



GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Bachelor of Computer Applications /
Bachelor of Computer Applications (Honours/Honours with Research) /
Master of Computer Applications (Integrated)**

Level: Under Graduate

Course / Subject Code: BC05001061

Course / Subject Name: Neural Networks

w. e. f. Academic Year:	2026-27
Semester:	5
Category of the Course:	Discipline-Specific Elective-3

Prerequisite:	Basic programming knowledge (preferably Python), elementary mathematics including algebra and basic probability, and introductory knowledge of machine learning and data analysis.
Rationale:	- To introduce students to the fundamental concepts of artificial neural networks and their applications in intelligent computing systems. - To develop an understanding of neuron models, neural network architectures, and learning mechanisms. - To study training algorithms and optimization methods used in neural networks. - To gain practical exposure to neural network implementation using modern programming tools. - To enhance analytical and problem-solving abilities for solving real-world computational problems.

Course Outcome:

After Completion of the Course, the Student will able to:

No	Course Outcomes	RBT Level
01	Understand the fundamental concepts, architecture, and applications of neural networks.	R,U
02	Explain artificial neuron models and activation functions used in neural networks.	U,A
03	Apply neural network learning algorithms and training techniques.	A,N
04	Analyze different neural network architectures and their practical applications.	A,C
05	Implement simple neural network models using modern programming tools and libraries.	U,A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA / CA (M)	PA(I)	ESE (V)	
4	0	2	5	70	30	20	30	150



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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction to Neural Networks Introduction to artificial intelligence, machine learning and neural networks, motivation for neural networks, biological neuron and artificial neuron, components of artificial neuron, neural network terminology, architecture of neural networks, types of neural networks, advantages, and limitations of neural networks.	9	18%
2.	Artificial Neuron Models and Activation Functions Structure of artificial neuron models, perceptron model, single layer perceptron, multilayer perceptron, weights and bias in neural networks, activation functions including step function, sigmoid, tanh and ReLU, feedforward neural networks, representation, and interpretation of neural network models.	12	20%
3.	Neural Network Learning and Training Learning rules in neural networks, supervised learning and unsupervised learning, perceptron learning rule, gradient descent optimization, forward propagation, backpropagation, training process in neural networks, overfitting and underfitting in neural networks, hyper parameters: epochs, batch size and learning rate.	15	22%
4.	Neural Network Architectures Multilayer neural networks, deep feedforward networks, introduction to convolutional neural networks (CNN), convolution and pooling operations, introduction to recurrent neural networks (RNN), sequence data processing, applications of different neural network architectures.	12	20%
5.	Neural Network Implementation and Applications Introduction to neural network tools and frameworks, Python libraries for neural networks, building simple neural network models using Python, training, and testing neural network models, evaluation of neural network performance, visualization of results, practical applications of neural networks in classification and prediction tasks.	12	20%
	Total	60	100



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Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
15	22	30	18	11	4

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Neural Networks and Deep Learning: A Textbook — Charu C. Aggarwal, Springer, 2023
2. Deep Learning with Python — François Chollet, 2nd Edition, Manning, 2021
3. Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow — Aurélien Géron, 3rd Edition, O'Reilly, 2022

(b) Open-source software and website:

1. Development Environment & IDEs
 - Anaconda Distribution – <https://www.anaconda.com>
 - Jupyter Notebook – <https://jupyter.org>
 - VS Code – <https://code.visualstudio.com>
2. Programming Language
 - Python – <https://www.python.org>
3. Libraries
 - TensorFlow – <https://www.tensorflow.org>
 - Keras – <https://keras.io>
 - NumPy – <https://numpy.org>
 - Pandas – <https://pandas.pydata.org>
 - Matplotlib – <https://matplotlib.org>
4. Dataset Sources
 - Kaggle – <https://www.kaggle.com/datasets>
 - UCI Repository – <https://archive.ics.uci.edu>

Suggested Project List:

1. Python Environment Setup and Numerical Computation

- Install Anaconda or Python environment and create a Jupyter Notebook.
- Write a Python program using NumPy to perform basic numerical operations such as vector addition, matrix multiplication.



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2. Implementation of Artificial Neuron

Write a Python program to simulate a simple artificial neuron model.

Perform the following tasks:

- Define input values and weights
- Calculate weighted sum
- Add bias term
- Compute output of the neuron

3. Implementation of Activation Functions

Write a Python program to implement commonly used activation functions.

Implement the following functions:

- Step function
- Sigmoid function
- Tanh function
- ReLU function

Plot the activation functions using Matplotlib.

4. Single Layer Perceptron

Write a Python program to implement a single-layer perceptron.

Perform the following tasks:

- Define input dataset
- Initialize weights and bias
- Apply activation function
- Compute the output of the perceptron model

5. Perceptron Learning Algorithm

Write a Python program to implement the Perceptron Learning Algorithm.

Perform the following tasks:

- Train perceptron using simple dataset
- Update weights based on error
- Display final weights after training



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6. Feedforward Neural Network

Write a Python program to simulate a Feedforward Neural Network.

Perform the following tasks:

- Define input layer, hidden layer, and output layer
- Initialize weights randomly
- Perform forward propagation
- Calculate output values

7. Implementation of Gradient Descent

Write a Python program to demonstrate Gradient Descent optimization

Perform the following tasks:

- Define simple cost function
- Calculate gradient
- Update weights iteratively
- Display optimized results after several iterations

8. Backpropagation Concept

Write a Python program to demonstrate the concept of Backpropagation.

Perform the following tasks:

- Perform forward propagation
- Calculate output error
- Update weights using error correction
- Repeat training for multiple epochs

9. Neural Network using Keras

Write a Python program to create a simple Neural Network using Keras.

Perform the following tasks:

- Load a dataset (Iris Dataset recommended)
- Define neural network model
- Train the model
- Test the model and display accuracy

Dataset: <https://archive.ics.uci.edu/dataset/53/iris>



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10. Neural Network for Classification

Write a Python program to classify dataset records using a simple Neural Network model.

Perform the following tasks:

- Load dataset
- Split dataset into training and testing data
- Train neural network model
- Evaluate performance using accuracy

(Use any small dataset from Kaggle or UCI Repository.)

CO- PO Mapping:

Semester :	Course Name : Neural Networks										
5	POs										
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	-	-	-	-	-	-
CO2	3	2	2	1	1	-	-	-	-	-	-
CO3	3	3	3	2	2	-	1	-	-	-	-
CO4	3	3	3	3	2	-	1	-	-	-	1
CO5	3	2	3	2	3	-	2	-	1	-	2

Legend: '3' for high, '2' for medium, '1' for low and '-' for no correlation of each CO with PO.

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