

## NIRMA UNIVERSITY

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| Institute:            | Institute of Technology                            |
| Name of Programme:    | B Tech Electronics and Instrumentation Engineering |
| Semester:             | VI   |
| Course Code:          |  |
| Course Title:         | Deep Learning for Vision Systems                   |
| Course Type:          | Department Elective - II                           |
| Year of Introduction: | 2025-26  |

| L | T | Practical component |    |   |   | C |
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### Course Learning Outcomes (CLOs):

At the end of the course, students will be able to –

1. illustrate basic architecture of convolution neural networks **(BL2)**
2. evaluate existing practical vision systems **(BL5)**
3. optimize convolutional neural network model **(BL5)**
4. design deep learning based real life vision applications. **(BL6)**

| Unit            | Contents  | Teaching Hours<br>(Total 45) |
|-----------------|---|------------------------------|
| <b>Unit- I</b>  | <b>Introduction to Computer Vision</b><br>Image acquisition, image pre-processing, feature extraction, computer vision pipeline, applications of computer vision.   | <b>04</b>                    |
| <b>Unit-II</b>  | <b>Deep Learning</b><br>Single layer perceptron, multi-layer perceptron (MLP), activation functions, errors functions, backpropagation, feedforward process, optimization algorithm.  | <b>09</b>                    |
| <b>Unit-III</b> | <b>Convolutional Neural Networks</b><br>Image classifications using MLP, basic components of a convolutional neural network (CNN), CNN architecture, image classification using CNN, overfitting and underfitting, popular CNN architectures.   | <b>08</b>                    |
| <b>Unit-IV</b>  | <b>Design of Deep Learning Structure</b><br>Baseline model design, define performance metrics, data preparation, model training, model evaluation, performance estimation, network improvements, hyperparameter tuning, optimization and learning, regularization, batch normalization. | <b>11</b>                    |
| <b>Unit-V</b>   | <b>Image Classification and Detection</b><br>Advanced CNN architectures, object detection, transfer learning, object classification.  | <b>08</b>                    |
| <b>Unit-VI</b>  | <b>Applications, Case Studies and Research</b><br>Industrial and commercial applications of deep learning in vision systems, case studies and latest research in the area of deep learning.   | <b>05</b>                    |

**Suggested Readings/References:**

1. Mohamed elgendy, Deep learning for vision systems, Manning publications.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep learning, The MIT press publications.
3. Francois chollet, Deep learning with python, Manning publications.
4. Josh patterson, Adam gibson, Deep learning: A practitioner's approach,
5. Shroff/O'Reilly publications.
6. Nikhil buduma, Nicholas locascio, Fundamentals of deep learning: Designing next-generation machine intelligence algorithms, Shroff/O'Reilly publications.

**Suggested List of experiments:**

Laboratory work will be based on the above syllabus with a minimum 09 experiments/exercises to be incorporated. The students in a suitable group size will design and perform one experiment as a part of laboratory work.

**(Only for Information)**

| <b>Sr. No.</b> | <b>Name of Experiments/Exercises</b>                                | <b>Hours</b>   |
|----------------|---|----------------|
| 1.             | Understand the basic image acquisition and pre-processing process   | <b>(02Hrs)</b> |
| 2.             | Understand and implement the basic pipeline of a vision application | <b>(02Hrs)</b> |
| 3.             | Implement the activation functions and error functions              | <b>(02Hrs)</b> |
| 4.             | Implement the back-propagation and feed-forward process             | <b>(02Hrs)</b> |
| 5.             | Apprehend the data preparation for an application                   | <b>(02Hrs)</b> |
| 6.             | Implement a basic CNN architecture - I                              | <b>(02Hrs)</b> |
| 7.             | Implement a basic CNN architecture - II                             | <b>(02Hrs)</b> |
| 8.             | Apprehend the model evaluation and analysis                         | <b>(02Hrs)</b> |
| 9.             | Apprehend the model improvement techniques                          | <b>(02Hrs)</b> |
| 10.            | Develop a simple CNN application                                    | <b>(02Hrs)</b> |
| 11.            | Develop an object detection application                             | <b>(02Hrs)</b> |
| 12.            | Develop an object classification application                        | <b>(02Hrs)</b> |