implement efficient (vectorized) neural networks for real time application

SECTION II

Unit	Unit details	Week	Hours per week	Pedagogy (teaching learning methods used)/ activities and or class trips/ dates for assessment	Resource/ Reference details
UNIT - 1 Introduction to Artificial Neural Networks	Neural Networks - Application Scope of Neural Networks - Fundamental Concept of ANN. The Artificial Neural Network - Biological Neural Network - Comparison between Biological Neuron and Artificial Neuron Evolution of Neural Networks.	Week 01 Sept 9-14	**6**	Diagnostic assessment - Mentimeter, Lecture, Demo, Discussion, Problem Solving	**Textbook / Online Resources**
	Basic models of ANN - Learning Methods - Activation Functions - Importance - Terminologies of ANN **Lab Exercises:** 1. Create Single Layer Perceptron for Binary Classification using binary and bipolar sigmoid activation functions.	Week 02 Sep 16 – 20	**6**	Lecture, Demo, Discussion, PPT, Problem Solving	
UNIT - 2 Supervised Learning Network	Shallow neural networks- Perceptron Networks - Theory - Perceptron Learning Rule - Architecture - Flowchart for training Process - Perceptron Training Algorithm for Single and Multiple Output Classes. **Lab Exercises:** 2. Implementation of logical gates AND, OR, NAND and XOR using perceptron network.	Week 03 Sep 23 – 28	**6**	Lecture, Demo, Discussion, Problem Solving, Participatory learning (Flippity Quizzes)	

	Back Propagation Network-Theory-Architecture-Flowchart for training process - Training Algorithm-Learning Factors for Back-Propagation Network. **Lab Exercises:** 3. Demonstrate Activation Functions in Artificial Neural Networks	Week 04 Sept 30 - Oct -05	**6**	Problem Solving, Lecture, Demo, Discussion **CIA I – Lab Test**	**Textbook / Online Resources**
	Radial Basis Function Network RBFN: Theory, Architecture, Flowchart and Algorithm. **Lab Exercises:** 4. Develop Backpropagation Network for Handwritten Digit Recognition	Week 05 Oct 7 -12	**6**	Problem Solving, Lecture, Demo,Peer learning, Discussion **ETE I - MCQ**	
UNIT - 3 Convolutional Neural Network	Introduction to CNN, Components of CNN Architecture - Rectified Linear Unit (ReLU) Layer **Lab Exercises:** 5.Demonstrate Radial Basis Function Network for Function Approximation	Week 06 Oct 14 -18	**6**	Problem Solving, Lecture, Demo, Discussion. Powerpoint presentation	**Textbook / Online Resources**
	Exponential Linear Unit (ELU, or SELU), Unique Properties of CNN	Week 07 Oct 21 -26	**4**	Problem Solving, Lecture, Demo, Discussion **ETE II – Theory Test**	

	Architecture of CNN, Applications of CNN. **Lab Exercises:** 6. Create Convolutional Neural Network for Image Classification and Demonstrate Convolution Operation in CNN	Week 08 Oct 28 – Nov 2	**4**	Problem Solving, Lecture, Demo, Discussion Experiential learning (play with CNN's)	
UNIT 4 - Recurrent Neural Networks	Introduction - The Architecture of Recurrent Neural Networks. The Challenges of Training Recurrent Networks- Echo -State Networks **Lab Exercises:** 7. Implementation of Recurrent Neural Networks	Week 09 Nov 04 - 09	**6**	Problem Solving, Lecture, powerpoint presentation, Demo, Discussion	**Textbook / Online Resources**
	Long Short - Term Memory (LSTM) - Applications of RNN. **Lab Exercises:** 8. Demonstrate Echo State Networks for Time Series Prediction	Week 10 Nov 11 – 15	**6**	Problem Solving, Lecture, Demo, powerpoint presentation, Discussion	
UNIT - 5 Auto Encoder and Restricted Boltzmann Machine	Introduction - Features of Auto encoder, Types of Autoencoder. Restricted Boltzmann Machine- Boltzmann Machine **Lab Exercises:** **9.** Develop LSTM for Sentiment Analysis	Week 11 Nov 18 – 23	**6**	Problem Solving, Lecture, Demo, Discussion **ETE III – Lab Test**	**Textbook / Online Resources**

	Restricted Boltzmann Machine Architecture -Example - Types of Restricted Boltzmann Machine **Lab Exercise:** 10. Create Denoising Autoencoder for Image Reconstruction	Week 12 Nov 25 – 30	**6**	Problem Solving, Lecture, Demo, Discussion	
	Revision and Retest	Week 13 Dec 2 – Dec 7	**6**	Problem Solving, Lecture, Demo, Discussion, powerpoint presentation	
	Revision	Week 14 Dec 9 – Dec 14	**6**	Problem Solving, Lecture, Demo, Discussion	

Essential Reading:

[1] Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, Alanna Maldonado, 2023.

[2] Charu C. Aggarwal, Neural Networks and Deep Learning, Springer, September 2018.

[3] Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

Recommended Reading:

[1] S Lovelyn Rose, L Ashok Kumar, D Karthika Renuka, Deep Learning Using Python, Wiley India, 1st Edition, 2019.

[2] Francois Chollet, Deep Learning with Python, Manning Publications; 1st edition, 2017.

[3] John D. Kelleher, Deep Learning (MIT Press Essential Knowledge series), The MIT Press, 2019.

Web Resources:

[1] http://neuralnetworksanddeeplearning.com

[2] https://www.deeplearningbook.org/

[3] https://infyspringboard.onwingspan.com/

[4] https://www.bishopbook.com/

Lab Exercises

Each program carries 10 marks and the Evaluation Rubrics for each program would be:

Evaluation Criteria	
5 marks	**C1-Implementation, Correctness and Complexity**
2 marks	**C2-Documentation and Visualization**
3 marks	**C3-Concept Clarity and Explanation**

SECTION III
CO-PO (Course Outcomes and Programme Outcome) MAPPING

PO/ CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	-	-	2	-	-	-	-	-	2	-
CO2	3	3	2	2	2	-	-	-	-	1	-	-
CO3	3	3	3	2	2	-	-	-	-	1	2	-

Level of mapping 1 indicates low, 2 indicates medium and 3 indicates high.

Assessment outline:

Weightage	Component	Marks	Description of the CIA component	Schedule
CIA 50 marks	Component – I	50	Lab Test – I Duration:2 hour Total Marks: 50 marks No of questions: 1 / 2 Scenario based questions	Week 4
	Component – II	45	Regular Lab exercises evaluations	
	Attendance	5	Regularity and Punctuality	
	Total	**100**	The total mark will be converted to 50	
ETE 50 marks	Component – III	20	MCQ	Week 5
	Component-IV	30	Theory Written Test would be conducted in a common schedule proposed by the department. Duration:2 hours No of questions: 5 with internal choices Each question is for 10 Marks Total Marks: 50 marks and reduced to 30 Marks	Week 7
	Component – V (Comprehensive Examination)	50	Lab Test / Project Presentation / Statistical Inference report submission for the given scenario Duration:2 hours Total Marks: 50 marks	Week 11
	Total	**100**	The total mark will be converted to 50	
	Total	**100**	The total mark will be converted to 50	

A template to map the Course Outcomes with the components of assessment is given below.

Course Outcomes	Components of assessment (with the break-up of marks)					
	CIA			ETE		
	CIA C1 (Lab Test1) 50 Marks	CIA C2 (Regular Program) 45 Marks	Attendance 5 Marks	ETE - I (MCQ) 20 Marks	ETE - II (Theory Test) 30 Marks	ETE - III (Project & Presentation) 50 Marks
CO1: Understand the major technology trends in neural networks and deep learning	25	10		15	10	10
CO2: Build, train and apply neural networks and fully connected deep neural networks	25	10		5	10	15
CO3: Implement efficient (vectorized) neural networks for real time application		25			10	25

SECTION IV
ASSESSMENT : CIA I

Assessment description:

Assessment Component	Lab Test
Assignment Topic	Fundamentals of Neural Network
Nature of the assignment	Individual submission in Google Classroom
Submission mode	Softcopy submission – Google Classroom
Deadline for submission	Week 4
Maximum marks	50
General Instruction	• Late submission will not be entertained

	• The lab should be completed in the stipulated time and only that submission will be considered for evaluation. • It's mandatory to submit the screenshot/screen recording of output along with the program .

Learning outcomes:

LO1: Build basic neural network models using perception rule

LO2: Able to use learning factors and differentiate the NN architecture

Evaluation Rubrics:

Evaluation Rubrics	Max marks	CRITERIA		
	50	0-18	19- 32	33-50
R1: Defining Problem and R2: Data Collection	15	Unclear problem objective; Unplanned data collection (0-5)	Moderately defined problem objectives; Partially relevant data collection (6-10)	Well defined problem objectives; Highly relevant data collection (11-15)
R3: Model Building	25	Improper implementation; Complete inappropriate model construction (0-8)	Partial implementation; Inadequate model construction (9-16)	Complete implementation; Well defined model construction (17-25)
R4: Report Design and formatted document	10	No inference of results; Unformatted document (0-3)	Partial inference of results; Formatted document (4-7)	Good inference of results; Well formatted document (7-10)

Assessment Description: ETE Component-1

Nature of Assignment	MCQ
Submission Mode	Online (Moodle Platform)

Learning outcomes:

LO1: Analyze the use of foundation models and its applications in various domains.

LO2: Understand the basic concepts of Large Language Models.

Evaluation Rubric/s:

Score	**Impression**	**Description**
16-20	Proficient	Excellent understanding and comprehensive knowledge in the area of Artificial Neural Networks. Demonstrates a clear understanding of the topics and provides accurate answers to the MCQs.
11-15	Good	Good understanding of Artificial Neural Networks. Provides correct answers to most of the MCQs, with a few minor errors or omissions.

6-10	Satisfactory	Fair understanding of Artificial Neural Networks. Provides partially correct answers to some of the MCQs but lacks clarity or makes significant errors in understanding.
1-5	Need to Improve	Limited understanding of Artificial Neural Networks. Provides incorrect or incomplete answers to the MCQs, demonstrating a lack of knowledge in the topics covered.

ASSESSMENT: ETE Component II

Assessment Component	Written Test
Portion for the Test	Unit 1, 2 and 3
Date	17/11/2024
Type of Questions	Problems and Brief Questions
Duration	2 Hours
Maximum marks	50 Marks - (Scale down to 30 marks)
General Instruction	• Absenteeism is not entertained

Learning Outcomes

LO1: Able to understand various types of neural network

LO2: Able to apply Back Propagation algorithm and RBF

LO3: Able to understand and apply CNN

Evaluation Rubrics

Score (Marks)	**Impression**
>=27	Proficient
22-26	Very Good
18-25	Good
15-17	Satisfactory

12-14	Needs to Improve
<12	Poor

Mapping the Learning Outcomes of the assignment with components of the evaluation rubrics:

Learning Outcomes of the assignment	Method of assessment	Component of the evaluation rubrics
LO1: Able to understand various types of neural network	✔ Review of written document	Clarity in Concepts
LO2: Able to apply Back Propagation algorithm and RBF		
LO3: Able to understand and apply CNN		

ASSESSMENT: ETE Component III

Assessment description:

Assessment Component	Programming Assignment
Assignment Topic	Applications and Implementation of Deep Learning Models 1. Identify the problem and collect the dataset(s) 2. Explore any two of the deep learning models and give your observation.
Nature of the assignment	Individual
Submission mode	Need to submit in Google Classroom 1. Code (Github) and 2. PDF document with problem, results and inference
Deadline for submission	Week 11
Page limit	Code (As per the logic); PDF document (minimum 5 pages with results and visualization)
Maximum marks	50
Assignment Description	● Choose any domain of your interest and define the problem objectives. ● Data acquisition / Data collection ● Model(s) Building ● Result interpretation and report designing
General Instruction	● Format the report using IEEE standards

	• Plagiarised assignment will not be considered for evaluation • Late submission will not be entertained • Expected to submit a well formatted copy of assignment

Learning outcomes:

LO1: Able to collect data with relevance to the problem domain.

LO2: Able to choose relevant activation functions and tune hyperparameters of CNN, RNN and Autoencoder.

LO3: Able to infer beneficial solutions from the chosen NN model

Evaluation Rubrics

1. Data Collection and EDA – 5 Marks
2. Implementation Program – 15 Marks
3. Visualization of results – 8 Marks
4. Accuracy & Interpretation - 7 Marks
5. Concept Clarity (VIVA)– 5 Marks
6. Report Submission – 10 Marks

Score	Impression
>=32	Proficient
31-23	Good
22-15	Satisfactory
<=14	Needs to improve