**📌 MODULE 1: Introduction to NLP**

* **What is NLP?**
* **Applications of NLP** (Chatbots, Sentiment Analysis, Machine Translation, etc.)
* **Challenges in NLP**
* **Basic Text Processing Concepts**
  + Tokenization
  + Stopword Removal
  + Stemming & Lemmatization
  + Part-of-Speech (POS) Tagging

🔧 **Tools & Libraries**:

* **NLTK** (Natural Language Toolkit)
* **spaCy**
* **TextBlob**

**📌 MODULE 2: Text Preprocessing & Cleaning**

* **Regular Expressions (RegEx) for Text Cleaning**
* **Handling Punctuation, Stopwords, and Special Characters**
* **Lowercasing and Normalization**
* **Handling Unicode & Encoding Issues**
* **Spell Checking and Correction**
* **Removing HTML Tags and URLs**

🔧 **Tools & Libraries**:

* **Python’s re module**
* **BeautifulSoup** (for HTML Parsing)
* **SymSpell** / **Hunspell** (for Spell Checking)

**📌 MODULE 3: Feature Engineering for NLP**

* **Bag of Words (BoW) Model**
* **Term Frequency - Inverse Document Frequency (TF-IDF)**
* **Word Embeddings: Word2Vec, FastText, GloVe**
* **Sentence Embeddings: USE (Universal Sentence Encoder) & BERT Embeddings**
* **N-grams and Skip-grams**
* **Dimensionality Reduction in NLP (PCA, t-SNE, UMAP)**

🔧 **Tools & Libraries**:

* **Scikit-learn** (BoW, TF-IDF)
* **Gensim** (Word2Vec, FastText)
* **Spacy & Transformers (for Embeddings)**

**📌 MODULE 4: Named Entity Recognition (NER)**

* **What is Named Entity Recognition?**
* **Rule-based vs ML-based NER**
* **Custom Named Entity Recognition**
* **NER with spaCy and Transformers**
* **Fine-tuning NER Models**

🔧 **Tools & Libraries**:

* **spaCy**
* **Hugging Face Transformers**
* **Flair**

**📌 MODULE 5: Text Classification**

* **Binary & Multi-class Text Classification**
* **Supervised vs Unsupervised Text Classification**
* **Popular ML Models for Text Classification**
  + Naïve Bayes
  + Logistic Regression
  + Support Vector Machines (SVM)
  + Decision Trees & Random Forests
  + Neural Networks (RNN, CNN, LSTM, Transformers)
* **Fine-Tuning BERT for Text Classification**
* **Explainability in NLP Models (LIME, SHAP)**

🔧 **Tools & Libraries**:

* **Scikit-learn** (Traditional ML Models)
* **TensorFlow/Keras & PyTorch** (Deep Learning)
* **Hugging Face Transformers**

**📌 MODULE 6: Sentiment Analysis**

* **Understanding Sentiment Analysis**
* **Lexicon-based vs Machine Learning-based Approaches**
* **VADER for Social Media Sentiment**
* **Fine-tuning Pre-trained Transformers for Sentiment Analysis**
* **Aspect-Based Sentiment Analysis (ABSA)**

🔧 **Tools & Libraries**:

* **VADER (NLTK)**
* **TextBlob**
* **Transformers (BERT, RoBERTa, DistilBERT, XLNet)**

**📌 MODULE 7: Topic Modeling**

* **What is Topic Modeling?**
* **Latent Dirichlet Allocation (LDA)**
* **Non-Negative Matrix Factorization (NMF)**
* **Dynamic Topic Modeling**
* **Interactive Topic Visualization**

🔧 **Tools & Libraries**:

* **Gensim (LDA, LSI, NMF)**
* **Scikit-learn (NMF, LDA)**
* **pyLDAvis (Visualization)**

**📌 MODULE 8: Text Generation & Summarization**

* **Extractive vs Abstractive Summarization**
* **TF-IDF and TextRank-based Summarization**
* **Neural Network-based Summarization (Seq2Seq, Transformers)**
* **Generating Text with GPT, BART, T5**
* **Fine-Tuning GPT for Custom Text Generation Tasks**

🔧 **Tools & Libraries**:

* **Sumy** (Extractive Summarization)
* **BART, Pegasus, T5 (Abstractive Summarization)**
* **Hugging Face Transformers**

**📌 MODULE 9: Machine Translation**

* **Introduction to Language Translation**
* **Classical Approaches: Rule-based & Statistical MT (SMT)**
* **Neural Machine Translation (NMT)**
* **Transformers for Language Translation (BERT, T5, MarianMT)**
* **Fine-Tuning Language Translation Models**

🔧 **Tools & Libraries**:

* **Google Translate API**
* **Fairseq (Facebook’s NMT Toolkit)**
* **Hugging Face Transformers**

**📌 MODULE 10: Speech Recognition & Speech-to-Text**

* **Understanding Speech Processing**
* **Converting Speech to Text (STT)**
* **Fine-Tuning ASR Models**
* **Speaker Identification & Diarization**

🔧 **Tools & Libraries**:

* **CMU Sphinx**
* **Google Speech-to-Text API**
* **Wav2Vec2 (Facebook AI)**

**📌 MODULE 11: Advanced NLP with Deep Learning**

* **Recurrent Neural Networks (RNN) & Long Short-Term Memory (LSTM)**
* **Bidirectional LSTMs & GRUs**
* **Transformers and Self-Attention**
* **Fine-Tuning Pre-Trained NLP Models**
* **Zero-shot & Few-shot Learning in NLP**

🔧 **Tools & Libraries**:

* **TensorFlow/Keras**
* **PyTorch**
* **Hugging Face Transformers**

**📌 MODULE 12: Ethical Considerations & Bias in NLP**

* **Bias in NLP Models**
* **Fairness in AI and NLP**
* **Techniques to Reduce Bias**
* **Privacy and Security in NLP Applications**

🔧 **Tools & Libraries**:

* **AI Fairness 360 (IBM)**
* **Hugging Face Datasets for Bias Mitigation**

**📌 MODULE 13: NLP Deployment & Real-World Applications**

* **Deploying NLP Models using Flask & FastAPI**
* **Optimizing Model Performance for Production**
* **Using ONNX for Efficient Inference**
* **Building a Full NLP Pipeline**
* **Scaling NLP Applications with Cloud Services**

🔧 **Tools & Libraries**:

* **Flask / FastAPI**
* **Docker & Kubernetes**
* **AWS/GCP/Azure for Model Hosting**

**📌 MODULE 14: Case Studies & Industry Applications**

* **Chatbot Development**
* **Fake News Detection**
* **Medical NLP (Processing Electronic Health Records)**
* **Legal Document Analysis**
* **Financial Text Analytics (Stock Predictions, News Analysis)**