Amrita Vishwa Vidyapeetham
Amrita School of Computing, Amritapuri.
Department of Computer Science and Engineering

Course Plan

1. Course Information

Course code/Title: 23RAI312 DEEP LEARNING L-T-P-C: 2-0-3-3

Academic year and term: 2026-2027 Even Semester
Program/Batch/Semester: BTech. / 2023-2027 / Semester V

2. Course Mentors: Anjali T

3. Course Objectives

- To explore the neural networks and deep learning architectures.
- To enable students to implement, train and debug deep feed forward neural networks.
- To familiarize the application of convolutional neural networks and RNN for images and image sequences.

4. Course Outcomes

CO #	Outcome
CO1	Describe the architecture and parameters involved in deep neural nets.
CO2	Exhibit the design and usage of Convolutional Neural networks. .
CO3	Apply neural networks for sequential models.
CO4	Design Neural networks and implement for real time applications.

5. CO-PO Affinity Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	–	–	–	2	2	–	2	1	3	3
CO2	2	2	2	2	3	–	–	–	2	2	–	2	1	3	3
CO3	2	2	2	2	3	–	–	–	2	2	–	2	1	3	3
CO4	2	2	2	3	3	–	–	–	2	2	–	2	1	3	3

6. CO-PO Affinity Justification

CO	PO / PSO	Affinity	Justification
CO1	PO1	2	Builds fundamental understanding of neural networks and deep learning concepts, supporting mathematical and theoretical analysis.
CO1	PO2	2	Enables students to analyze basic learning problems using neural network models and appropriate techniques.
CO1	PO3	2	Supports the development of basic solution designs using standard neural network architectures.
CO1	PO4	2	Applies theoretical knowledge to well-defined engineering problems in classification and prediction tasks.
CO1	PO5	3	Encourages the use of modern tools and platforms for implementing deep learning models effectively.
CO1	PSO1	1	Introduces domain-specific concepts relevant to intelligent systems with limited specialization.
CO1	PSO2	3	Strengthens foundational knowledge of deep learning essential for advanced robotics and AI applications.
CO1	PSO3	3	Supports interdisciplinary application of neural network concepts in robotics-related problems.
CO2	PO1	2	Enhances understanding of deep learning architectures and training algorithms through theoretical exposure.
CO2	PO2	2	Develops the ability to analyze learning behavior and performance of neural network models.
CO2	PO3	2	Facilitates design of learning-based solutions using feedforward and convolutional neural networks.
CO2	PO4	2	Applies learned concepts to solve standard engineering problems involving data-driven decision making.

CO2	PO5	3	Promotes effective use of deep learning frameworks and libraries for model development.
CO2	PSO1	1	Provides introductory exposure to AI tools applied in interdisciplinary engineering contexts.
CO2	PSO2	3	Enhances competency in deep learning techniques essential for intelligent system development.
CO2	PSO3	3	Encourages application of deep learning models in robotics perception and control problems.
CO3	PO1	2	Strengthens theoretical understanding of convolutional and recurrent neural network models.
CO3	PO2	2	Enables analysis of image and sequence data using deep learning techniques.
CO3	PO3	2	Supports design of learning-based solutions for vision and sequence processing applications.
CO3	PO4	2	Applies deep learning models to well-defined engineering problems involving images and sequences.
CO3	PO5	3	Encourages the use of modern tools and libraries for implementing CNN and RNN models.
CO3	PSO1	1	Introduces application of learning models to interdisciplinary problem domains.
CO3	PSO2	3	Develops strong proficiency in advanced deep learning methods relevant to robotics.
CO3	PSO3	3	Facilitates application of deep learning techniques in robotics vision and sequence-based systems.
CO4	PO1	2	Reinforces conceptual understanding of deep learning models and their engineering relevance.
CO4	PO2	2	Encourages analysis and evaluation of deep learning model performance.
CO4	PO3	2	Supports the design and implementation of optimized learning-based engineering solutions.
CO4	PO4	3	Emphasizes application of deep learning techniques to complex and well-defined engineering problems.
CO4	PO5	3	Promotes advanced use of modern tools and frameworks for developing deep learning solutions.

CO4	PSO1	1	Provides limited exposure to interdisciplinary applications in intelligent systems.
CO4	PSO2	3	Strengthens advanced knowledge required for robotics and AI system development.
CO4	PSO3	3	Encourages integration of deep learning solutions in robotics and automation domains.

7. Syllabus

Unit 1

Deep Feed forward Networks Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms Dataset Augmentation, Noise Robustness Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training.

Unit 2

Convolutional Networks the Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features.

Unit 3

Sequence Modeling: Recurrent and Recursive Nets Recurrent Neural Networks, Bidirectional RNNs, Encoder Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory.

Lab Component: Specific exercises based on research articles / Case studies / data set for DL/ Robotic application

Text Books

Goodfellow I, Bengia Y, Couwille A. DeeF learning. MIT ¿ire,ss,- 2016.

Patter.son J, Gibson A. Deep learning: A ƒractitioner's afifiroach. "O'Reilly Media, Inc.",- 2017.

9. Evaluation Policy

Sl. No.	Exam	CO Coverage	Weightage%
1	Midterm	CO1 (70%), CO2 (30%)	30
2	**Data Camp Submission + Assessment**	CO1 (40%), CO2 (30%), CO3 (30%)	10
3	Project	CO2 (30%), CO3 (30%), CO4 (40%)	20
4	End Semester Exam	CO1 (30%), CO2 (35%), CO3 (35%)	40
	Total		100

Evaluation Plan

Continuous Evaluation – 30 marks

- 3 Datacamp course submissions and assessment (10 marks)
  - **Introduction to deep learning using PyTorch** - Basics of deep learning and neural networks, Optimizing a neural network with backward propagation, Building deep learning models, Fine-tuning models.
  - **Intermediate Deep Learning with PyTorch** - Training Robust Neural Networks, Images & Convolutional Neural Networks, Sequences & Recurrent Neural Networks, Multi-Input & Multi-Output Architectures.
- Project (20 marks)

Week	Submission	Details	Marks
Week 4	Project Proposal	Problem statement – Dataset to be used – Model idea and tools	1
Week 6	Interim Progress Report	Literature summary (3–5 papers) - Preliminary model architecture - Data preprocessing status	2
Week 8	Model Implementation Submission	Working code – Training outputs – Initial results (e.g., accuracy)	5
Week 10	Results Presentation with Viva	Viva/presentation	7
Week 11	Final Report/Paper	Complete report (structured, with references)/ Technical report in IEEE format	5

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10. Direct Assessment Tools

Sl. No	Direct Assessment Tools	Weightage (%)	Max Exam Marks	CO1	CO2	CO3	CO4
1	Midterm Exam	30	50	✓	✓		
2	DataCamp Submission + Assessment	10	10	✓	✓	✓	
3	Project	20	20		✓	✓	✓
4	End Semester Exam	40	100	✓	✓	✓	

11. CO Attainment Levels

Attainment Level	Target %
High	>= 70
Medium	>= 50
Low	< 50

12. Course Delivery Plan

Unit 1						
Week	**Topics (from syllabus ONLY)**	**Objective**	**CO**	**PO**	**PSO**	**Activity**
Week 1	Deep Feed Forward Networks, Gradient-Based Learning, Hidden Units, Architecture Design	To understand deep feedforward networks and learning principles	CO1	PO1, PO2	PSO1	PyTorch basics – DataCamp practice
Week 2	Back-Propagation and Other Differentiation Algorithms, Gradient Descent Variants	To learn training and optimization methods	CO1	PO1, PO2	PSO1	Implement backpropagation
Week 3	Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning	To study learning improvements and robustness techniques	CO1, CO2	PO1, PO2, PO3	PSO1	Data augmentation lab

Week 4	Early Stopping, Parameter Tying & Sharing, Sparse Representations, Bagging, Dropout, Adversarial Training	To apply regularization and ensemble methods	CO2	PO1, PO2, PO3	PSO1	**Project Proposal Submission**
Unit 2						
Week	**Topics (from syllabus ONLY)**	**Objective**	**CO**	**PO**	**PSO**	**Activity**
Week 5	Convolution Operation, Pooling, Convolution & Pooling as Strong Prior	To understand CNN fundamentals	CO2	PO1, PO2	PSO1	**Midterm Exam**
Week 6	Variants of Basic Convolution Function, Structured Outputs, Data Types	To analyze CNN variants and outputs	CO2, CO3	PO1, PO2, PO3	PSO1	CNN implementation
Week 7	Efficient Convolution Algorithms, Random or Unsupervised Features	To apply efficient CNN techniques	CO3	PO2, PO3, PO4	PSO1	Interim project review
Unit 3						
Week	**Topics (from syllabus ONLY)**	**Objective**	**CO**	**PO**	**PSO**	**Activity**
Week 8	Recurrent Neural Networks, Bidirectional RNNs	To understand basic sequence modeling	CO3	PO1, PO2, PO3	PSO1	RNN lab
Week 9	Encoder–Decoder Seq2Seq Architectures, Deep Recurrent Networks	To learn advanced sequence architectures	CO3	PO2, PO3, PO4	PSO1	Model implementation
Week 10	Recursive Neural Networks, Long-Term Dependencies, Echo State Networks	To address long-term dependency challenges	CO3	PO2, PO3, PO4	PSO1, PSO2	Final demo & viva
Week 11	LSTM & Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory	To design and optimize sequence models	CO4	PO2, PO3, PO4, PO5	PSO1, PSO2	Final report / End Sem

13. Faculty Information with Signature

Faculty Name	Class	Signature
Anjali T	S6 Robotics	