GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Computer Science and Engineering (Data Science)
Course / Subject Code: 3164601
Course / Subject Name: Deep Learning

w. e. f. Academic Year:	A.Y 2022-23
Semester:	6
Category of the Course:	Professional core

Prerequisite:	Basics of Machine Learning
Rationale:	The rationale for deep learning lies in its potential to revolutionize technology by solving complex problems efficiently, learning from vast amounts of data, and delivering superior performance across an array of applications.

Course Outcomes:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
1	Understand core concepts of Neuron and Neural Networks	U
2	Study various deep learning algorithms like CNN, LSTM, RNN	A
3	Compare and evaluate various deep learning algorithms	N
4	Create a project to demonstrate application of deep learning algorithms for real world problem solving.	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
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
4	0	2	5	70	30	20	30	150

Course Content:

Unit No.	Content	Total Lectures	weightage
1	Introduction to Neural Network Neural Networks Overview: Biological inspiration, Role of neural networks in machine learning, Neural Network applications.	04	10
2	Basic Concepts of Neural Networks: Learning rules and activation functions, Single-layer Perceptron and Learning, Backpropagation Networks, Feedforward Neural Networks, transformers, encoders and decoders, autoencoders, attention mechanism Optimization: Bias-Variance Tradeoff, Regularization Techniques: L2 regularization, Early stopping ,Gradient Descent and its variants (SGD, Momentum),Advanced optimizers.	15	30
3	Foundations of Deep Learning History of Deep Learning, Evolution and key milestones McCulloch Pitts Neuron and Thresholding Logic, Perceptron, Multilayer Perceptron (MLPs), Dataset Augmentation: Techniques for improving training datasets, Deep Learning Algorithms: CNN, LSTM, RNN	15	30
4	Advanced Optimization Techniques Injecting Noise at Input, Ensemble methods, Dropout: Preventing overfitting in neural networks Explainable AI in Deep Learning	08	20
5	Reinforcement Learning Basics Introduction to reinforcement learning concepts and applications Recent trends in Deep Learning architectures	04	10

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
30	25	20	15	-	10

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

Textbooks :

1. Ian Goodfellow and YoshuaBengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.
2. Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2019.
3. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning", Amazon Science, 2021.

References/Suggested Learning Resources:
(a) Books:

1. Jacek M. Zurada," Introduction to artificial neural systems", West Publishing Co., 1992, ISBN: 0-3 14-93391 - 3.
2. Zaccone, G., Karim, M. R., Menshawy, A. "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
3. S. Rajasekaran and G.A. VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI Learning Pvt. Ltd., 2003, ISBN:978-81-203-2186-1.

(b) List of Laboratory/Learning Resources Required:
Software: Anaconda Distribution (https://www.anaconda.com/)
Google Colab (https://colab.research.google.com/)
Tensorflow libraries (Jupyter Notebooks)

(c) Other Resources/MOOCs:
1. NPTEL: Computer Science and Engineering – NOC: Deep Learning- Part 1
2. Deep Learning - Course (nptel.ac.in)
3. https://www.coursera.org/learn/neural-networks-deep-learning

1. Rahul Dubey, “An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications”, Cengage India Publication
2. Raj Kamal, “Internet of Things: Architecture and Design Principles, Mc Graw Hill Education
3. Hanes et al “IoT Fundamentals”, Cisco Press
4. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, , Paperback, 2015.
5. A. McEwen, H. Cassimally, “Designing the Internet of Things”, Wiley, 2013.
6. YashwantKanetkar, “21 Internet of Things Experiments”, Kindle edition
7. AdeelJaved, “Building Arduino projects for Internet of Things”, Apress publication
8. Donald Noris, “The Internet of Things: Do it yourself Projects with Arduino, Raspberry PI and BeagleBone Black” Mc Graw Hill Publication
9. Adrian McEwen & Hakim Cassimally, “Designing the Internet of things”, Willey publication

10. Rahul Dubey, "An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications", Cengage India Publication
11. Raj Kamal, "Internet of Things: Architecture and Design Principles, Mc Graw Hill Education
12. Hanes et al "IoT Fundamentals", Cisco Press
13. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", , Paperback, 2015.
14. A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.
15. YashwantKanetkar, "21 Internet of Things Experiments", Kindle edition
16. AdeelJaved, "Building Arduino projects for Internet of Things", Apress publication
17. Donald Noris, "The Internet of Things: Do it yourself Projects with Arduino, Raspberry PI and BeagleBone Black" Mc Graw Hill Publication
18. Adrian McEwen & Hakim Cassimally, "Designing the Internet of things", Willey publication
19. Rahul Dubey, "An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications", Cengage India Publication

Suggested Course Practical List: (List can be change according to Latest Development)

1. At least 10 practical based on deep learning algorithms must be performed
2. Mini subject project in group 2-3 students

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