# B. Tech - AI & ML (BR23) - COURSE STRUCTURE & SYLLABUS
## (Applicable from the academic year 2023-24 and onwards)

**B. Tech. – III Year I Semester**

| III YEAR Semester–I | | | | | | | |
|---|---|---|---|---|---|---|---|
| S.No. | Course Category | Course Code | Course Name | L | T | P | Credits |
| 1 | 23AM5T03 | PCC | Deep Learning | 3 | 0 | 0 | 3 |
| 2 | 23AD5T03 | PCC | Computer Networks | 3 | 0 | 0 | 3 |
| 3 | 23AM5T04 | PCC | Natural Language Processing | 3 | 0 | 0 | 3 |
| 4 | 23AD5D01<br>23AM5D01<br>23AD5D03<br>23AD5D04<br>23CS5D01 | PE-I | 1. Automata Theory & Compiler Design<br>2. Operating Systems<br>3. Internet of Things (IoT)<br>4. Exploratory Data Analysis with Python<br>5. Object Oriented Analysis and Design | 3 | 0 | 0 | 3 |
| 5 | | OE- I | | 3 | 0 | 0 | 3 |
| 6 | 23AM5L02 | PCC | Deep Learning Lab | 0 | 0 | 3 | 1.5 |
| 7 | 23AM5L03 | PCC | Natural Language Processing Lab | 0 | 0 | 3 | 1.5 |
| 8 | 23CS5S06 | SEC | Full Stack Development -II<br>SWAYAM Plus – Data Engineer / AI Engineer | 0 | 1 | 2 | 2 |
| 9 | 23ES5L09 | ES | Tinkering Lab<br>*(User Interface Design using Flutter) /*<br>SWAYAM Plus - Android Application Development (with Flutter) | 0 | 0 | 2 | 1 |
| 10 | 23BS5P01 | PR | Evaluation of Community Service Project | - | - | - | 2 |
| **Total** | | | | **20** | **1** | **8** | **23** |

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**Deep Learning**

**CourseObjectives:**

The main objective of the course is to

- To introduce foundational concepts of neural computation through perceptron models and learning algorithms.
- To impart knowledge on training deep neural net works using gradient-based methods, regularization, and auto encoders.
- To explore advanced optimization and regularization techniques for efficient neural net work training.
- To develop understanding of RNNs, CNNs, and generative models for complex learning tasks.
- To introduce recent deep learning models like VAEs and Transformers for applications in vision, NLP, and speech.

**Course Outcomes: Students are able**

| CO Number | Course Outcome | Blooms Level |
|---|---|---|
| CO1 | Analyze perceptron learning and neuron models with concepts of linear separability and convergence. | BL2 |
| CO2 | Apply back propagation and regularization in training deep neural networks using empirical risk minimization. | BL3 |
| CO3 | Apply advanced optimization and regularization techniques to improve neural network training. | BL3 |
| CO4 | Analyze advanced RNNs, CNNs, and generative models like RBMs and Deep Boltzmann Machines. | BL4 |
| CO5 | Evaluatedeepgenerativemodelsandtransformerarchitecturesforapplicationsin vision, NLP, and speech. | BL5 |

**UNITI** **15Hrs**

**Basics-** Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm.

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| **UNIT II** | **15Hrs** |
| **Feed forward Networks** –Multilayer Perceptron, Gradient Descent, Back propagation, Empirical Risk Minimization, regularization, autoencoders.<br>Deep Neural Networks : Difficulty of training deep neural networks, Greedy layer wise training. | |
| **UNIT III** | **12Hrs** |
| **Better Training of Neural Networks**-Newer optimization methods for neural networks (Adagrad, ad delta, rms prop, a dam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization). | |
| **UNITIV** | **15Hrs** |
| **Recurrent Neural Networks** – Back propagation through time, Long Short-Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.<br>Convolutional Neural Networks: LeNet, AlexNet. Generative models: Restrictive Boltzmann Machines (RBMs),Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs ,Deep Boltzmann Machines | |
| **UNITV** | **12Hrs** |
| **Recenttrends** -Variational Auto encoders, Transformers, GPT Applications: Vision, NLP ,Speech | |
| **Text Books:**<br>1.Deep Learning, Ian Good fellow and YoshuaBengio and AaronCourville, MITPress,2016 | |
| **Reference Books:**<br>1. 1. Neural Networks: A Systematic Introduction, RaúlRojas,1996<br>2. Pattern Recognition and MachineLearning,ChristopherBishop,2007<br>3. Deep Learning with Python, FrançoisChollet,Manning Publications,2017 | |

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## Computer Networks
**(Common to CSE(AI&DS)/AIML/CSE(AI&ML))**

**Course Objectives:**

The main objectives of the course is to

- To understand the different types of networks
- To develop an understanding, the principles of computer networks.
- To familiarize with Reference model OSI and TCP/IP
- To understand various layers of Reference models functions
- To explore network protocols

**Course Outcomes: Students are able**

| CO Number | Course Outcome | Blooms Level |
|---|---|---|
| CO 1 | Explain the fundamental types of computer networks, reference models (OSI and TCP/IP), and the historical evolution of the Internet. | BL2 |
| CO 2 | Explain Data Link Layer functions, protocols, error control, and Ethernet technologies. | BL2 |
| CO 3 | Explain network layer functions, routing, congestion control, and IP addressing (IPv4/IPv6). | BL4 |
| CO 4 | Compare transport layer protocols and their services (UDP, TCP, SCTP). | BL3 |
| CO 5 | Describe web services, HTTP, DNS, remote login,email,and file transfer protocols. | BL3 |

**UNIT I** **15Hrs**

**Introduction:** Types of Computer Networks, Reference Models- The OSI Reference Model, The TCP/IP Reference Model, A Critique of the OSI Model and Protocols, A Critique of the TCP/IP Reference Model. History of Internet.

**UNIT II** **15Hrs**

**The Data Link Layer:** Transmission Media, Guided and Un-guided media, Data Link Layer Design Issues, Services Provided To the Network Layer, Error detecting and Error Correcting codes, Elementary Data Link Protocols, Sliding Window Protocols, HDLC, PPP. Multiple Access Protocols Wired Lans: Ethernet, Fast Ethernet, Gigabit Ethernet

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| **UNIT III** | **12Hrs** |
| **The Network Layer:** Network Layer Design Issues, Routing Algorithms, Congestion, Congestion control algorithms. The Network Layer in the Internet, The IP Version 4 Protocol, IP Addresses- Classful, CIDR, NAT, IP Version 6 Protocol, Transition from IPV4 to IPV6 | |
| **UNIT IV** | **15Hrs** |
| **The Transport Layer:** The Transport Layer Services, Transport Layer Protocols: UDP, TCP and SCTP | |
| **UNIT V** | **12Hrs** |
| **The Application Layer:** The World Wide Web, HTTP, Domain Name Space, Remote Loging, Electronic Mail and File Transfer | |

**Text Books:**

1. "Computer Networks", Andrew S Tanenbaum, David J Wetherall, 5th Edition, Pearson
2. "Data Communications and Networking", Behrouz A Forouzan, 4th Edition, Tata McGraw Hill Education

**Reference Books:**

1. "Data and Computer Communication", William Stallings, Pearson
2. "TCP/IP Protocol Suite", Behrouz Forouzan, McGraw Hill.

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## NATURAL LANGUAGE PROCESSING

**Course Objectives:**

The main objectives of the course is to

- Introduce foundational concepts of Natural Language Processing including language models, morphology, and text preprocessing techniques.
- Understand word-level NLP techniques including N-gram models, PoS tagging methods, and probabilistic models.
- Introduce syntactic analysis using grammar formalisms, parsing techniques, and probabilistic grammar models.
- Understand discourse analysis techniques and utilize key lexical resources for NLP tasks.

**Course Outcomes: Students are able**

| CO Number | Course Outcome | Blooms Level |
|---|---|---|
| CO1 | Apply NLP basics like language models, tokenization, and FSA for text processing tasks | BL3 |
| CO2 | Apply word-level NLP techniques including N-grams, PoS tagging, and probabilistic models | BL2 |
| CO3 | Apply syntactic parsing techniques using context-free and probabilistic grammars for sentence analysis | BL3 |
| CO4 | Apply semantic analysis techniques and word sense disambiguation using logical and lexical methods | BL3 |
| CO5 | Discourse analysis techniques and utilize lexical resources for coherent language understanding | BL4 |

**UNITI** **15Hrs**

**INTRODUCTION:** Origins and challenges of NLP – Language Modelling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

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| **UNITII** **15Hrs**<br>**WORD LEVEL ANALYSIS:** Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models |
| **UNITIII** **12Hrs**<br>**SYNTACTIC ANALYSIS:** Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing–ShallowparsingProbabilisticCFG,ProbabilisticCYK,ProbabilisticLexicalizedCFGs–Feature structures, Unification of feature structures |
| **UNITIV** **15Hrs**<br>**SEMANTICS AND PRAGMATICS:** Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions–Word Sense Disambiguation, WSD using Supervised, Dictionary& Thesaurus, Boot strapping methods – Word Similarity using Thesaurus and Distributional methods. |
| **UNITV** **12Hrs**<br>**DISCOURSE ANALYSIS AND LEXICAL RESOURCES:** Discourse segmentation, Coherence–Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution–Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, Prop Bank, Frame Net, Brown Corpus, British National Corpus (BNC). |
| **Text Books:**<br>1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2nd Edition, Daniel Jurafsky, James H. Martin -Pearson Publication,2014.<br>2. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media,2009. |
| **Reference Books:**<br>1. Language Processing with Java and Ling Pipe Cook book, 1st Edition, BreckBaldwin, Atlantic Publisher, 2015.<br>2. Natural Language Processing with Java, 2nd Edition, Richard MReese, OReilly Media,2015.<br>3. Hand book of Natural Language Processing, Second, NitinIndurkhya and FredJ.Damerau, Chapman and Hall/CRC Press, 2010.Edition<br>4. Natural Language Processing and Information Retrieval, 3rd Edition, TanveerSiddiqui, U.S. Tiwary, Oxford University Press,2008. |

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**BONAM VENKATA CHALAMAYYA ENGINERING COLLEGE ODALAREVU – 533 210, Andhra Pradesh, India**
**Autonomous**

| III Year - I Semester | Code: 23AD5D01 | L | T | P | C |
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**AUTOMATA THEORY AND COMPILER DESIGN**
**(Common to CSE(AI&DS)/AI&ML/CSE(AI&ML))**

**Course Objectives:**
The main objectives of the course is to

- Understand and apply formal language theory.
- Design and implement parsers.
- Understand the phases of a compiler.
- Apply semantic analysis and error handling.
- Optimize intermediate and target code.

**Course Outcomes: Students are able**

| CO Number | Course Outcome | Blooms Level |
|---|---|---|
| CO 1 | Apply finite automata concepts for modeling and solving language and pattern recognition problems. | BL3 |
| CO 2 | Apply regular expressions and context-free grammars for language representation and pattern matching. | BL2 |
| CO 3 | Apply pushdown automata and Turing machines to analyze language classes and undecidable problems. | BL3 |
| CO 4 | Apply lexical and syntax analysis techniques using grammars and parsing methods in compiler design. | BL3 |
| CO 5 | Apply syntax-directed translation and intermediate code generation for implementing compiler phases. | BL4 |

**UNIT I** **15Hrs**

**Introduction to Finite Automata:** Structural Representations, Automata and Complexity, the Central Concepts of Automata Theory – Alphabets, Strings, Languages, Problems. Nondeterministic Finite Automata: Formal Definition, an application, Text Search, Finite Automata with Epsilon-Transitions. **Deterministic Finite Automata:** Definition of DFA, How A DFA Process Strings, The language of DFA, Conversion of NFA with $\epsilon$-transitions to NFA without $\epsilon$-transitions. Conversion of NFA to DFA

**UNIT II** **15Hrs**

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**Regular Expressions:** Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Conversion of Finite Automata to Regular Expressions. Pumping Lemma for Regular Languages: Statement of the pumping lemma, Applications of the Pumping Lemma. **Context-Free Grammars:** Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Parse Trees, Ambiguity in Grammars and Languages.

**UNIT III** **12Hrs**

**Push Down Automata**: Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA's and CFG's, Acceptance by final state Turing Machines: Introduction to Turing Machine, Formal Description, Instantaneous description, The language of a Turing machine Undecidability: Undecidability, A Language that is Not Recursively Enumerable, An Undecidable Problem That is RE, Undecidable Problems about Turing Machines

**UNIT IV** **15Hrs**

**Introduction:** The structure of a compiler, Lexical Analysis: The Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, The Lexical- Analyzer Generator Lex, **Syntax Analysis:** Introduction, Context-Free Grammars, Writing a Grammar, Top-Down Parsing, Bottom- Up Parsing, Introduction to LR Parsing: Simple LR, More Powerful LR Parsers R18 B.Tech. CS&D Syllabus JNTU Hyderabad

**UNIT V** **12Hrs**

**Syntax-Directed Translation:** Syntax-Directed Definitions, Evaluation Orders for SDD's, SyntaxDirected Translation Schemes, Implementing L-Attributed SDD's. Intermediate-Code Generation: Variants of Syntax Trees, Three-Address Code Run-Time Environments: Stack Allocation of Space, Access to Nonlocal Data on the Stack, Heap Management

**Text Books:**

1. Introduction to Automata Theory, Languages, and Computation, 3nd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
2. Compilers: Principles, Techniques and Tools, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman, 2nd Edition, Pearson.
3. Theory of Computer Science – Automata languages and computation, Mishra and Chandrashekaran, 2nd Edition, PHI.

**Reference Books:**

1. Introduction to Formal languages Automata Theory and Computation, Kamala Krithivasan, Rama R, Pearson.
2. Introduction to Languages and The Theory of Computation, John C Martin, TMH.
3. lex &yacc – John R. Levine, Tony Mason, Doug Brown, O'reilly

Compiler Construction, Kenneth C. Loud en, Thomson. Course Technology

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## OPERATING SYSTEMS

**Course Objectives:**

The main objectives of the course is to

- Operating system fundamentals, structures, services, and system call mechanisms.
- Understand process management, multithreading ,inter –process communication, and CPU scheduling techniques.
- Learn synchronization mechanisms and strategies for deadlock detection, prevention, and recovery in OS.
- Understand memory and storage management techniques, including paging, virtual memory,and disk scheduling.
- Understand file system concepts, implementation, and protection mechanisms in operating systems.

**Course Outcomes : Students are able**

| CO Number | Course Outcome | Blooms Level |
|---|---|---|
| CO1 | Understand and explain operating system functions, structures, services, and system call mechanisms. | BL2 |
| CO2 | Apply process, thread, and CPU scheduling concepts to manage concurrency in operating systems | BL3 |
| CO3 | Apply synchronization and deadlock handling techniques to ensure safe process coordination | BL2 |
| CO4 | Apply memory and storage management techniques including paging, virtual memory, and disk scheduling | BL3 |
| CO5 | Apply file system and protection mechanisms for efficient and secured at a management | BL4 |

**UNITI** **15Hrs**

**Operating Systems Overview:** Introduction, operating system functions, operating system operations, Computing environments, Free and Open-Source Operating Systems.

**System Structures:** Operating System Services, User and Operating-System Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, Operating System Structure, Building and Booting an Operating System, Operating System Debugging.

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| **UNITII** **15Hrs**<br>**Processes:** Process Concept, Process Scheduling Operations on Processes, Inter-Process Communication.<br>**Threads and Concurrency:** Multithreading Models, Thread Libraries, Threading Issues.<br>**CPU Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple Processor Scheduling. |
| **UNITIII** **12Hrs**<br>**Synchronization Tools:** The Critical Section Problem, Peterson's Solution, Mutex Locks, Semaphores, Monitors, Classic Problems of Synchronization.<br>**Deadlocks:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock. |
| **UNITIV** **15Hrs**<br>**Memory- Management Strategies:** Introduction, Contiguous Memory Allocation, Paging, Structure of the Page Table, Swapping.<br>**Virtual Memory Management:** Introduction, Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing.<br>**Storage Management:** Overview of Mass Storage Structure, HDD Scheduling. |
| **UNITV** **12Hrs**<br>**: File System:** File System Interface, File Concept, Access Methods, Directory Structure. File System Implementation: File-System Structure, File-System Operations, Directory Implementation, Allocation Methods, Free Space Management.<br>**File-System Internals:** File-System Mounting, Partitions and Mounting, File Sharing.<br>**Protection:** Goals of Protection, Principles of Protection, Protection Rings, Domain of Protection, Access Matrix. |
| **Text Books:**<br>1. Operating System Concepts, SilberschatzA, GalvinPB, GagneG, 10thEdition, Wiley, 2018.Modern Operating Systems, TanenbaumAS, 4thEdition, Pearson, 2016. |
| **Reference Books:**<br>1. Operating Systems – Internals and Design Principles, Stallings W, 9th Edition, Pearson, 2018.<br>2. Operating Systems: A Concept-Based Approach, D.M.Dhamdhere, 3rdEdition, McGraw-Hill,2013. |

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**ODALAREVU – 533 210, Andhra Pradesh, India**
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**INTERNET OF THINGS**
**(Common to CSE(AI&DS)/AIML/CSE(AI&ML))**

**Course Objectives:**
The main objectives of the course is to
- Vision and Introduction to Internet of Things(IoT).
- Understand IoT Market perspective.
- Data and Knowledge Management and use of Devices in IoT Technology.
- Understand State of the Art – IoT Architecture.
- Understand Real World IoT Design Constraints, Industrial Automation and Commercial

**Course Outcomes: Students are able**

| CO Number | Course Outcome | Blooms Level |
|---|---|---|
| CO 1 | Apply IoT concepts and connectivity principles using application layer protocols for smart device communication | BL3 |
| CO 2 | Analyze IoT/M2M architectures, business models, and standards to design efficient and affordable systems | BL4 |
| CO 3 | Design web and message communication protocols for connected devices ensuring efficient connectivity | BL5 |
| CO 4 | Analyze and organize IoT/M2M data for business process integration and informed decision-making | BL4 |
| CO 5 | Apply cloud platforms and sensor technologies for data collection, storage, and computing in IoT/M2M | BL3 |

**UNIT I** **15Hrs**

The Internet of Things: An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples of IoTs, Design Principles For Connected Devices Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet.

**UNIT II** **15Hrs**

Business Models for Business Processes in the Internet of Things, IoT/M2M systems LAYERS AND designs standardizations, Modified OSI Stack for the IoT/M2M Systems, ETSI M2M domains and High-level capabilities, Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability

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| **UNIT III** | **12Hrs** |
| Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices. | |
| **UNIT IV** | **15Hrs** |
| Data Acquiring, Organizing and Analytics in IoT/M2M, Applications /Services /Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems. | |
| **UNIT V** | **12Hrs** |
| Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology, Sensing the World. | |
| **Text Books:**<br>1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education<br>2. Internet of Things, A.Bahgya and V.Madisetti, Univesity Press, 2015 | |
| **Reference Books:**<br>1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally,Wiley<br>2. Getting Started with the Internet of Things, Cuno Pfister , Oreilly | |

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**BONAM VENKATA CHALAMAYYA ENGINERING COLLEGE ODALAREVU – 533 210, Andhra Pradesh, India**
**Autonomous**

| III Year - I Semester | Code: 23AD5D04 | L | T | P | C |
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**EXPLORATORY DATA ANALYSIS WITH PYTHON**
**(Common to CSE(AI&DS)/AIML/CSE(AI&ML))**

**Course Objectives:**
The main objectives of the course is to

- Introduce the fundamentals of Exploratory Data Analysis
- Cover essential exploratory techniques for understanding multivariate data by
- summarizing it through statistical methods and graphical methods.
- Evaluate the Models and select the best model
- Develop and evaluate machine learning models using complete workflow and real-world data analysis.

**Course Outcomes: Students are able**

| CO Number | Course Outcome | Blooms Level |
|---|---|---|
| CO 1 | Analyze datasets using EDA tools and techniques to interpret, preprocess, and extract insights. | BL2 |
| CO 2 | Datasets using appropriate visualizations and case-based EDA techniques to uncover patterns and insights. | BL4 |
| CO 3 | Analyze and apply data transformation techniques to preprocess, clean, and restructure datasets effectively | BL3 |
| CO 4 | datasets using descriptive statistical techniques to summarize distributions and reveal data patterns | BL3 |
| CO 5 | Analyze and evaluate machine learning models using appropriate preprocessing, training, and performance metrics | BL4 |

**UNIT I** **15Hrs**

**Exploratory Data Analysis Fundamentals:** Understanding data science, The significance of EDA, Steps in EDA, Making sense of data, Numerical data, Categorical data, Measurement scales, Comparing EDA with classical and Bayesian analysis, Software tools available for EDA, Getting started with EDA.

**UNIT II** **15Hrs**

**Visual Aids for EDA:** Technical requirements, Line chart, Bar charts, Scatter plot using seaborn, Polar

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chart, Histogram, Choosing the best chart
**Case Study:** EDA with Personal Email, Technical requirements, Loading the dataset, Data transformation, Data cleansing, Applying descriptive statistics, Data refactoring, Data analysis.

**UNIT III** **12Hrs**

**Data Transformation**: Merging database-style dataframes, Concatenating along with an axis, Merging on index, Reshaping and pivoting, Transformation techniques, Handling missing data, Mathematical operations with NaN, Filling missing values, Discretization and binning, Outlier detection and filtering, Permutation and random sampling, Benefits of data transformation, Challenges.

**UNIT IV** **15Hrs**

**Descriptive Statistics**: Distribution function, Measures of central tendency, Measures of dispersion, Types of kurtosis, Calculating percentiles, Quartiles, Grouping Datasets, Correlation, Understanding univariate, bivariate, multivariate analysis, Time Series Analysis

**UNIT V** **12Hrs**

**Model Development and Evaluation:** Unified machine learning workflow, Data pre-processing, Data preparation, Training sets and corpus creation, Model creation and training, Model evaluation, Best model selection and evaluation, Model deployment
Case Study: EDA on Wine Quality Data Analysis

**Text Books:**

1. 1. Suresh Kumar Mukhiya, Usman Ahmed, Hands-On Exploratory Data Analysis with Python, Packt Publishing, 2020.

**Reference Books:**

1. 1. Ronald K. Pearson, Exploratory Data Analysis Using R, CRC Press, 2020
2. RadhikaDatar, Harish Garg, Hands-On Exploratory Data Analysis with R: Become an expert in exploratory data analysis using R packages, 1st Edition, Packt Publishing, 2019

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**DEEP LEARNING LAB**

**Course Objectives:**

- To understand the basics of deep learning and neural networks through practical Experiments.
- To build and train models using datasets like MNIST, IMDB, and Reuters.
- To apply deep learning tools such as Keras, TensorFlow, and PyTorch.
- To work with Convolutional and Recurrent Neural Networks.
- To use pre-trained models and techniques like word embeddings and one-hot encoding.

**CourseOutcomes:Studentsareableto**

| CO Number | CourseOutcome | Blooms Level |
|---|---|---|
| CO1 | Implement deep neural networks to solve real world problems | BL3 |
| CO2 | Choose appropriate pre-trained model to solve real time problem | BL5 |
| CO3 | Interpret the results of two different deep learning models | BL4 |
| CO4 | Apply convolutional and recurrent neural networks for image and text data. | BL3 |
| CO5 | Perform data preprocessing techniques like one-hot encoding and word embeddings for deep learning models. | BL3 |

Software Packages required:

- Keras
- Tensorflow
- PyTorch

**Sample Experiments:**

**Exercise – 1:**

Implement multi-layer perceptron algorithm for MNIST Handwritten Digit Classification.

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| **Exercise – 2:**<br>Design a neural network for classifying movie reviews (Binary Classification) using IMDB dataset. |
| **Exercise – 3:**<br>Design a neural Network for classifying news wires (Multi class classification) using Reuters dataset. |
| **Exercise–4**<br>Design a neural network for predicting house prices using Boston Housing Price dataset. |
| **Exercise–5**<br>Build a Convolution Neural Network for MNIST Handwritten Digit Classification. |
| **Exercise–6**<br>Build a Convolution Neural Network for simple image (dogs and Cats) Classification |
| **Exercise–7**<br>Use a pre-trained convolution neural network (VGG16)for image classification. |
| **Exercise–8**<br>Implement one hot encoding of words or characters. |
| **Exercise-9**<br>Implement word embedding's for IMDB dataset. |
| **Exercise–10**<br>Implement A Recurrent Neural Network for IMDB movie review classification problem. |
| **Text Books:**<br>1.RezaZadehandBharathRamsundar,"Tensorflow for Deep Learning", O'Reilly publishers, 2018 |
| **References:**<br>1.https://github.com/fchollet/deep-learning-with-python-notebooks |

**Note:AttheendofLabcoursestudentshavetocompleteaMiniProject/CaseStudyforevaluation of Internal Marks.**

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| III Year- I Semester | Code:23AM5L03 | L | T | P | C |
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**NATURAL LANGUAGE PROCESSING LAB**

**Course Objectives:**

The aim of this course is to

- Understand the fundamentals of Natural Language Processing (NLP): Students will learn the basics of NLP, including text processing, tokenization, and corpora.
- Apply NLP techniques using NLTK and spaCy: Students will be able to use popular NLP libraries like NLTK and spaCy to perform various NLP tasks.
- Analyze and preprocess text data: Students will learn to preprocess text data, including tokenization, stemming, lemmatization, and removing stop words.
- Develop programming logic for NLP tasks: Students will be able to write programs to perform various NLP tasks, such as text classification, sentiment analysis, and information extraction.
- Build NLP applications: Students will be able to build applications using NLP techniques, including text processing, entity recognition, and language modeling.

Course Outcomes: Students are able to

| CO Number | Course Outcome | Blooms Level |
|---|---|---|
| CO1 | Use the NLTK and spaCy toolkit for NLP Programming. | BL3 |
| CO2 | Analyze various corpora for developing programs. | BL4 |
| CO3 | Develop various pre-processing techniques for a given corpus. | BL6 |
| CO4 | Develop programming logic using NLTK functions. | BL6 |
| CO5 | Build applications using various NLP techniques for a given corpus. | BL6 |

Experiments covering the Topics:

- Object Oriented Programming fundamentals- data types, control structures
- Classes, methods, objects, Inheritance, polymorphism,
- Exception handling, Threads, Packages, Interfaces
- Files, I/O streams, Java FX GUI

**List of Experiments:**

1.Installation and exploring features of NLTK and spaCy tools. Download Word Cloud and few corpora.

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2. ((i)Write a program to implement word Tokenizer, Sentence and Paragraph Tokenizers.
   (ii) Check how many words are there in any corpus. Also check how many distinct words are there?

3. i)Write a program to implement both user-defined and pre-defined functions to generate
   (a) Uni-grams
   (b) Bi-grams
   (c) Tri-grams
   (d) N-grams
   (ii)Write a program to calculate the highest probability of a word(w2) occurring after another word(w1).

4. (i)Write a program to identify the word collocations.
   (ii) Write a program to print all words beginning with a given sequence of letters.
   (iii) Write a program to print all words longer than four characters.

5. (i)Write a program to identify the mathematical expression in a given sentence.
6. (ii)Write a program to identify different components of an email address.

7. (i)Write a program to identify all antonyms and synonyms of a word.
(ii)Write a program to find hyponymy, homonymy , polysemy for a given word

7. (i)Write a program to find all the stop words in any given text.
   (ii)Write a function that finds the 50 most frequently occurring words of a text that are not stop words.

8. Write a program to implement various stemming techniques and prepare a chart with the performance of each method.

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9. Write a program to implement various lemmatization techniques and prepare a chart with the performance of each method.

10. (i)Write a program to implement Conditional Frequency Distributions (CFD) for any corpus.
    (ii) Find all the four-letter words in any corpus. With the help of a frequency distribution (FreqDist), show these words in decreasing order of frequency.
    (iii) Define a conditional frequency distribution over the names corpus that allows you to see which initial letters are more frequent for males versus females.

11. (i)Write a program to implement Part-of-Speech (PoS) tagging for any corpus.
    (ii) Write a program to identify which word has the greatest number of distinct tags? What are they, and what do they represent?
    (iii) Write a program to list tags in order of decreasing frequency and what do the 20 most frequent tags represent?
    (iv) Write a program to identify which tags are nouns most commonly founda fter? What do these tags represent?

12. Write a program to implement TF-IDF for any corpus.

13. Write a program to implement chunking and chinking for any corpus.

14. (i)Write a program to find all the misspelled words in a paragraph.
    (ii) Write a program to prepare a table with frequency of misspelled tags for any given text.

15. Write a program to implement all the NLP Pre-Processing Techniques required toper form further NLP tasks

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**Case Studies: (At Least any one Case Study has to be performed)**

**Case Study-1.**Write a program to implement Named Entity Recognition (NER) for any corpus.
**Case Study-2.**Write a program to perform Auto-Correction of spellings for any text.
**Case Study-3.**Check for all positive words in a news article/any text.

**REFERENCEBOOKS:**

**1.**Toolkit StevenBirdEwanKlein, and EdwardLoper, "Natural Language Processing with Python– Analyzing Text with the Natural Language".

**WEB REFERENCES:**

1.http://www.nptelvideos.in/2012/11/natural-languageprocessing.html

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## FULL STACK DEVELOPMENT – II
## (Common to CSE,CSE-(AI&DS),AIML,CSE(AI&ML))

**Course Objectives:**

The main objectives of the course are to

- Make use of router, template engine and authentication using sessions to develop application in ExpressJS.
- Build a single page application using RESTful APIs in ExpressJS
- Apply router and hooksin designing ReactJS application
- Make use of MongoDB queries to perform CRUD operations on document database

**Experiments covering the Topics:**

- ExpressJS – Routing, HTTP Methods, Middleware, Templating, Form Data
- ExpressJS – Cookies, Sessions, Authentication, Database, RESTful APIs
- ReactJS – Render HTML, JSX, Components – function & Class, Props and States, Styles, Respond to Events
- ReactJS – Conditional Rendering, Rendering Lists, React Forms, React Router, Updating the Screen
- ReactJS – Hooks, Sharing data between Components, Applications – To-do list and Quiz
- MongoDB – Installation, Configuration, CRUD operations, Databases, Collections and Records

**Course Outcomes:**

**Students are able to**

| CO Number | Course Outcome | Blooms Level |
|---|---|---|
| CO1 | Develop server-side applications using ExpressJS with routing, middleware, and HTTP methods. | BL3 |
| CO2 | Implement user session management and authentication using cookies and sessions in ExpressJS. | BL4 |
| CO3 | Apply advanced ReactJS concepts such as conditional rendering, list rendering, forms, routing, hooks, and data sharing between components. | BL6 |
| CO4 | Design and implement real-world web applications by integrating front-end, back-end, and database technologies. | BL5 |

**List of Experiments:**

**Experiment 1: ExpressJS – Routing, HTTP Methods, Middleware.**

a. Write a program to define a route, Handling Routes, Route Parameters, Query Parameters and. URL building

b. Write a program to accept data, retrieve data and delete a specified resource using http methods.

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| c. Write a program to show the working of middleware. |
| **Experiment 2: ExpressJS – Templating, Form Data** |
| a. Write a program using templating engine. |
| b. Write a program to work with form data. |
| **Experiment 3: ExpressJS – Cookies, Sessions, Authentication** |
| a. Write a program for session management using cookies and sessions. |
| b. Write a program for user authentication. |
| **Experiment 4: ExpressJS – Database, RESTful APIs** |
| a. Write a program to connect MongoDB database using Mangoose and perform CRUD operations. |
| **b.** Write a program to develop a single page application using RESTful APIs |
| **Experiment 5: ReactJS – Render HTML, JSX, Components – function & Class** |
| a. Write a program to render HTML to a web page. |
| b. Write a program for writing markup with JSX. |
| c. Write a program for creating and nesting components (function and class). |
| **Experiment 6. ReactJS – Props and States, Styles, Respond to Events** |
| a. Write a program to work with props and states. |
| b. Write a program to add styles (CSS & Sass Styling) and display data. |
| c. Write a program for responding to events. |
| **Experiment 7. ReactJS – Conditional Rendering, Rendering Lists, React Forms** |
| a. Write a program for conditional rendering. |
| b. Write a program for rendering lists. |
| c. Write a program for working with different form fields using react forms. |
| **Experiment 8. ReactJS – React Router, Updating the Screen** |
| a. Write a program for routing to different pages using react router. |
| b. Write a program for updating the screen. |
| **Experiment 9. ReactJS – Hooks, Sharing data between Components** |
| a. Write a program to understand the importance of using hooks. |
| **b.** Write a program for sharing data between components. |
| **Experiment 10. MongoDB – Installation, Configuration, CRUD operations** |
| a. Install MongoDB and configure ATLAS |
| b. Write MongoDB queries to perform CRUD operations on document using insert(), find(), update(), remove() |
| **Experiment 11:MongoDB – Databases, Collections and Records** |
| a. Write MongoDB queries to Create and drop databases and collections. |
| b. Write MongoDB queries to work with records using find(), limit(), sort(), createIndex(), |

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| aggregate(). |
| **Experiment 12. Augmented Programs: (Any 2 must be completed)**<br>1. Design a to-do list application using NodeJS and ExpressJS.<br>2. Design a Quiz app using ReactJS.<br>3. Complete the MongoDB certification from MongoDB University website. |
| **Text Books:**<br>1. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.<br>2. Node.Js in Action, Mike Cantelon, Mark Harter, T.J. Holowaychuk, Nathan Rajlich,Manning Publications. (Chapters 1-11)<br>3. React Quickly, AzatMardan,Manning Publications(Chapters 1-8,12-14) |
| **Web Links:**<br>1. ExpressJS - https://www.tutorialspoint.com/expressjs<br>2. ReactJS - https://www.w3schools.com/REACT (and) https://react.dev/learn#<br>3. MongoDB - https://learn.mongodb.com/learning-paths/introduction-to-mongodb |

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**TINKERING LAB**
**USER INTERFACE DESIGN USING FLUTTER**
**(Common to CSE,CSE-(AI&DS),AIML,CSE(AI&ML),IT)**

**Course Objectives:**

The main objectives of the course are to

- Learns to Implement Flutter Widgets and Layouts
- Understands Responsive UI Design and with Navigation in Flutter
- Knowledge on Widges and customize widgets for specific UI elements, Themes
- Understand to include animation apart from fetching data

**Course Outcomes: Students are able**

| CO Number | Course Outcome | Blooms Level |
|---|---|---|
| CO 1 | Install and configure the Flutter and Dart environment, and demonstrate Dart programming basics. | BL2 |
| CO 2 | Develop responsive user interfaces adaptable to various screen sizes using media queries and layout management. | BL3 |
| CO 3 | Create custom widgets and apply themes and styling to enhance UI consistency and aesthetics. | BL6 |
| CO 4 | Integrate animations into UI components to improve user experience using Flutter's animation features. | BL3 |

**List of Experiments:**

Students need to implement the following experiments

**Experiment 1:**

a) Install Flutter and Dart SDK.
b) Write a simple Dart program to understand the language basics

**Experiment 2:**

a) Explore various Flutter widgets (Text, Image, Container, etc.)
b) Implement different layout structures using Row, Column, and Stack widgets

**Experiment 3:**

a) Design a responsive UI that adapts to different screen sizes.
b) Implement media queries and breakpoints for responsiveness.

**Experiment 4:**

a) Set up navigation between different screens using Navigator.
b) Implement navigation with named routes.

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| University Nominee | Subject Expert | Subject Expert | Industrial Expert | Alumni Expert | Chairperson-BOS. |

**Experiment 5:**
a) Learn about stateful and stateless widgets.
b) Implement state management using set State and Provider

**Experiment 6:**
a) Create custom widgets for specific UI elements.
b) Apply styling using themes and custom styles

**Experiment 7:**
a) Design a form with various input fields.
b) Implement form validation and error handling

**Experiment 8:**
a) Add animations to UI elements using Flutter's animation framework.
b) Experiment with different types of animations (fade, slide, etc.).

**Experiment 9:**
a) Fetch data from a REST API.
b) Display the fetched data in a meaningful way in the UI.

**Experiment 10:**
a) Write unit tests for UI components.
b) Use Flutter's debugging tools to identify and fix issues.

**Text Books:**

1. Marco L. Napoli, Beginning Flutter: A Hands-on Guide to App Development.
2. Rap Payne, Beginning App Development with Flutter: Create Cross-Platform Mobile Apps 1st Edition, Apres
3. Richard Rose, Flutter & Dart Cookbook, Developing Full stack Applications for the Cloud, Oreilly..

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