Deep Learning		Semester	7
Course Code	**BCA701**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory/practical		

Course objectives:

- Understand the fundamentals of deep learning.
- Understanding the working of Convolutional Neural Networks and RNN in decision making.
- Illustrate the strength and weaknesses of many popular deep learning approaches.
- Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding

MODULE-1

Introduction: What is a Neural Network?, The Human Brain, Models of a Neuron, Neural Networks Viewed As Directed Graphs, Feedback, Network Architectures, **Rosenblatt‟s Perceptron**: Introduction, Perceptron, The Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment.

MODULE-2

Multilayer Perceptrons: Introduction, Batch Learning and On-Line Learning, The Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back- Propagation Algorithm Perform Better, Back Propagation and Differentiation.

MODULE-3

Regularization for Deep Learning: Parameter Norm Penalties - L2 Parameter Regularization, Dataset Augmentation, Semi-Supervised Learning**. Optimization for Training Deep Models:** Challenges in Neural Network Optimization – Ill Conditioning, Local Minima, Plateaus, Saddle Points and Other Flat Regions.

MODULE-4

Convolution neural networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Convolutional Networks and the History of Deep Learning.

MODULE-5
Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to- Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Design and implement a neural based network for generating word embedding for words in a document corpus.
2	Write a program to demonstrate the working of a deep neural network for classification task.
3	Design and implement a Convolutional Neural Network (CNN) for classification of image dataset
4	Build and demonstrate an autoencoder network using neural layers for data compression on image dataset.
5	Design and implement a deep learning network for classification of textual documents.
6	Design and implement a deep learning network for forecasting time series data.
7	Write a program to enable pre-train models to classify a given image dataset.
8	Write a program to read a dataset of text reviews. Classify the reviews as positive or negative.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1. Analyze and interpret the concepts of neural networks relating to artificial intelligence.
2. Illustrate the learning processes and their statistical properties.
3. Design deep learning models using regularization and convolutional operations.
4. Analyze sequential data to build recurrent and recursive models.
5. Develop and analyze the applications using Autoencoders.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Book:

1. Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016. https://www.deeplearningbook.org/lecture_slides.html

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=VyWAvY2CF9c
https://www.youtube.com/watch?v=7sB052Pz0sQ
https://www.youtube.com/watch?v=Mubj_fqiAv8
https://www.coursera.org/learn/neural-networks-deep-learning
https://onlinecourses.nptel.ac.in/noc20_cs62/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Mini projects (2 to 4 students) using Deep Learning concepts - 10 marks

NATURAL LANGUAGE PROCESSING		Semester	VII
Course Code	**BCA702**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory/Practical		

Course objectives:

This course will enable students to,

- Learn the importance of natural language modelling
- Understand the Applications of natural language processing
- Study spelling, error detection and correction methods and parsing techniques in NLP
- Illustrate the information retrieval models in natural language processing

Teaching-Learning Process (General Instructions)

These are sample Strategies that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture methods, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters student's Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

MODULE-1

Introduction: What is Natural Language Processing? Origins of NLP, Language and Knowledge, The Challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications.

Language Modeling: Statistical Language Model - N-gram model (unigram, bigram), Paninion Framework, Karaka theory.

Textbook 1: Ch. 1, Ch. 2.

MODULE-2

Word Level Analysis: Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes, Part-of Speech Tagging.

Syntactic Analysis: Context-Free Grammar, Constituency, Top-down and Bottom-up Parsing, CYK Parsing.

Textbook 1: Ch. 3, Ch. 4.

MODULE-3

Naive Bayes, Text Classification and Sentiment: Naive Bayes Classifiers, Training the Naive Bayes Classifier, Worked Example, Optimizing for Sentiment Analysis, Naive Bayes for Other Text Classification Tasks, Naive Bayes as a Language Model.

Textbook 2: Ch. 4.

MODULE-4

Information Retrieval: Design Features of Information Retrieval Systems, Information Retrieval Models - Classical, Non-classical, Alternative Models of Information Retrieval - Custer model, Fuzzy model, LSTM model**,** Major Issues in Information Retrieval.

Lexical Resources: WordNet, FrameNet, Stemmers, Parts-of-Speech Tagger, Research Corpora.

Textbook 1: Ch. 9, Ch. 12.

MODULE-5

Machine Translation: Language Divergences and Typology, Machine Translation using Encoder-Decoder, Details of the Encoder-Decoder Model, Translating in Low-Resource Situations, MT Evaluation, Bias and Ethical Issues.

Textbook 2: Ch. 13.

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Write a Python program for the following preprocessing of text in NLP: • Tokenization • Filtration • Script Validation • Stop Word Removal • Stemming
2	Demonstrate the N-gram modeling to analyze and establish the probability distribution across sentences and explore the utilization of unigrams, bigrams, and trigrams in diverse English sentences to illustrate the impact of varying n-gram orders on the calculated probabilities.
3	Investigate the Minimum Edit Distance (MED) algorithm and its application in string comparison and the goal is to understand how the algorithm efficiently computes the minimum number of edit operations required to transform one string into another. • Test the algorithm on strings with different type of variations (e.g., typos, substitutions, insertions, deletions) • Evaluate its adaptability to different types of input variations
4	Write a program to implement top-down and bottom-up parser using appropriate context free grammar.
5	Given the following short movie reviews, each labeled with a genre, either comedy or action: • fun, couple, love, love comedy • fast, furious, shoot action • couple, fly, fast, fun, fun comedy • furious, shoot, shoot, fun action • fly, fast, shoot, love action and A new document D: fast, couple, shoot, fly Compute the most likely class for D. Assume a Naive Bayes classifier and use add-1

	smoothing for the likelihoods.
6	Demonstrate the following using appropriate programming tool which illustrates the use of information retrieval in NLP: ● Study the various Corpus – Brown, Inaugural, Reuters, udhr with various methods like filelds, raw, words, sents, categories ● Create and use your own corpora (plaintext, categorical) ● Study Conditional frequency distributions ● Study of tagged corpora with methods like tagged_sents, tagged_words ● Write a program to find the most frequent noun tags ● Map Words to Properties Using Python Dictionaries ● Study Rule based tagger, Unigram Tagger Find different words from a given plain text without any space by comparing this text with a given corpus of words. Also find the score of words.
7	Write a Python program to find synonyms and antonyms of the word "active" using WordNet.
8	Implement the machine translation application of NLP where it needs to train a machine translation model for a language with limited parallel corpora. Investigate and incorporate techniques to improve performance in low-resource scenarios.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Apply the fundamental concept of NLP, grammar-based language model and statistical-based language model.
- Model morphological analysis using Finite State Transducers and parsing using context-free grammar and different parsing approaches.
- Develop the Naïve Bayes classifier and sentiment analysis for Natural language problems and text classifications.
- Apply the concepts of information retrieval, lexical semantics, lexical dictionaries such as WordNet, lexical computational semantics, distributional word similarity.
- Identify the Machine Translation applications of NLP using Encode and Decoder.

Assessment Details (both CIE and SEE)

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CIE for the theory component of the IPCC (maximum marks 50)

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- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two

Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
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CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Textbook:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press.
2. Daniel Jurafsky, James H. Martin, "Speech and Language Processing, An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 2023.

Reference Books:

1. Akshay Kulkarni, Adarsha Shivananda, “Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python”, Apress, 2019.
2. T V Geetha, “Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives”, Pearson, 2024.
3. Gerald J. Kowalski and Mark.T. Maybury, “Information Storage and Retrieval systems”, Kluwer Academic Publishers.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=M7SWr5xObkA
2. https://youtu.be/02QWRAhGc7g
3. https://www.youtube.com/watch?v=CMrHM8a3hqw
4. **https://onlinecourses.nptel.ac.in/noc23_cs45/preview**
5. **https://archive.nptel.ac.in/courses/106/106/106106211/**

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Text Classification Game (5 Marks)

- **Objective:** Learn supervised learning and text classification.
- **Activity:** Provide students with a set of documents (e.g., movie reviews) labeled as positive or negative. Divide them into groups and have them create a simple classification model using keywords or phrases. They can then test their model on new reviews.

Grammar Check and Correction (5 Marks)

- **Objective:** Learn about language structure and NLP tools.
- **Activity:** Provide sentences with grammatical errors. Students can use grammar checking tools (like Grammarly or LanguageTool) to identify errors and suggest corrections, discussing why each suggestion is made.

	CRYPTOGRAPHY & NETWORK SECURITY		Semester	7
	Course Code	**BCS703**	CIE Marks	50
	Teaching Hours/Week (L:T:P: S)	4:0:0:0	SEE Marks	50
	Total Hours of Pedagogy	50	Total Marks	100
	Credits	04	Exam Hours	3
	Examination type (SEE)	Theory		

Course objectives:

1. Understand the basics of Cryptography concepts, Security and its principle
2. To analyse different Cryptographic Algorithms
3. To illustrate public and private key cryptography
4. To understand the key distribution scenario and certification
5. To understand approaches and techniques to build protection mechanism in order to secure computer networks

Teaching-Learning Process

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding
9. Use any of these methods: Chalk and board, Active Learning, Case Studies

Module-1 10 hours

A model for Network Security, Classical encryption techniques: Symmetric cipher model, Substitution ciphers-Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One time pad, Steganography.

Block Ciphers and Data Encryption Standards: Traditional Block Cipher structures, data Encryption Standard (DES), A DES Example, The strength of DES, Block cipher design principles.

Chapter 1: 1.8 Chapter 3: 3.1, 3.2, 3.5 Chapter 4: 4.1, 4.2, 4.3, 4.4, 4.5

Module-2 10 hours

	Pseudorandom number Generators: Linear Congruential Generators, Blum Blum Shub Generator. Public key cryptography and RSA: Principles of public key cryptosystems-Public key cryptosystems, Applications for public key cryptosystems, Requirements for public key cryptography, Public key Cryptanalysis, The RSA algorithm: Description of the Algorithm, Computational aspects, The Security of RSA. Diffie-Hellman key exchange: The Algorithm, Key exchange Protocols, Man-in-the-middle Attack, Elliptic Curve Cryptography: Analog of Diffie-Hellman key Exchange, Elliptic Curve Encryption/Decryption, Security of Elliptic Curve Cryptography. Chapter 8: 8.2 Chapter 9: 9.1, 9.2 Chapter 10: 10.1, 10.4
	Module-3 10 hours
	Applications of Cryptographic Hash functions, Two simple Hash functions, Key management and distribution: Symmetric key distribution using symmetric encryption, Symmetric key distribution using asymmetric encryption, Distribution of public keys, X.509 Certificates, Public Key Infrastructures Chapter 11: 11.1, 11.2 Chapter 14: 14.1, 14.2, 14.3, 14.4, 14.5
	Module-4 10 hours
	User Authentication: Remote user authentication principles**,** Kerberos**,** Remote user authentication using asymmetric encryption. Web security consideration, Transport layer security. Email Threats and comprehensive email security, S/MIME, Pretty Good Privacy. Chapter 15: 15.1, 15.3, 15.4 Chapter 17: 17.1, 17.2 Chapter 19: 19.3, 19.4, 19.5
	Module-5 10 hours
	Domainkeys Identified Mail. IP Security: IP Security overview, IP Security Policy, Encapsulating Security Payload, Combining security associations, Internet key exchange. Chapter 19: 19.9 Chapter 20: 20.1, 20.2, 20.3, 20.4, 20.5

Course outcome

At the end of the course, the student will be able to :

CO1: Explain the basic concepts of Cryptography and Security aspects

CO2: Apply different Cryptographic Algorithms for different applications

CO**3:** Analyze different methods for authentication and access control.

CO4: Describe key management, key distribution and Certificates.

CO5: Explain about Electronic mail and IP Security.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Books

Text Books:

William stallings, "Cryptography and Network Security", Pearson Publication, Seventh Edition.

References:

1. Keith M Martin, "Everyday Cryptography", Oxford University Press
2. V.K Pachghare,"Cryptography and Network Security", PHI, 2nd Edition

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group assignment (TWO) to implement Cryptographic Algorithms (15 + 10 marks)