



K L Deemed to be University
Department of Artificial Intelligence and Data Science -- KLVZA
Course Handout
2023-2024, Even Sem

| | |
|---------------------|------------------------------|
| Course Title | :NATURAL LANGUAGE PROCESSING |
| Course Code | :21AD3202 |
| L-T-P-S Structure | : 2-0-2-0 |
| Pre-requisite | : |
| Credits | : 3 |
| Course Coordinator | :V Viswanath Shenoi |
| Team of Instructors | : |
| Teaching Associates | : |

Syllabus :Module 1 Introduction: overview of NLP, Statistical machine translation, Language models and their role in speech processing, The problem of ambiguity, NLP tasks in syntax, semantics, and pragmatics, Words: Structure, Semantics, Parts of Speech, Sentences: Basic ideas in compositional semantics, Classical Parsing (Bottom up, top down, Dynamic Programming: CYK parser), Sentences: Parsing using Probabilistic Context Free Grammars and EM based approaches for learning PCFG parameters, N-gram Language Models, and Information Theory: The role of language models, Simple N-gram models. Module 2 Entropy, relative entropy, cross entropy, Statistical estimation and smoothing for language models, Parts of Speech Tagging and Sequence Labelling, Lexical syntax, Hidden Markov Models (Forward and Viterbi algorithms and EM training), n-gram models. Module 3 Syntactic parsing: Grammar formalisms and treebanks, Efficient parsing for context-free grammars (CFGs), Statistical parsing and probabilistic CFGs (PCFGs), Top-down and bottom-up parsing, empty constituents, left recursion. Modern Statistical Parsers Search methods in parsing: Agenda-based chart, A*, and "best-first" parsing, Dependency parsing. Discriminative parsing, Semantic Analysis: Lexical semantics and word-sense disambiguation. Discourse: Reference resolution and phenomena, syntactic and semantic constraints on Coreference, pronoun resolution algorithm, text coherence, discourse structure. Semantic Role Labelling and Semantic Parsing. Module 4 Information Extraction (IE): Named entity recognition and relation extraction, IE using sequence labelling, Information sources, rule-based methods, evaluation (recall, precision), Statistical Machine Translation (SMT), Alignment Models. Statistical Alignment Models, Topic Modeling, Rule based Techniques, Statistical Machine translation (SMT), word alignment, phrase-based translation, and synchronous grammars. case study: IBM models. Additional topics: Advanced Language Modelling (including LDA), other applications like summarization.

Text Books :1. An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Daniel Jurafsky and James H. Martin. 2. Natural Language Processing with Python Bird, S., Klein, E., Loper, E. 3. Natural language Understanding, James A. 4. Natural language processing: A Paninian perspective, Bharati Akshar, Chaitanya Vineet Sangal, Rajeev.

Reference Books :5. Foundations of Statistical Natural Language Processing, Manning, Christopher D., Hinrich Schuetze. 6. Natural language processing and Information retrieval U.S. Tiwary & Tanveer Siddiqui.

Web Links :Natural Language Processing IIT Kharagpur Prof. Pawan Goyal <https://cse.iitkgp.ac.in/~pawang/> 12 <https://nptel.ac.in/courses/106105158> Natural Language Processing IIT Bombay Prof. Pushpak Bhattacharyya <https://www.cse.iitb.ac.in/~pb/> 8 <https://nptel.ac.in/courses/106101007>

MOOCS :Deeplearning.ai A Complete Guide to NLP Natural Language Processing (NLP) [A Complete Guide] ([deeplearning.ai](https://deeplearning.ai/resources/natural-language-processing/)) <https://www.deeplearning.ai/resources/natural-language-processing/>

Course Rationale :This course is about how to build systems that analyse unstructured natural language texts and extract useful information from them. Students should expect to gain familiarity with the most common types of natural language processing (NLP) tasks, including text classification, sequence labelling, and

structure prediction and to learn appropriate frameworks for performing these tasks. The course will cover the technical methodology in sufficient detail to allow students to apply these frameworks in an informed way and to make current research accessible.

Course Objectives : The objective of the course "NATURAL LANGUAGE PROCESSING" is to inculcate students in gaining in-depth understanding of the computational properties of natural languages and commonly used algorithms for processing linguistic information. Students will be able to understand mathematical fundamentals of language processing, and examine NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.

COURSE OUTCOMES (COs):

| CO NO | Course Outcome (CO) | PO/PSO | Blooms Taxonomy Level (BTL) |
|-------|--|---------------|-----------------------------|
| CO1 | Apply approaches to syntax and semantics of NLP in language processing. | PO1,PO2,PSO2 | 3 |
| CO2 | Apply the statistical estimation and statistical alignment models in language processing. | PO3,PO2,PSO2 | 3 |
| CO3 | Analyze grammar formalism and context free grammars in language processing. | PO3,PSO1,PO2 | 4 |
| CO4 | Analyze Rule based Techniques, Statistical Machine translation (SMT), word alignment in language processing. | PSO1,PO2,PO3 | 4 |
| CO5 | Inspect and Evaluate Language Processing Methods using python. | PO5,PSO1,PSO2 | 5 |

COURSE OUTCOME INDICATORS (COIs)::

| Outcome No. | Highest BTL | COI-1 | COI-2 | COI-3 | COI-4 |
|-------------|-------------|---|---|--|-------|
| CO1 | 3 | Btl-2 Understand Syntax, Semantics, pragmatics, words, sentences in engineering. | Btl-3 Apply Parser approaches and EM based approaches for learning PCFG parameters. | | |
| CO2 | 3 | Btl-2 Understand N-gram language Models and Statistical estimation and smoothing for language models. | Btl-3 Apply parts of speech tagging, sequence labelling, and Hidden Markov Models. | | |
| CO3 | 4 | | Btl-3 Apply CFG's, PCFG's, Modern Statistical Parsers Search methods in parsing and discourse algorithms. | Btl-4 Analyze syntactic parsing techniques and Modern Statistical Parsers Search methods in parsing. | |
| CO4 | 4 | | Btl-3 Apply rule-based | Btl-4 Analyze Statistical | |

| | | | | | |
|-----|---|--|---|--|---|
| | | | methods, Statistical Machine Translation (SMT), Alignment Models. | Alignment Models and Expectation Maximization (EM) and its use in statistical MT alignment models. | |
| CO5 | 5 | | Btl-3 Apply language processing tools of Python for tokenization. | Btl-4 Analyze the parsing techniques using Python. | Btl-5 Evaluate the learned skills in implementing the project |

PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES (POs/PSOs)

| Po No. | Program Outcome |
|--------|---|
| PO1 | Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
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| PO2 | Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences |
| PO2 | Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences |
| PO3 | Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations |
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| PO4 | Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline. |
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| PO5 | Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. |
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| PO6 | The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |

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|------|--|--|--|--|--|
| PO6 | The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. | | | | |
| PO7 | Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development | | | | |
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| PO8 | Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice | | | | |
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| PO9 | Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. | | | | |
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| PO10 | Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions | | | | |
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| PO11 | Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. | | | | |
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| PO12 | Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change. | | | | |
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| PSO1 | An ability to design and develop Artificial Intelligence technology into innovative products for solving real world problems | | | | |
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| PSO2 | An ability to design and develop Data Science methods for analyzing massive datasets to extract insights by applying AI as a tool. | | | | |
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Lecture Course DELIVERY Plan:

| Sess.No. | CO | COI | Topic | Book No[CH No][Page No] | Teaching-Learning Methods | Evaluation Components |
|----------|-----|-------|--|-------------------------|---------------------------|-----------------------|
| 1 | CO1 | COI-1 | Introduction: overview of NLP, Statistical machine translation | TB-1 [1-5] | Chalk,PPT,Talk | ALM,ATTN,End |

| Sess.No. | CO | COI | Topic | Book No[CH No][Page No] | Teaching-Learning Methods | Evaluation Components |
|----------|-----|-------|---|-------------------------|---------------------------|---|
| | | | | | | Semester Exam, HA, SEM-EXAM1 |
| 2 | CO1 | COI-1 | Language models and their role in speech processing, The problem of ambiguity. | TB-1 [45-52] [69-77] | PPT, Talk | ALM, End Semester Exam, SEM-EXAM1 |
| 3 | CO1 | COI-1 | NLP tasks in syntax, semantics, and pragmatics | TB-1 [389-405] | PPT, Talk | ALM, ATTN, End Semester Exam, HA, SEM-EXAM1 |
| 4 | CO1 | COI-1 | Words: Structure, Semantics, Parts of Speech | TB-1 [466-477] | PPT, Talk | ALM, ATTN, End Semester Exam, HA, SEM-EXAM1 |
| 5 | CO1 | COI-1 | Sentences: Basic ideas in compositional semantics | TB-1 [465-485] | PPT, Talk | ALM, ATTN, End Semester Exam, HA, Lab In Semester Exam, SEM-EXAM1 |
| 6 | CO1 | COI-2 | Sentences: Parsing using Probabilistic Context Free Grammars and EM based approaches for learning PCFG parameters | TB-1 [83-95] | PPT, Talk | ALM, ATTN, End Semester Exam, HA, LCE, SEM-EXAM1 |
| 7 | CO1 | COI-2 | N-gram Language Models, and Information Theory: The role of language models, Simple N-gram models. | TB-1 [95-112] | PPT, Talk | ALM, End Semester Exam, SEM-EXAM1 |
| 8 | CO2 | COI-1 | Entropy, relative entropy, cross entropy | TB-I [113-117] | PPT, Talk | ALM, ATTN, End Semester Exam, HA, SEM-EXAM1 |
| 9 | CO2 | COI-2 | Statistical estimation and smoothing for language models | TB-I [113-117] | Chalk, PPT, Talk | ALM, ATTN, End Semester Exam, HA, SEM-EXAM1 |
| 10 | CO2 | COI-1 | Parts of Speech Tagging and Sequence Labelling, Lexical syntax | TB-I [123-137] | Chalk, PPT, Talk | ALM, End Semester Exam, SEM-EXAM1 |
| 11 | CO2 | COI-2 | Hidden Markov Models (Forward and Viterbi algorithms and EM training) | TB-I [139-150] | PPT, Talk | End Semester Exam, HA, SEM-EXAM1 |
| 12 | CO2 | COI- | N-gram models | TB-I [139- | PPT, Talk | End Semester |

| Sess.No. | CO | COI | Topic | Book No[CH No][Page No] | Teaching-Learning Methods | Evaluation Components |
|----------|-----|-------|---|-------------------------|---------------------------|-------------------------------------|
| | | 1 | | 150] | | Exam,HA,SEM-EXAM1 |
| 13 | CO3 | COI-2 | Syntactic parsing: Grammar formalisms and treebanks | TB-1 [343-347] | PPT,Talk | ATTN,End Semester Exam,HA,SEM-EXAM2 |
| 14 | CO3 | COI-3 | Efficient parsing for context-free grammars (CFGs) | TB-1 [343-347] | PPT,Talk | ATTN,End Semester Exam,HA,SEM-EXAM2 |
| 15 | CO3 | COI-3 | Statistical parsing and probabilistic CFGs (PCFGs) | TB-1 [452-455] | PPT,Talk | ALM,End Semester Exam,SEM-EXAM2 |
| 16 | CO3 | COI-3 | Top-down and bottom-up parsing, empty constituents, left recursion | TB-1 [452-455] | PPT,Talk | End Semester Exam,SEM-EXAM2 |
| 17 | CO3 | COI-3 | Modern Statistical Parsers Search methods in parsing | TB5- [455-470] | Chalk,PPT,Talk | ATTN,End Semester Exam,HA,SEM-EXAM2 |
| 18 | CO3 | COI-3 | Semantic Analysis: Lexical semantics and word-sense disambiguation | TB5-[463-470] | PPT,Talk | End Semester Exam,HA,SEM-EXAM2 |
| 19 | CO3 | COI-3 | Discourse: Reference resolution and phenomena | TB5-[566-567] | PPT,Talk | ATTN,End Semester Exam,HA,SEM-EXAM2 |
| 20 | CO3 | COI-3 | Semantic Role Labelling and Semantic Parsing. | TB1-[405-406 | PPT,Talk | End Semester Exam,HA,SEM-EXAM2 |
| 21 | CO4 | COI-3 | Information Extraction (IE): Named entity recognition and relation extraction | TB1-[165-167] | PPT,Talk | End Semester Exam,HA,SEM-EXAM2 |
| 22 | CO4 | COI-3 | IE using sequence labelling, Information sources | TB5-[160-165] | PPT,Talk | End Semester Exam,SEM-EXAM2 |
| 23 | CO4 | COI-3 | Rule-based methods, evaluation (recall, precision) | TB3-[428-430] | PPT,Talk | ATTN,End Semester Exam,HA,SEM-EXAM2 |
| 24 | CO4 | COI-3 | Statistical Machine Translation (SMT) | TB-1 [486-489] | PPT,Talk | End Semester Exam,HA,SEM-EXAM2 |
| 25 | CO4 | COI-3 | Alignment Models. Statistical Alignment Models | TB-1 [486-489] | PPT,Talk | ATTN,End Semester Exam,HA,SEM-EXAM2 |
| 26 | CO4 | COI-3 | Topic Modelling | TB1-[503-504] | PPT,Talk | ATTN,End Semester Exam,HA,SEM-EXAM2 |

Lecture Session wise Teaching – Learning Plan

SESSION NUMBER : 1

Session Outcome: 1 Able to understand the basic of Statistical Machine Translation

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|-------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 20 | Course Handout Explanation | 2 | PPT | --- NOT APPLICABLE --- |
| 20 | Basic concepts of NLP. Statistical machine translation. | 2 | PPT | --- NOT APPLICABLE --- |
| 5 | Question and Answer Session | 1 | Talk | --- NOT APPLICABLE --- |
| 10 | Session Summary | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 2

Session Outcome: 1 Language models and their role in speech processing, The problem of ambiguity

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|-------------------------|
| 5 | Recap of the previous Session | 2 | Talk | --- NOT APPLICABLE --- |
| 20 | Language models and their role in speech processing | 2 | PPT | --- NOT APPLICABLE --- |
| 20 | The problem of ambiguity and its resolution. | 2 | PPT | --- NOT APPLICABLE --- |
| 5 | Session Summary | 2 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 3

Session Outcome: 1 Able to understand the NLP tasks in syntax, semantics, and pragmatics

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|-------|-----|---------------------------|-------------------------|
| | | | | |

| | | | | |
|----|--|---|------|---------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 20 | NLP tasks in syntax, semantics, and pragmatics | 2 | PPT | --- NOT APPLICABLE --- |
| 20 | NLP tasks in pragmatics | 2 | PPT | --- NOT APPLICABLE --- |
| 5 | Session Summary | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 4

Session Outcome: 1 Able to understand Words: Structure, Semantics, Parts of Speech

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|---------------------------|
| 5 | Recap of the previous Session | 2 | Talk | --- NOT APPLICABLE --- |
| 20 | Words: Structure, Semantics | 2 | PPT | --- NOT APPLICABLE --- |
| 20 | Parts of Speech | 2 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 2 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 5

Session Outcome: 1 Able to understand the Sentences: Basic ideas in compositional semantics

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|--|-----|---------------------------|---------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 20 | Sentences: Basic ideas in compositional semantics | 2 | PPT | --- NOT APPLICABLE --- |
| 20 | Classical Parsing (Bottom up, top down, Dynamic Programming: CYK parser) | 3 | PPT | Case Study |
| 5 | Summarization and Clarification of Doubts | 2 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 6

Session Outcome: 1 Able to understand the Sentences: Parsing using Probabilistic Context Free Grammars

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|--|-----|---------------------------|---------------------------|
| 5 | Recap of the previous Session | 2 | Talk | --- NOT APPLICABLE --- |
| 20 | Sentences: Parsing using Probabilistic Context Free Grammars | 3 | PPT | --- NOT APPLICABLE --- |
| 20 | EM based approaches for learning PCFG parameters. | 3 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 7

Session Outcome: 1 Able to apply N-gram Language Models in language processing

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|---------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 20 | N-gram Language Models | 3 | PPT | --- NOT APPLICABLE --- |
| 20 | Simple N-gram models. | 3 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 8

Session Outcome: 1 able to understand the concept of Entropy, relative entropy, cross entropy

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|-------------------------------|-----|---------------------------|---------------------------|
| 5 | Recap of the previous Session | 2 | Talk | --- NOT APPLICABLE --- |

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|----|---|---|-------|---------------------------|
| 20 | Entropy, relative entropy, cross entropy | 2 | PPT | --- NOT APPLICABLE --- |
| 20 | Problems | 3 | Chalk | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 9

Session Outcome: 1 Able to apply language models in NLP

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|---------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 20 | Statistical estimation | 2 | PPT | --- NOT APPLICABLE --- |
| 20 | Smoothing for language models | 3 | PPT | Brain storming session |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 10

Session Outcome: 1 Able to understand Parts of Speech Tagging and Sequence Labelling

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|---------------------------|
| 5 | Recap of the previous Session | 2 | Talk | --- NOT APPLICABLE --- |
| 20 | Parts of Speech Tagging | 2 | PPT | --- NOT APPLICABLE --- |
| 20 | Sequence Labelling, Lexical syntax | 3 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 11

Session Outcome: 1 Able to apply Hidden Markov Models for NLP

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|---------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 20 | Hidden Markov Models (Forward and Viterbi algorithms) | 2 | PPT | --- NOT APPLICABLE --- |
| 20 | EM training | 3 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 12**Session Outcome: 1 Able to understand N-gram models**

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|---------------------------|
| 5 | Recap of the previous Session | 2 | Talk | --- NOT APPLICABLE --- |
| 20 | N-gram models | 3 | PPT | --- NOT APPLICABLE --- |
| 20 | Other types of N-gram models | 3 | PPT | Group Discussion |
| 5 | Summarization and Clarification of Doubts | 2 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 13**Session Outcome: 1 Syntactic parsing: Grammar formalisms and treebanks**

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|---------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 40 | Syntactic parsing: Grammar formalisms and treebanks | 3 | PPT | --- NOT APPLICABLE --- |

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|---|---|---|------|---------------------------|
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |
|---|---|---|------|---------------------------|

SESSION NUMBER : 14

Session Outcome: 1 Able to apply Efficient parsing for context-free grammars (CFGs) of NLP in language processing

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|--|-----|---------------------------|---------------------------|
| 5 | Recap of the previous Session | 2 | Talk | --- NOT APPLICABLE --- |
| 40 | Efficient parsing for context-free grammars (CFGs) | 3 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 3 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 15

Session Outcome: 1 Able to apply Statistical parsing and probabilistic CFGs (PCFGs) for language processing

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|--|-----|---------------------------|---------------------------|
| 5 | Attendance | 1 | Talk | --- NOT APPLICABLE --- |
| 40 | Statistical parsing and probabilistic CFGs (PCFGs) | 3 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 1 | PPT | --- NOT APPLICABLE --- |

SESSION NUMBER : 16

Session Outcome: 1 Able to apply Top-down and bottom-up parsing of a sentence

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|--|-----|---------------------------|---------------------------|
| 5 | Recap of the previous Session | 2 | Talk | --- NOT APPLICABLE --- |
| 40 | Top-down and bottom-up parsing, empty constituents, left recursion | 3 | PPT | One minute paper |

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|---|---|---|------|---------------------------|
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |
|---|---|---|------|---------------------------|

SESSION NUMBER : 17

Session Outcome: 1 Apply Modern Statistical Parsers Search methods in parsing of sentences

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|--|-----|---------------------------|---------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 40 | Modern Statistical Parsers Search methods in parsing | 3 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 18

Session Outcome: 1 Able to apply Semantic Analysis: on text

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|---------------------------|
| 5 | Recap of the previous Session | 1 | Talk | --- NOT APPLICABLE --- |
| 20 | Semantic Analysis: | 3 | PPT | --- NOT APPLICABLE --- |
| 20 | Lexical semantics and word-sense disambiguation | 3 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 19

Session Outcome: 1 Discourse: Reference resolution and phenomena

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|------------|-----|---------------------------|---------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |

| | | | | |
|----|---|---|------|---------------------------|
| 40 | Discourse: Reference resolution and phenomena | 3 | PPT | Case Study |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 20

Session Outcome: 1 Able to apply Semantic Parsing on text data.

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|---------------------------|
| 5 | Recap of the previous Session | 1 | Talk | --- NOT APPLICABLE --- |
| 40 | Semantic Role Labelling and Semantic Parsing. | 3 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 21

Session Outcome: 1 Able to apply Named entity recognition and relation extraction for Information extraction

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|---------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 40 | Information Extraction (IE): Named entity recognition and relation extraction | 3 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 1 | PPT | --- NOT APPLICABLE --- |

SESSION NUMBER : 22

Session Outcome: 1 Able to perform information extraction using sequence labelling

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|--|-----|---------------------------|---------------------------|
| 5 | Recap of the previous Session | 1 | Talk | --- NOT APPLICABLE --- |
| 40 | IE using sequence labelling, Information sources | 3 | PPT | Think / Pair / Share |

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|---|---|---|------|------------------------|
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |
|---|---|---|------|------------------------|

SESSION NUMBER : 23

Session Outcome: 1 Able to apply rule-based methods for information extraction

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|--|-----|---------------------------|-------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 40 | Rule-based methods rule-based methods, evaluation (recall, precision) | 3 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 24

Session Outcome: 1 Able to apply the concept of Statistical Machine Translation (SMT) on text

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|-------------------------|
| 5 | Recap of the previous Session | 2 | Talk | --- NOT APPLICABLE --- |
| 40 | Statistical Machine Translation (SMT) | 3 | PPT | --- NOT APPLICABLE --- |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 25

Session Outcome: 1 Able to apply Statistical Alignment Models for text processing

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|--|-----|---------------------------|-------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 40 | Alignment Models. Statistical Alignment Models | 3 | PPT | --- NOT APPLICABLE --- |

| | | | | |
|---|---|---|------|------------------------|
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |
|---|---|---|------|------------------------|

SESSION NUMBER : 26

Session Outcome: 1 Able to identify the Topic based on the discourse

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|---|-----|---------------------------|-------------------------|
| 5 | Recap of the previous Session | 2 | Talk | --- NOT APPLICABLE --- |
| 40 | Topic Modelling | 3 | PPT | Fish Bowl |
| 5 | Summarization and Clarification of Doubts | 1 | Talk | --- NOT APPLICABLE --- |

Tutorial Course DELIVERY Plan: NO Delivery Plan Exists

Tutorial Session wise Teaching – Learning Plan

No Session Plans Exists

Practical Course DELIVERY Plan:

| Tutorial Session no | Topics | CO-Mapping |
|---------------------|---|------------|
| 1 | Installation of NLTK in python | CO5 |
| 2 | Implementation of Word Tokenizer | CO5 |
| 3 | Implementemtation of Sentence Tokenizer | CO5 |
| 4 | Implement Paragraph Tokenizer | CO5 |
| 5 | Implement various actions in Corpora | CO5 |
| 6 | Implement Probabilistic Parsing | CO5 |
| 7 | Learning Grammar | CO5 |
| 8 | Conditional Frequency Distribution | CO5 |
| 9 | Lexical Analyzer | CO5 |
| 10 | Wordnet | CO5 |

| Tutorial Session no | Topics | CO-Mapping |
|---------------------|--------------------------|------------|
| 11 | Context Free Grammar | CO5 |
| 12 | Named Entity Recognition | CO5 |

Practical Session wise Teaching – Learning Plan

SESSION NUMBER : 1

Session Outcome: 1 Able to apply the NLTK package in python

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|----------------------------|-----|---------------------------|---------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 35 | Demo- Installation of NLTK | 3 | PPT | --- NOT APPLICABLE --- |
| 60 | Execution of program | 4 | PPT | --- NOT APPLICABLE --- |

SESSION NUMBER : 2

Session Outcome: 1 Able to implement of Word Tokenizer

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|----------------------------------|-----|---------------------------|---------------------------|
| 5 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 30 | Implementation of Word Tokenizer | 2 | PPT | --- NOT APPLICABLE --- |
| 60 | Execution of program | 3 | PPT | --- NOT APPLICABLE --- |

SESSION NUMBER : 3

Session Outcome: 1 Able to implement of Sentence Tokenizer

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|-------|-----|---------------------------|-------------------------|
| | | | | |

| | | | | |
|----|--------------------------------------|---|------|---------------------------|
| 10 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 30 | Implementation of Sentence Tokenizer | 2 | PPT | --- NOT APPLICABLE --- |
| 60 | Execution of program | 3 | PPT | --- NOT APPLICABLE --- |

SESSION NUMBER : 4**Session Outcome:** 1 Able to implement Paragraph Tokenizer

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|-------------------------------|-----|---------------------------|---------------------------|
| 10 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 30 | Implement Paragraph Tokenizer | 2 | PPT | --- NOT APPLICABLE --- |
| 60 | Execution of program | 3 | PPT | --- NOT APPLICABLE --- |

SESSION NUMBER : 5**Session Outcome:** 1 Implement various actions in Corpora

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|--------------------------------------|-----|---------------------------|---------------------------|
| 10 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 30 | Implement various actions in Corpora | 2 | PPT | --- NOT APPLICABLE --- |
| 60 | Execution of program | 3 | PPT | --- NOT APPLICABLE --- |

SESSION NUMBER : 6**Session Outcome:** 1 Able to Implement Probabilistic Parsing

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|-------|-----|---------------------------|-------------------------|
| | | | | |

| | | | | |
|----|---------------------------------|---|------|---------------------------|
| 10 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 30 | Implement Probabilistic Parsing | 2 | PPT | --- NOT APPLICABLE --- |
| 60 | Execution of program | 3 | PPT | --- NOT APPLICABLE --- |

SESSION NUMBER : 7

Session Outcome: 1 Able to implement Learning Grammar from the given text

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|----------------------|-----|---------------------------|---------------------------|
| 10 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 30 | Learning Grammar | 2 | PPT | --- NOT APPLICABLE --- |
| 60 | Execution of program | 3 | PPT | --- NOT APPLICABLE --- |

SESSION NUMBER : 8

Session Outcome: 1 Conditional Frequency Distribution

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|------------------------------------|-----|---------------------------|---------------------------|
| 10 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 30 | Conditional Frequency Distribution | 2 | PPT | --- NOT APPLICABLE --- |
| 60 | Execution of program | 3 | PPT | --- NOT APPLICABLE --- |

SESSION NUMBER : 9

Session Outcome: 1 Lexical Analyzer

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|-------|-----|---------------------------|-------------------------|
| | | | | |

| | | | | |
|----|----------------------|---|------|---------------------------|
| 10 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 30 | Lexical Analyzer | 2 | PPT | --- NOT APPLICABLE --- |
| 60 | Execution of program | 3 | PPT | --- NOT APPLICABLE --- |

SESSION NUMBER : 10**Session Outcome:** 1 Wordnet

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|----------------------|-----|---------------------------|---------------------------|
| 10 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 30 | Wordnet | 2 | PPT | --- NOT APPLICABLE --- |
| 60 | Execution of program | 3 | Talk | --- NOT APPLICABLE --- |

SESSION NUMBER : 11**Session Outcome:** 1 Able to apply Context Free Grammar for text

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|----------------------|-----|---------------------------|---------------------------|
| 10 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 30 | Context Free Grammar | 2 | PPT | --- NOT APPLICABLE --- |
| 60 | Execution of program | 3 | PPT | --- NOT APPLICABLE --- |

SESSION NUMBER : 12**Session Outcome:** 1 Able to identify text using Named Entity Recognition

| Time(min) | Topic | BTL | Teaching-Learning Methods | Active Learning Methods |
|-----------|-------|-----|---------------------------|-------------------------|
| | | | | |

| | | | | |
|----|--------------------------|---|------|---------------------------|
| 10 | Attendance | 2 | Talk | --- NOT APPLICABLE --- |
| 30 | Named Entity Recognition | 2 | PPT | --- NOT APPLICABLE --- |
| 60 | Execution of program | 3 | PPT | --- NOT APPLICABLE --- |

Skilling Course DELIVERY Plan: NO Delivery Plan Exists

Skilling Session wise Teaching – Learning Plan

No Session Plans Exists

WEEKLY HOMEWORK ASSIGNMENTS/ PROBLEM SETS/OPEN ENDED PROBLEM-SOLVING EXERCISES etc:

| Week | Assignment Type | Assignment No | Topic | Details | co |
|------|-----------------|---------------|-------|---------|----|
|------|-----------------|---------------|-------|---------|----|

COURSE TIME TABLE:

| | Hour | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-----|-----------|---|---|---|---|---|---|---|---|---|
| Day | Component | | | | | | | | | |
| Mon | Theory | - | - | V-S21,V-S22,V-S23 | V-S21,V-S22,V-S23 | --- | --- | - | - | - |
| | Tutorial | - | - | -- | -- | --- | --- | - | - | - |
| | Lab | - | - | V-S24,V-S24,V-S24,V-S25,V-S25,V-S25,V-S26,V-S26,V-S26 | V-S24,V-S24,V-S24,V-S25,V-S25,V-S25,V-S26,V-S26,V-S26 | --- | --- | - | - | - |
| | Skilling | - | - | -- | -- | --- | --- | - | - | - |
| Tue | Theory | - | - | --- | --- | V-S24,V-S25,V-S26 | V-S24,V-S25,V-S26 | - | - | - |
| | Tutorial | - | - | --- | --- | -- | -- | - | - | - |
| | Lab | - | - | --- | --- | V-S21,V-S21,V-S21,V-S22,V-S22,V-S23,V-S23,V-S23 | V-S21,V-S21,V-S21,V-S22,V-S22,V-S22,V-S23,V-S23,V-S23 | - | - | - |

| | | | | | | |
|------------|----------|-------|-------|-------|-------------------|-------------------|
| | Skilling | - - - | --- | -- | -- | - - - |
| Wed | Theory | - - - | -- | -- | -- | - - - |
| | Tutorial | - - - | -- | -- | -- | - - - |
| | Lab | - - - | -- | -- | -- | - - - |
| | Skilling | - - - | -- | -- | -- | - - - |
| Thu | Theory | - - - | -- | -- | -- | - - - |
| | Tutorial | - - - | -- | -- | -- | - - - |
| | Lab | - - - | -- | -- | -- | - - - |
| | Skilling | - - - | -- | -- | -- | - - - |
| Fri | Theory | - - - | V-S11 | V-S11 | --- | --- |
| | Tutorial | - - - | -- | -- | --- | --- |
| | Lab | - - - | -- | -- | --- | --- |
| | Skilling | - - - | -- | -- | --- | --- |
| Sat | Theory | - - - | --- | --- | -- | - - - |
| | Tutorial | - - - | --- | --- | -- | - - - |
| | Lab | - - - | --- | --- | V-S11,V-S11,V-S11 | V-S11,V-S11,V-S11 |
| | Skilling | - - - | --- | --- | -- | - - - |
| Sun | Theory | - - - | -- | -- | -- | - - - |
| | Tutorial | - - - | -- | -- | -- | - - - |
| | Lab | - - - | -- | -- | -- | - - - |

| | | | | | | | | | |
|----------|---|---|----|----|----|----|---|---|---|
| | - | - | | | | | - | - | - |
| Skilling | - | - | -- | -- | -- | -- | - | - | - |

REMEDIAL CLASSES:

Supplement course handout, which may perhaps include special lectures and discussions that would be planned, and schedule notified accordingly

SELF-LEARNING:

Assignments to promote self-learning, survey of contents from multiple sources.

| S.no | Topics | CO | ALM | References/MOOCs |
|------|--------|----|-----|------------------|
|------|--------|----|-----|------------------|

DELIVERY DETAILS OF CONTENT BEYOND SYLLABUS:

Content beyond syllabus covered (if any) should be delivered to all students that would be planned, and schedule notified accordingly.

| S.no | Advanced Topics, Additional Reading, Research papers and any | CO | ALM | References/MOOCs |
|------|--|----|-----|------------------|
|------|--|----|-----|------------------|

EVALUATION PLAN:

| Evaluation Type | Evaluation Component | Weightage/Marks | | Assessment Dates | Duration (Hours) | CO1 | CO2 | CO3 | CO4 | CO5 |
|--|--------------------------------------|-----------------|-----|------------------|------------------|------|------|------|------|-----|
| End Semester Summative Evaluation Total= 40 % | SEM End Project | Weightage | 8 | | 90 | | | | | 8 |
| | | Max Marks | 50 | | | | | | | 50 |
| | End Semester Exam | Weightage | 24 | | 180 | 6 | 6 | 6 | 6 | |
| | | Max Marks | 100 | | | 25 | 25 | 25 | 25 | |
| | Lab End Semester Exam | Weightage | 8 | | 90 | | | | | 8 |
| | | Max Marks | 50 | | | | | | | 50 |
| In Semester Formative Evaluation Total= 22 % | Continuous Evaluation - Project | Weightage | 4 | | 90 | | | | | 4 |
| | | Max Marks | 50 | | | | | | | 50 |
| | MOOCs Review | Weightage | 4 | | 90 | | | | | 4 |
| | | Max Marks | 50 | | | | | | | 50 |
| | ALM | Weightage | 5 | | 90 | 1.25 | 1.25 | 1.25 | 1.25 | |
| | | Max Marks | 100 | | | 25 | 25 | 25 | 25 | |
| | Home Assignment and Textbook | Weightage | 5 | | 90 | 1.25 | 1.25 | 1.25 | 1.25 | |
| | | Max Marks | 100 | | | 25 | 25 | 25 | 25 | |
| | Continuous Evaluation - Lab Exercise | Weightage | 4 | | 90 | | | | | 4 |
| | | Max Marks | 120 | | | | | | | 120 |

| | | | | | | | | | | | |
|---|-----------------------------|-----------|----|--|----|----|----|----|----|--|----|
| In Semester Summative Evaluation Total= 38 % | MOOCs Certification | Weightage | 4 | | 90 | | | | | | 4 |
| | | Max Marks | 50 | | | | | | | | 50 |
| | Semester in Exam-I | Weightage | 12 | | 90 | 6 | 6 | | | | |
| | | Max Marks | 50 | | | 25 | 25 | | | | |
| | Semester in Exam-II | Weightage | 12 | | 90 | | | 6 | 6 | | |
| | | Max Marks | 50 | | | | | 25 | 25 | | |
| | Lab In Semester Exam | Weightage | 10 | | 90 | | | | | | 10 |
| | | Max Marks | 50 | | | | | | | | 50 |

ATTENDANCE POLICY:

Every student is expected to be responsible for regularity of his/her attendance in class rooms and laboratories, to appear in scheduled tests and examinations and fulfill all other tasks assigned to him/her in every course. In every course, student has to maintain a minimum of 85% attendance to be eligible for appearing in Semester end examination of the course, for cases of medical issues and other unavoidable circumstances the students will be condoned if their attendance is between 75% to 85% in every course, subjected to submission of medical certificates, medical case file and other needful documental proof to the concerned departments.

DETENTION POLICY :

In any course, a student has to maintain a minimum of 85% attendance and In-Semester Examinations to be eligible for appearing to the Semester End Examination, failing to fulfill these conditions will deem such student to have been detained in that course.

PLAGIARISM POLICY :

Supplement course handout, which may perhaps include special lectures and discussions

COURSE TEAM MEMBERS, CHAMBER CONSULTATION HOURS AND CHAMBER VENUE DETAILS:

Supplement course handout, which may perhaps include special lectures and discussions

| Name of Faculty | Delivery Component of Faculty | Sections of Faculty | Chamber Consultation Day (s) | Chamber Consultation Timings for each day | Chamber Consultation Room No: | Signature of Course faculty: |
|-------------------------|-------------------------------|---------------------|------------------------------|---|-------------------------------|------------------------------|
| Praveena Mandapati | P | 11-B | - | - | - | - |
| Swarna Kuchibhotla | L | 21-MA | - | - | - | - |
| Swarna Kuchibhotla | P | 21-A | - | - | - | - |
| Karthikeyan C | P | 22-B | - | - | - | - |
| Lakshmi Lalitha Vuyyuru | P | 23-B | - | - | - | - |
| Smritilekha Das | P | 12-C,24-B | - | - | - | - |
| Jyothi N.M | P | 26-B | - | - | - | - |

| | | | | | | |
|--------------------------------|---|-----------|---|---|---|---|
| Suryakanth Gangashetty | L | 11-MA | - | - | - | - |
| Suryakanth Gangashetty | P | 11-A | - | - | - | - |
| Imran Rasheed | P | 25-B | - | - | - | - |
| Basant Sah | P | 12-B | - | - | - | - |
| N B Arunekumar Balasubramanian | P | 11-C | - | - | - | - |
| Vikram Dara | L | 25-MA | - | - | - | - |
| Vikram Dara | P | 25-A | - | - | - | - |
| Adapa Rao | L | 12-MA | - | - | - | - |
| Adapa Rao | P | 12-A | - | - | - | - |
| Murali Puttagunta | P | 24-C | - | - | - | - |
| Selvam Kombaiya | L | 24-MA | - | - | - | - |
| Selvam Kombaiya | P | 24-A | - | - | - | - |
| DUPATY MOHAN | P | 22-C | - | - | - | - |
| Naveen Mukkapati | P | 23-C | - | - | - | - |
| V Viswanath Shenoi | L | 22-MA | - | - | - | - |
| V Viswanath Shenoi | P | 22-A | - | - | - | - |
| RUDRAMANI BHUTIA | L | 23-MA | - | - | - | - |
| RUDRAMANI BHUTIA | P | 23-A | - | - | - | - |
| PURNA KASARANENI | P | 26-C | - | - | - | - |
| G Venkata Ramana Reddy | L | 26-MA | - | - | - | - |
| G Venkata Ramana Reddy | P | 26-A | - | - | - | - |
| ARUNDATHI JILLAPALLI | P | 25-C,21-B | - | - | - | - |
| praveen kumar pinjala | P | 21-C | - | - | - | - |

GENERAL INSTRUCTIONS

Students should come prepared for classes and carry the text book(s) or material(s) as prescribed by the Course Faculty to the class.

NOTICES

Most of the notices are available on the LMS platform.

All notices will be communicated through the institution email.

All notices concerning the course will be displayed on the respective Notice Boards.

Signature of COURSE COORDINATOR

(V Viswanath Shenoi)

Signature of Department Prof. Incharge Academics & Vetting Team Member

Department Of AI&DS

HEAD OF DEPARTMENT:

Approval from: DEAN-ACADEMICS

(Sign with Office Seal) [object HTMLDivElement]