# LNCT UNIVERSITY, BHOPAL

**Programme:- BCA (AI&DA)** **Semester – V** **wef: July 2025**

| Name of Paper & Category | Paper Code | Theory | | | | | |
|---|---|---|---|---|---|---|---|
| | | Credit | | | Marks | | |
| | | L | T | J | EST | CAT | Total |
| Natural Language Processing & Generative AI (Major-Core) | BAI-501 | 3 | 1 | 0 | 70 | 30 | 100 |

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|---|---|
| **Course Objective** | To understand NLP concepts and text representation methods, and implement models, including large language models, with a focus on fairness and reliability. |

| Units | Contents (*Theory*) | Hours /week |
|---|---|---|
| I | **Natural Language Processing & Learning Approaches :**What is NLP? NLP in the real world: assistants, search, chatbots, translation, Key NLP tasks: sentiment analysis, NER, POS tagging, summarization, Linguistic Foundations, Phonemes, Morphemes, Lexemes, Syntax, Semantics, and Context Language ambiguity and complexity Challenges in NLP, Ambiguity in interpretation, Sarcasm, idioms, and figurative language, Language diversity and code-switching, Naive Bayes, Support Vector Machine (SVM), Decision Trees, Deep Learning for NLP Neural Networks, RNNs, LSTMs, GRUs, Convolutional Neural Networks for text, Introduction to Transformers (BERT, GPT), Transfer learning in NLP, Limitations of Deep Learning | **8** |
| II | **NLP Project Pipeline** : The NLP Workflow Define task, Collect data, Preprocess, Model, Evaluate, Deploy, Data Acquisition Using public datasets (e.g., Kaggle, Hugging Face), Web scraping for NLP (BeautifulSoup, newspaper3k), Data Augmentation in NLP, Synonym, replacement, Back translation, TF-IDF-based word substitution ,Bigram flipping, Named Entity perturbation, Text Cleaning & Preprocessing, Removing HTML, Unicode normalization, Lowercasing, punctuation, stopword removal, Spelling correction and noise injection, Tokenization & Segmentation Sentence segmentation, Word tokenization (spaCy, Hugging Face Tokenizers) | **8** |
| III | **Data Processing :**Subword methods: BPE, WordPiece, Text Representation, Bag of Words, TF-IDF Word Embeddings: Word2Vec, GloVe, FastText, Contextual Embeddings: BERT, ELMo, N-gram language models, Masked Language Modeling (MLM), Causal Language Modeling (CLM) | **8** |
| IV | **Deep Dive into Transformers and LLM Architectures :**Why Transformers? Self-Attention Mechanism, Multi-Head Attention overview, Encoder vs Decoder, Positional Encoding, Residual Connections + Layer Norm, Evolution from Transformer → BERT → GPT, BERT Architecture:, Encoder-only, Masked Language Modeling (MLM), GPT Architecture: Decoder-only, Causal Language Modeling (CLM), Fine-tuning Concepts, Fine-tuning vs Pretraining, Why Fine-tuning | **8** |

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|---|---|---|
| | is important (adapt LLMs to tasks), Introduction to LoRA / PEFT ideas, Evaluating Language Models + Challenges, Perplexity, BLEU, ROUGE, Issues in LLMs: Hallucination, Bias, Computation C | |
| **V** | **Text Generation and Evaluation in Generative AI :** How AI generates Text, Autoregressive Gereration, Conditional Generation, Strategies for Text Generation, Greedy Search, Beam Search, Top-k sampling, Top-p sampling, Evaluating Generated Text, Human evaluation, Fluency, Coherence, Relevance, Automatic metrics, Perplexity, BLEU Score, ROUGE Score, Bias, Hallucinations, and Toxicity in LLMs, Techniques to Control AI Behavior, Prompt Engineering, Conditioning, Safe Decoding Methods | **8** |

**Text Books/ Reference Books:-**

| Name of Authors | Titles of the Book | Edition | Name of the Publisher |
|---|---|---|---|
| Daniel Jurafsky, James H. Martin | Speech and Language Processing | 3rd | Pearson |
| Steven Bird, Ewan Klein, Edward Loper | Natural Language Processing with Python | 1st | O'Reilly Media |
| Palash Goyal, Sumit Pandey, Karan Jain | Deep Learning for Natural Language Processing | 1st | Apress |
| Christopher D. Manning, Hinrich Schütze | Foundations of Statistical Natural Language Processing | 1st | MIT Press |
| Denis Rothman | Transformers for Natural Language Processing | 2nd | Packt Publishing |

**COURSE OUTCOMES: Students will be able to**

| | |
|---|---|
| **CO1** | Understand foundational NLP concepts, linguistic structures, and tasks like sentiment analysis, NER, and POS tagging. |
| **CO2** | Explore machine learning and deep learning methods including Naive Bayes, SVM, Decision Trees, RNNs, LSTMs, and Transformers. |
| **CO3** | Implement an end-to-end NLP pipeline including data collection, preprocessing, modeling, evaluation, and deployment. |
| **CO4** | Apply and compare text representation methods such as Bag of Words, TF-IDF, Word2Vec, GloVe, FastText, and contextual embeddings like BERT and ELMo. |
| **CO5** | Evaluate large language models and text generation techniques while addressing issues like hallucination, bias, and toxicity using prompt engineering and decoding strategies. |

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| | | Credit | | | Marks | | |
| | | L | T | J | EST | CAT | Total |
| **Deep Learning and Neural Networks with TensorFlow** | **BAI-502** | 3 | 1 | 0 | 70 | 30 | 100 |

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|---|---|
| **Course Objective** | To understand TensorFlow and neural network architectures, and apply deep learning models such as CNNs, RNNs, LSTMs, and GANs using Keras for real-world applications. |

| Units | Contents (*Theory*) | Hours /week |
|---|---|---|
| **I** | **Tensorflow and Tensors:** About TensorFlow, TensorFlow Architecture, TensorFlow 1.x vs 2.x, Setting Up TensorFlow, Introduction to Tensor: Tensor, Real-Word Analogy, Tensor vs. Numpy Array, Tensor Data Types, Ranks, Shape, Attributes. | **8** |
| **II** | **Tensor Operations & Broadcasting:** Element-wise Operation, Basic Arithmetic, Matrix Manipulation, Broadcasting, Tensor Slicing, Indexing, and Reshaping, expand_dims(), squeeze(), TensorFlow Variables, Automatic Differentiation, tf.GradientTape(), Functions and Graphs: @tf.function, eager execution, graph execution. | **8** |
| **III** | **Neural Networks** : What is Neural Network, Neural Networks vs. Traditional Programming, Biological vs Artificial Neurons, Architecture of Neural Networks, Structure of Neural Network, Input Layer, Hidden Layer, Output Layer, Activation Functions, Sigmoid Function, Tanh Function, ReLU, Softmax Function, Forward Propagation, How Forward Propagation Works? Weights and Bias, Nodes and Layers, Loss Functions, MSE, Cross Entropy, Common Loss Functions, Gradient Descent & Learning Rate, Gradients, Local vs Global Minimum, Local Maximum, Saddle Point, Optimizers, SGD, Momentum, Adam Optimizer, RMS Prop, Backpropagation, Chain Rule, Gradients in Backpropagation, Epochs, Batches, Iterations. | **8** |
| **IV** | **Implementing and Training Neural Network :** Data Pre-processing, Missing Data, Feature Scaling, Encoding Categorical Data, Shuffle Data, Train, Validation & Test Split, Feature Engineering, Feature Selection, Feature Transformation, Feature Creation, Keras for Neural Networks: Build a Neural Network with Keras, Regularization Techniques, Overfitting, L1 Regularization, L2 Regularization, Dropout, Batch Normalization, Early Stopping, Model Checkpointing, Hyperparameter Tuning, Layers, Neurons per Layer, Learning Rate, Batch Size, Grid Search, Random Search, Model Evaluation, Confusion Matrix, Accuracy, Precision, | **8** |

| | | |
|---|---|---|
| | Recall, F1 Score. | |
| **V** | **Deep Learning :** About Deep Learning, CNN Overview, How CNN See Image, CNN Architecture, Convolution, Filter, Activation Function, Pooling, Stride, Padding, Flattening, Softmax Layer, Applications of CNN, RNN, RNN Architecture, Vanishing Gradient Problem, LSTM, How LSTM Works, Foget, Inout, Output Gates, Transfer Learning, GANs (Generative Adversarial Networks), How GANs works, Generator and Discriminator, Real World Applications of Deep Learn. | **8** |

**Text Books/ Reference Books:-**

| Name of Authors | Titles of the Book | Edition | Name of the Publisher |
|---|---|---|---|
| François Chollet | Deep Learning with Python | 2nd | Manning Publications |
| Aurélien Géron | Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow | 3rd | O'Reilly Media |
| Michael Nielsen | Neural Networks and Deep Learning | 1st | Determination Press |
| Christopher M. Bishop | Pattern Recognition and Machine Learning | 1st | Springer |
| Ian Goodfellow, Yoshua Bengio, Aaron Courville | Deep Learning | 1st | MIT Press |

**COURSE OUTCOMES: Students will be able to**

| | |
|---|---|
| **CO1** | Understand TensorFlow fundamentals, architecture, and how tensors operate within it. |
| **CO2** | Perform tensor operations, broadcasting, reshaping, and automatic differentiation using TensorFlow. |
| **CO3** | Gain conceptual and practical understanding of neural network architecture, activation functions, and training mechanisms. |
| **CO4** | Build, train, and optimize neural networks using Keras, applying regularization and hyperparameter tuning techniques. |
| **CO5** | Explore and implement deep learning models including CNNs, RNNs, LSTMs, and GANs for real-world applications. |

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|---|---|---|---|---|---|---|---|
| | | Credit | | | Marks | | |
| | | L | T | J | EST | CAT | Total |
| Computer Networks (SEC) | BAI-503 | 3 | 1 | 0 | 70 | 30 | 100 |

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|---|---|
| **Course Objective** | The course objective includes learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks. |

| Units | Contents (Theory) | Hours /week |
|---|---|---|
| **I** | Definition of a Computer Network, Networking, Advantages and disadvantages of Networks, Components of a computer network, Use of Computer networks, Networks for companies, Networks for people, Social Issues, Classification of networks, Based on transmission technology, Type of Networks: LAN, MAN, WAN, Wireless networks. | **8** |
| **II** | Networks Software, Protocol hierarchy, Design issues for the layers, Merits and De-merits of Layered Architecture, The OSI Reference Model, The TCP/IP Reference Model, Comparison of the OSI & the TCP/IP Reference Models, Transmission Medium, Guided & Unguided Transmission medium, Twisted pair, Coaxial cable, Optical fiber, Wireless transmission, Electromagnetic spectrum, Radio transmission, | **8** |
| **III** | Data Communications, Data transmission modes, Serial &Parallel, Simplex, Half duplex & full duplex, Synchronous & Asynchronous, Network topologies, Linear Bus Topology, Ring Topology, Star Topology, Hierarchical or Tree Topology, Topology Comparison transmission, Standards – Ethernet, Token bus, Token ring, interfacing devices – bridge, hub, switch, router, gateway. | **8** |
| **IV** | Considerations when choosing a Topology, Switching, Circuit switching, Message switching, Packet switching, Implementation of packet switching, Multiplexing, FDM – Frequency division multiplexing, WDM – Wavelength division multiplexing, TDM – Time division multiplexing: | **8** |
| **V** | Modulations & demodulations, Comparison of channel access protocols, IEEE standards, Ethernets, Fast Ethernet, Gigabit Ethernet, IEEE 802.3 frame format, File transfer protocol (FTP), IP protocol (IPV4), UDP protocol. | **8** |

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**Text Books/Reference Books:-**

| Name of Authors | Titles of the Book | Edition | Name of the Publisher |
|---|---|---|---|
| Brijendra Singh | Data Communication and Computer Networks | 2nd Edition | PHI |
| Behrouz A Forouzan | Data Communication and Computer networks | 4th Edition | McGraw Hill |
| Achyut S Godbole | Data communications and networks, | 2nd Edition | McGraw Hill |

**COURSE OUTCOMES: Students will be able to**

| | |
|---|---|
| **CO1** | Characterize and understand computer networks from the view point of components and from the view point of services. |
| **CO2** | Display good understanding of the flow of protocols in general and a network protocol in particular. |
| **CO3** | Model a problem or situation in terms of layering concept and map it to the TCI/IP stack. |
| **CO4** | To understand how to send a huge number of signals at the same time |
| **CO 5** | Analysis and design of various modulation and demodulation techniques. |

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| Name of Paper& Category | Paper Code | Practical | | | | |
|---|---|---|---|---|---|---|
| | | Credit | | Marks | | |
| | | P | J | ESP | CAP | Total |
| Lab in Scala for Data Science (Major-core) | BAI-504 | 2 | - | 70 | 30 | 100 |

**Contents (Practical):-**

1. Write a program to install Scala
2. Write a program to use Scala REPL/Shell
3. Write a program to implement Hello World in Scala
4. Write a program to define mutable and immutable functions in Scala
5. Write a program to define Scala Data types
6. Write a program to implement string operations in Scala
7. Write a program to illustrate Boolean expressions in Scala
8. Write a program to define and invoke a function
9. Write a program to implement Collections in Scala.
10. Write a program to implement Loops in Scala
11. Write a program to create classes and objects
12. Write a program to implement exceptional handling

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|---|---|---|---|---|---|---|
| | | Credit | | Marks | | |
| | | P | J | ESP | CAP | Total |
| **Internship (Field)** | **BAI-505** | - | 10 | 200 | 100 | 300 |
| **Course Objective** | Internships are valuable learning experiences, so make the most of the opportunity to develop your skills, build professional connections, and explore the student's career interests. | | | | | |

**Instructions for Internship:**

1. Set clear goals for your internship.
2. Research companies offering internships in your field of interest.
3. Prepare a well-written and tailored resume highlighting your relevant skills and experience.
4. Craft a compelling cover letter expressing your interest and explaining why you are a suitable candidate.
5. Submit your applications following the instructions provided by each company.
6. Prepare for interviews by researching common internship interview questions and practicing your responses.
7. Attend career fairs and networking events to connect with potential employers.
8. Follow up with a thank-you email after interviews or networking events.
9. Carefully review internship offers and consider if they align with your goals and learning objectives.
10. Accept the offer formally and clarify any remaining details.
11. Once the internship starts, maintain professionalism and a positive attitude.
12. Take initiative, ask questions, and seek feedback to maximize your learning experience.
13. Network with colleagues to build professional connections.
14. Make the most of the opportunity to gain practical experience in your field.