INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

APPLIED NATURAL LANGUAGE PROCESSING								
VII Semester: CSE(DS)								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACDD24	Elective	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisites: Basic knowledge of programming in Python, linear algebra, probability, statistics, and machine learning fundamentals.								

I. COURSE OVERVIEW:

This course introduces students to the practical and applied aspects of Natural Language Processing (NLP), equipping them with the skills to develop intelligent applications that understand, interpret, and generate human language. The course blends foundational NLP techniques with modern deep learning-based methods such as word embeddings, transformers, and large language models. Students will explore text preprocessing, syntactic parsing, sentiment analysis, topic modeling, and language generation using real-world datasets and Python libraries like NLTK, spaCy, and Hugging Face Transformers.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamental concepts of natural language processing and linguistic structures.
II. The Latest Techniques for text preprocessing, part-of-speech tagging, syntactic parsing, and named entity recognition.
III. The Modern machine learning and deep learning methods used in NLP tasks such as classification, translation, and question answering.
IV. The application of NLP in real-world domains such as chatbots, sentiment analysis, and search engines.

III. COURSE OUTCOMES:

CO1 **Explain** the core components of natural language such as morphology, syntax, semantics, and their representation in computational models.
CO2 **Perform** text preprocessing tasks including tokenization, stemming, lemmatization, stop-word removal, and normalization.
CO3 **Apply** NLP techniques like POS tagging, named entity recognition, dependency parsing, and word embeddings.
CO4 **Analyze** NLP models for tasks like text classification, sentiment analysis, topic modeling, and translation.
CO5 **Develop** NLP applications using deep learning architectures such as RNNs, LSTMs, and Transformers.
CO6 **Evaluate** NLP systems in terms of accuracy, performance, and real-world applicability.

IV. COURSE CONTENT:

MODULE I: INTRODUCTION TO NATURAL LANGUAGE PROCESSING (9)
Definition and Scope of NLP, Linguistic Background: Syntax, Semantics, Morphology, Phonology, NLP Applications, Challenges in NLP, Text Processing Techniques: Tokenization, Lemmatization, Stemming, Stop-word Removal

MODULE II: LANGUAGE MODELING AND TEXT REPRESENTATION (10)
n-gram Language Models, Smoothing Techniques, Perplexity, TF-IDF, Bag-of-Words, Word Embeddings (Word2Vec, GloVe, FastText), Subword Embeddings, Sentence Embeddings, Contextual Word Representations

MODULE III: SYNTACTIC AND SEMANTIC ANALYSIS (9)
Part-of-Speech Tagging (HMM, CRF), Chunking and Parsing (CFG, Dependency Parsing).

Named Entity Recognition, Coreference Resolution, Semantic Role Labeling, Word Sense Disambiguation

MODULE IV: MACHINE LEARNING & DEEP LEARNING FOR NLP (10)
Text Classification using Naive Bayes, SVM, RNNs, and CNNs for Sequence Modeling, Introduction to LSTMs and GRUs, Attention Mechanism, Transformer Architecture, BERT and its Variants (RoBERTa, DistilBERT)

MODULE V: APPLIED NLP TASKS AND CASE STUDIES (10)
Sentiment Analysis, Topic Modeling (LDA), Text Summarization (Extractive and Abstractive), Machine Translation, Question Answering, Chatbot Development, Ethical Considerations in NLP, Case Studies using Hugging Face and spaCy

V. TEXTBOOKS:

1. Dan Jurafsky and James H. Martin, Speech and Language Processing, 3rd Edition, Pearson, 2023.
2. Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, O'Reilly Media, 2009.
3. Yoav Goldberg, Neural Network Methods for Natural Language Processing, Morgan & Claypool, 2017.

VI. REFERENCE BOOKS:

1. Delip Rao and Brian McMahan, Natural Language Processing with PyTorch, O'Reilly, 2019.
2. Jacob Eisenstein, Introduction to Natural Language Processing, MIT Press, 2019.

VII. WEB REFERENCES

1. NPTEL – Natural Language Processing – by IIT Madras
2. Hugging Face Transformers Documentation
3. spaCy NLP Library Documentation
4. Stanford NLP Group Resources
5. Google AI Blog – NLP Research

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open-ended experiments

5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. PowerPoint presentation
11. E-Learning Readiness Videos (ELRV)