

**Department of Computer Science and Engineering (Data Science)**

**B.Tech – II Year I Semester**

| S.No.        | Category | Code     | Title                                                                        | L         | T        | P         | Credits   |
|--------------|----------|----------|------------------------------------------------------------------------------|-----------|----------|-----------|-----------|
| 1            | BS       | 23AHS32T | Discrete Mathematics                                                         | 3         | 0        | 0         | 3         |
| 2            | HSSM     | 23AHS35T | Universal Human Values -<br>Understanding Harmony & Ethical<br>Human Conduct | 2         | 1        | 0         | 3         |
| 3            | ES       | 23A3231T | Introduction to Data Science                                                 | 3         | 0        | 0         | 3         |
| 4            | PC       | 23A0532T | Advanced Data Structures &<br>Algorithms Analysis                            | 3         | 0        | 0         | 3         |
| 5            | PC       | 23A0533T | Object-Oriented Programming<br>Through Java                                  | 3         | 0        | 0         | 3         |
| 6            | PC       | 23A3231L | Data Science Lab                                                             | 0         | 0        | 3         | 1.5       |
| 7            | PC       | 23A0533L | Object-Oriented Programming<br>Through Java Lab                              | 0         | 0        | 3         | 1.5       |
| 8            | SEC      | 23A0534L | The Joy of Computing Using<br>Python                                         | 0         | 1        | 2         | 2         |
| 9            | MC       | 23AHS39T | Environmental Science                                                        | 2         | 0        | 0         | -         |
| <b>Total</b> |          |          |                                                                              | <b>15</b> | <b>2</b> | <b>10</b> | <b>20</b> |

### B. Tech– II Year II Semester

[illegible]

## Department of Computer Science and Engineering (Data Science)

### ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET (An Autonomous Institution)

|                             |                                        |
|-----------------------------|----------------------------------------|
| <b>Title of the Course:</b> | Discrete Mathematics                   |
| <b>Category:</b>            | BS                                     |
| <b>Couse Code:</b>          | 23AHS32T                               |
| <b>Branch/es:</b>           | CSE, CSE(DS), CSE(AI), AI&DS and AI&ML |
| <b>Semester:</b>            | II B Tech I Sem                        |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 3                    | 0                     | 0                     | 3              |

#### Course Objectives:

1. Formulate and analyze compound propositions using truth tables and logical equivalences.
2. Integrate knowledge from sets, functions, and algebraic structures to solve engineering problems
3. To study applications of combinatorial methods in cryptography, coding theory, and algorithm design.
4. Familiarize closed form solution of linear recurrence relations by various methods.
5. Bring awareness of basic concepts of graphs, trees and its applications.

#### Course Outcomes:

At the end of the course, the student will be able to

1. Describe the logical connectives in inference theory
2. Explain relations, functions and algebraic structures in computer science and engineering
3. Describe combinatorial mathematics in various fields, such as computer science, cryptography, and optimization.
4. Solve the various types of recurrence relations in engineering
5. Apply graph theory concepts in network analysis

#### Unit 1 Mathematical Logic

Introduction, Statements and Notation, Connectives, Well-formed formulas, Tautology, Duality law, Equivalence, Implication, Normal Forms, Functionally complete set of connectives, Inference Theory of Statement Calculus, Predicate Calculus, Inference theory of Predicate Calculus.

#### Unit 2 Set theory

The Principle of Inclusion- Exclusion, Pigeon hole principle and its application, Functions composition of functions, Inverse Functions, Recursive Functions, Lattices and its properties. Algebraic structures: Algebraic systems-Examples and General Properties, Semi groups and Monoids, groups, sub groups, homomorphism, Isomorphism.

#### Unit 3 Elementary Combinatorics

Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutations with Constrained Repetitions, Binomial Coefficients, The Binomial and Multinomial Theorems.

#### Unit 4 Recurrence Relations

Generating Functions of Sequences, Calculating Coefficients of Generating Functions, Recurrence relations, Solving Recurrence Relations by Substitution and Generating functions, The Method of Characteristic roots, Solutions of Inhomogeneous, Recurrence Relations.

## Department of Computer Science and Engineering (Data Science)

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| <b>Unit 5</b>                                                                                                                                                                                            | <b>Graphs</b> |  |
| Basic Concepts, Isomorphism and Subgraphs, Trees and their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Euler's Formula, Multigraphs and Euler Circuits, Hamiltonian Graphs. |               |  |

### Prescribed Textbooks:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 2002.
2. Kenneth H. Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, 7th Edition, McGraw Hill Education (India) Private Limited.

### Reference Books:

1. Joe L. Mott, Abraham Kandel and Theodore P. Baker, Discrete Mathematics for Computer Scientists & Mathematicians, 2nd Edition, Pearson Education.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science.

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23AHS32T.1      | 2                     | 2                | 1                               | 1                                          | -                 | -                        | -                              | -      | -                        | -             | -                              | 1                  | -    | -    | -    |
| 23AHS32T.2      | 2                     | 2                | 1                               | 1                                          | -                 | -                        | -                              | -      | -                        | -             | -                              | 1                  | -    | -    | -    |
| 23AHS32T.3      | 2                     | 2                | 1                               | 1                                          | -                 | -                        | -                              | -      | -                        | -             | -                              | 1                  | -    | -    | -    |
| 23AHS32T.4      | 3                     | 2                | 1                               | 2                                          | -                 | -                        | -                              | -      | -                        | -             | -                              | 1                  | -    | -    | -    |
| 23AHS32T.5      | 3                     | 2                | 1                               | 2                                          | -                 | -                        | -                              | -      | -                        | -             | -                              | 1                  | -    | -    | -    |

## Department of Computer Science and Engineering (Data Science)

### ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET (An Autonomous Institution)

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| <b>Title of the Course:</b> | Universal Human Values - Understanding Harmony and Ethical Human Conduct |
| <b>Category:</b>            | HSSM                                                                     |
| <b>Couse Code:</b>          | 23AHS35T                                                                 |
| <b>Branch/es:</b>           | CSE, CSE-AI, CSE-DS, AIDS, AIML                                          |
| <b>Semester:</b>            | II B Tech I Sem                                                          |

| Lecture Hours | Tutorial Hours | Practice Hours | Credits |
|---------------|----------------|----------------|---------|
| 2             | 1              | 0              | 3       |

#### Course Objectives:

- 1.To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity.
- 2.To facilitate the development of a holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the human reality and the rest of existence ultimately towards value-based living in a natural way.
- 3.To highlight plausible implications of such a holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with nature.

#### Course Outcomes:

At the end of the course, the student will be able to

1. Comprehend the terms like Natural Acceptance, Happiness and Prosperity
2. Analyze one's self, and one's surroundings (family, society, nature)
3. Apply human values in enriching human relationships and human society.
4. Analyze the need for universal human values and harmonious existence.
5. Evaluate themselves as socially and ecologically responsible engineers.

| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Introduction to Value Education | 9 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---|
| Lecture1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)<br>Lecture2: Understanding Value Education<br>Tutorial 1: Practice Session1: Sharing about Oneself<br>Lecture 3: Self-Exploration as the Process for Value Education<br>Lecture4: Continuous Happiness and Prosperity – The Basic Human Aspirations<br>Tutorial 2: Practice Session2: Exploring Human Consciousness<br>Lecture 5: Happiness and Prosperity – Current Scenario<br>Lecture 6: Method to Fulfill the Basic Human Aspirations<br>Tutorial 3: Practice Session3: Exploring Natural Acceptance |                                 |   |

| Unit 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Harmony in the Human Being | 9 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---|
| Lecture 7: Understanding Human being as the Co-existence of the self and the body.<br>Lecture 8: Distinguishing between the needs of the self and the body<br>Tutorial 4: Practice Session4: Exploring the difference of needs of self and body.<br>Lecture 9: The body as an instrument of the self<br>Lecture 10: Understanding harmony in the self<br>Tutorial 5: Practice Session5: Exploring sources of imagination in the self<br>Lecture 11: Harmony of the self with the body<br>Lecture 12: Programme to ensure self-regulation and health |                            |   |

## Department of Computer Science and Engineering (Data Science)

|                                                                         |
|-------------------------------------------------------------------------|
| Tutorial 6: Practice Session 6: Exploring harmony of self with the body |
|-------------------------------------------------------------------------|

| Unit 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Harmony in the Family and Society | 9 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|---|
| Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction<br>Lecture 14: 'Trust' – the Foundational Value in Relationship<br>Tutorial 7: Practice Session7: Exploring the Feeling of Trust<br>Lecture 15: 'Respect' – as the Right Evaluation<br>Tutorial 8: Practice Session 8: Exploring the Feeling of Respect<br>Lecture 16: Other Feelings, Justice in Human-to-Human Relationship<br>Lecture 17: Understanding Harmony in the Society<br>Lecture 18: Vision for the Universal Human Order<br>Tutorial 9: Practice Session9: Exploring systems to fulfil human goal |                                   |   |

| Unit 4                                                                                                                                                                                                                                                                                                                                                                                                                                    | Harmony in the Nature/Existence | 6 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---|
| Lecture 19: Understanding Harmony in the Nature<br>Lecture 20: Interconnectedness, Self-Regulation and Mutual Fulfilment among the Four Orders of Nature<br>Tutorial 10: Practice Session 10: Exploring the Four Orders of Nature<br>Lecture 21: Realizing Existence as Co-existence at All Levels<br>Lecture 22: The Holistic Perception of Harmony in Existence<br>Tutorial 11: Practice Session11: Exploring Co-existence in Existence |                                 |   |

| Unit 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Implications of the Holistic Understanding – a Look at Professional Ethics | 9 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|---|
| Lecture 23: Natural Acceptance of Human Values<br>Lecture 24: Definitiveness of (Ethical) Human Conduct<br>Tutorial 12: Practice Session 12: Exploring Ethical Human Conduct<br>Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order<br>Lecture 26: Competence in Professional Ethics<br>Tutorial 13: Practice Session13: Exploring Humanistic Models in Education<br>Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies<br>Lecture 28: Strategies for Transition towards Value-based Life and Profession<br>Tutorial 14: Practice Session14: Exploring Steps of Transition towards Universal Human Order |                                                                            |   |

### Practice Sessions for UNIT I – Introduction to Value Education

PS1 Sharing about Oneself  
 PS2 Exploring Human Consciousness  
 PS3 Exploring Natural Acceptance

### Practice Sessions for UNIT II – Harmony in the Human Being

PS4 Exploring the Difference of Needs of Self and Body  
 PS5 Exploring Sources of Imagination in the Self  
 PS6 Exploring Harmony of Self with the Body

### Practice Sessions for UNIT III – Harmony in the Family and Society

PS7 Exploring the Feeling of Trust  
 PS8 Exploring the Feeling of Respect  
 PS9 Exploring Systems to fulfil Human Goal

### Practice Sessions for UNIT IV – Harmony in the Nature (Existence)

PS10 Exploring the Four Orders of Nature  
 PS11 Exploring Co-existence in Existence

### Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics

PS12 Exploring Ethical Human Conduct

## Department of Computer Science and Engineering (Data Science)

PS13 Exploring Humanistic Models in Education

PS14 Exploring Steps of Transition towards Universal Human Order

### Prescribed Textbooks:

#### Textbook and Teachers Manual

##### 1. The Textbook

R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

##### 2. The Teacher's Manual

R R Gaur, R Asthana, G P Bagaria, Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

### Reference Books:

1. Jeevan Vidya: Ek Parichaya, A. Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

1. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

2. The Story of Stuff (Book).

3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

4. Small is Beautiful - E. F Schumacher.

5. Slow is Beautiful - Cecile Andrews

6. Economy of Permanence - J C Kumarappa

7. Bharat Mein Angreji Raj – Pandit Sunderlal

8. Rediscovering India - by Dharampal

9. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

10. India Wins Freedom - Maulana Abdul Kalam Azad

11. Vivekananda - Romain Rolland (English)

13. Gandhi - Romain Rolland (English)

### Web Resources:

1. <https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201Introduction%20to%20Value%20Education.pdf>

2. <https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf>

3. <https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3S2%20Respect%20July%2023.pdf>

4. <https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf>

5. <https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%20325%20Ethics%20v1.pdf>

6. <https://www.studocu.com/in/document/kiet-group-of-institutions/universal-humanvalues/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385>

[https://onlinecourses.swayam2.ac.in/aic22\\_ge23/preview](https://onlinecourses.swayam2.ac.in/aic22_ge23/preview)

7. <https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf>

## Department of Computer Science and Engineering (Data Science)

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Investigation of complex | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PS01 | PS02 | PS03 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23AHS35T.1      | -                     | -                | -                               | -                        | -                 | -                        | -                              | 3      | -                        | 1             | -                              | 2                  | -    | -    | -    |
| 23AHS35T.2      | -                     | -                | -                               | -                        | -                 | -                        | -                              | 3      | -                        | 1             | -                              | 2                  | -    | -    | -    |
| 23AHS35T.3      | -                     | -                | -                               | -                        | -                 | -                        | -                              | 3      | -                        | 1             | -                              | 2                  | -    | -    | -    |
| 23AHS35T.4      | -                     | -                | -                               | -                        | -                 | -                        | 2                              | 3      | -                        | 1             | -                              | 2                  | -    | -    | -    |
| 23AHS35T.5      | -                     | -                | -                               | -                        | -                 | 2                        | 3                              | 3      | -                        | 1             | -                              | 2                  | -    | -    | -    |

## Department of Computer Science and Engineering (Data Science)

### ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET (An Autonomous Institution)

|                             |                              |
|-----------------------------|------------------------------|
| <b>Title of the Course:</b> | Introduction to Data Science |
| <b>Category:</b>            | ES                           |
| <b>Couse Code:</b>          | 23A3231T                     |
| <b>Branch/es:</b>           | CSE(DS)                      |
| <b>Semester:</b>            | II B Tech I Sem              |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 3                    | 0                     | 0                     | 3              |

#### Course Objectives:

From the course the student will learn

1. Knowledge and expertise to become a data scientist.
2. Essential concepts of statistics and machine learning that are vital for data science;
3. Significance of exploratory data analysis (EDA) in data science.
4. Critically evaluate data visualizations presented on the dashboards
5. Suitability and limitations of tools and techniques related to data science process

#### Course Outcomes:

At the end of the course, the student will be able to

1. Understand the data science process and its components, including data cleansing and exploratory analysis. (L2)
2. Apply machine learning techniques for feature engineering and model selection using Python tools.(L3)
3. Analyze the NoSQL movement and the principles guiding NoSQL databases in handling big data.(L4)
4. Utilize graph databases and Python libraries for text mining and analytics in data science applications. (L3)
5. Develop data visualizations and interactive dashboards to present findings from data science projects.(L5)

|                                                                                                                                                                                                                                                                                                                                                                                              |                                     |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------|
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                | <b>Introduction to Data science</b> | <b>12</b> |
| Introduction to Data science, benefits and uses, facets of data, data science process in brief, big data ecosystem and data science<br><b>Data Science process:</b> Overview, defining goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory analysis, model building, presenting findings and building applications on top of them |                                     |           |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                            |           |
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| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Handling large data</b> | <b>12</b> |
| Applications of machine learning in Data science, role of ML in DS, Python tools like sklearn, modelling process for feature engineering, model selection, validation and prediction, types of ML, semi-supervised learning<br><b>Handling large data:</b> problems and general techniques for handling large data, programming tips for dealing large data, case studies on DS projects for predicting malicious URLs, for building recommender systems |                            |           |

## Department of Computer Science and Engineering (Data Science)

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| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                   | <b>NoSQL movement for handling Bigdata</b> | <b>11</b> |
| <b>NoSQL movement for handling Bigdata:</b> Distributing data storage and processing with Hadoop framework, case study on risk assessment for loan sanctioning, ACID principle of relational databases, CAP theorem, base principle of NoSQL databases, types of NoSQL databases, case study on disease diagnosis and profiling |                                            |           |

|                                                                                                                                                                                                                                                                                    |                                               |           |
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| <b>Unit 4</b>                                                                                                                                                                                                                                                                      | <b>Tools and Applications of Data Science</b> | <b>10</b> |
| <b>Tools and Applications of Data Science:</b> Introducing Neo4j for dealing with graph databases, graph query language Cypher, Applications graph databases, Python libraries like nltk and SQLite for handling Text mining and analytics, case study on classifying Reddit posts |                                               |           |

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| <b>Unit 5</b>                                                                                                                                                                                                                                                                                                                  | <b>Data Visualization and Prototype Application Development</b> | <b>10</b> |
| <b>Data Visualization and Prototype Application Development:</b> Data Visualization options, Crossfilter, the JavaScript MapReduce library, Creating an interactive dashboard with dc.js, Dashboard development tools.<br>Applying the Data Science process for real world problem solving scenarios as a detailed case study. |                                                                 |           |

### Prescribed Textbooks:

- 1) Davy Cielen, Arno D.B.Meysman, and Mohamed Ali, “Introducing to Data Science using Python tools”, Manning Publications Co, Dreamtech press, 2016
- 2) Prateek Gupta, “Data Science with Jupyter” BPB publishers, 2019 for basics

### Reference Books:

- 1) Joel Grus, “Data Science From Scratch”, OReilly, 2019
- 2) Doing Data Science: Straight Talk From The Frontline, 1 st Edition, Cathy O’Neil and Rachel Schutt, O’Reilly, 2013

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23A3231T.1      | 3                     | 3                | 3                               | 3                                          | 2                 | -                        | -                              | -      | -                        | -             | 2                              | 2                  | 3    | 3    | 2    |
| 23A3231T.2      | 3                     | 3                | 3                               | 3                                          | 3                 | -                        | -                              | -      | -                        | -             | 2                              | 2                  | 3    | 3    | 2    |
| 23A3231T.3      | 3                     | 3                | 3                               | 3                                          | 2                 | -                        | -                              | -      | -                        | -             | 2                              | 2                  | 3    | 3    | 2    |
| 23A3231T.4      | 3                     | 3                | 3                               | 3                                          | 2                 | -                        | -                              | -      | -                        | -             | 2                              | 2                  | 3    | 3    | 2    |
| 23A3231T.5      | 3                     | 3                | 3                               | 3                                          | 2                 | 2                        | -                              | -      | -                        | -             | 3                              | 3                  | 3    | 3    | 3    |

## Department of Computer Science and Engineering (Data Science)

### ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET (An Autonomous Institution)

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|-----------------------------|-----------------------------------------------|
| <b>Title of the Course:</b> | Advanced Data Structures & Algorithm Analysis |
| <b>Category:</b>            | PC                                            |
| <b>Couse Code:</b>          | 23A0532T                                      |
| <b>Branch/es:</b>           | CSE, CSE(DS), CSE(AI), AI&DS and AI&ML        |
| <b>Semester:</b>            | II B Tech I Sem                               |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| <b>3</b>             | <b>0</b>              | <b>0</b>              | <b>3</b>       |

#### Course Objectives:

The main objectives of the course is to

1. Provide knowledge on advance data structures frequently used in Computer Science domain.
2. Develop skills in algorithm design techniques popularly used.
3. Understand the use of various data structures in the algorithm design.

#### Course Outcomes:

At the end of the course, the student will be able to

1. Analyze the time and space complexity of algorithms and implement AVL and B-Trees for various operations. (L4)
2. Apply heap structures and graph algorithms for problem-solving and data representation. (L3)
3. Implement greedy and dynamic programming techniques to solve optimization problems effectively.(L4)
4. Utilize backtracking and branch-and-bound strategies to tackle combinatorial problems.(L5)
5. Understand NP-hard and NP-complete problems and apply relevant techniques for solving complex computational issues. (L4)

|                                                                                                                                                                                                                                                |           |
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| <b>Unit 1</b>                                                                                                                                                                                                                                  | <b>12</b> |
| Introduction to Algorithm Analysis, Space and Time Complexity analysis, Asymptotic Notations.<br>AVL Trees – Creation, Insertion, Deletion operations and Applications<br>B-Trees – Creation, Insertion, Deletion operations and Applications. |           |

|                                                                                                                                                                                                                                                                                                                                      |           |
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| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                        | <b>11</b> |
| Heap Trees (Priority Queues) – Min and Max Heaps, Operations and Applications<br>Graphs – Terminology, Representations, Basic Search and Traversals, Connected Components and Biconnected Components, applications<br>Divide and Conquer: The General Method, Quick Sort, Merge Sort, Strassen's matrix multiplication, Convex Hull. |           |

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| <b>Unit 3</b>                                                                                                                                                                                                                            | <b>12</b> |
| Greedy Method: General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths<br>Dynamic Programming: General Method, All pairs shortest paths, Single Source Shortest Paths |           |

## Department of Computer Science and Engineering (Data Science)

– General Weights (Bellman Ford Algorithm), Optimal Binary Search Trees, 0/1 Knapsack, String Editing, Travelling Salesperson problem.

|                                                                                                                                                                                                          |           |
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| <b>Unit 4</b>                                                                                                                                                                                            | <b>11</b> |
| Backtracking: General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, 0/1 Knapsack Problem Branch and Bound: The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem. |           |

|                                                                                                                                                                                                                                                                                                    |  |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------|
| <b>Unit 5</b>                                                                                                                                                                                                                                                                                      |  | <b>10</b> |
| NP Hard and NP Complete Problems: Basic Concepts, Cook's theorem, NP Hard Graph Problems: Clique Decision Problem (CDP), Chromatic Number Decision Problem (CNDP), Traveling Salesperson Decision Problem (TSP), NP Hard Scheduling Problems: Scheduling Identical Processors, Job Shop Scheduling |  |           |

**Prescribed Textbooks:**

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta, Dinesh 2nd Edition Universities Press.
2. Computer Algorithms/C++ Ellis Horowitz, Sartaj Sahni, SanguthevarRajasekaran 2nd Edition University Press.

### Reference Books:

1. Data Structures and program design in C, Robert Kruse, Pearson Education Asia
2. An introduction to Data Structures with applications, Trembley & Sorenson, McGraw Hill
3. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth, Addison-Wesley, 1997.
4. Data Structures using C & C++: Langsam, Augenstein & Tanenbaum, Pearson, 1995
5. Algorithms + Data Structures & Programs:, N. Wirth, PHI
6. Fundamentals of Data Structures in C++: Horowitz Sahni & Mehta, Galgottia Pub.
7. Data structures in Java:, Thomas Standish, Pearson Education Asia

**CO-PO Mapping:**

[illegible]

## Department of Computer Science and Engineering (Data Science)

### ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET (An Autonomous Institution)

|                             |                                          |
|-----------------------------|------------------------------------------|
| <b>Title of the Course:</b> | Object-Oriented Programming through JAVA |
| <b>Category:</b>            | PC                                       |
| <b>Couse Code:</b>          | 23A0533T                                 |
| <b>Branch/es:</b>           | CSE, CSE(DS), CSE(AI), AI&DS and AI&ML   |
| <b>Semester:</b>            | II B Tech I Sem                          |

| Lecture Hours | Tutorial Hours | Practice Hours | Credits  |
|---------------|----------------|----------------|----------|
| <b>3</b>      | <b>0</b>       | <b>0</b>       | <b>3</b> |

#### Course Objectives:

The learning objectives of this course are to:

1. Identify Java language components and how they work together in applications
2. Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
3. Learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
4. Understand how to design applications with threads in Java
5. Understand how to use Java APIs for program development

#### Course Outcomes:

At the end of the course, the student will be able to

1. Understand and implement basic concepts of Java programming, including data types, operators, and control statements. (L2)
2. Apply object-oriented programming principles by creating and using classes and methods effectively in Java. (L3)
3. Utilize arrays and inheritance in Java to design flexible data structures and implement polymorphism.(L4)
4. Demonstrate package creation, exception handling, and file I/O operations in Java applications. (L4)
5. Develop multi-threaded applications and implement Java Database Connectivity (JDBC) for data manipulation. (L5)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>12</b> |
| <p><b>Object Oriented Programming:</b> Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.</p> <p><b>Data Types, Variables, and Operators :</b>Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final,</p> <p><b>Introduction to Operators,</b> Precedence and Associativity of Operators, Assignment Operator ( = ), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.</p> <p><b>Control Statements:</b> Introduction, if Expression, Nested if Expressions, if-else Expressions,</p> |           |

## Department of Computer Science and Engineering (Data Science)

Ternary Operator?:, Switch Statement, Iteration Statements, while Expression, do-while Loop, for Loop, Nested for Loop, For-Each for Loop, Break Statement, Continue Statement.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----|
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | 10 |
| <p><b>Classes and Objects:</b> Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.</p> <p><b>Methods:</b> Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.</p> |  |    |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----|
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  | 12 |
| <p><b>Arrays:</b> Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors.</p> <p><b>Inheritance:</b> Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.</p> <p><b>Interfaces:</b> Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.</p> |  |    |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----|
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  | 11 |
| <p><b>Packages and Java Library:</b> Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class.</p> <p><b>Exception Handling:</b> Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.</p> <p><b>Java I/O and File:</b> Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java(Text Book 2)</p> |  |    |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----|
| <b>Unit 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | 11 |
| <p><b>String Handling in Java:</b> Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.</p> <p><b>Multithreaded Programming:</b> Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.</p> <p><b>Java Database Connectivity:</b> Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, ResultSet</p> |  |    |

## Department of Computer Science and Engineering (Data Science)

Interface

**Java FX GUI:** Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

### Prescribed Textbooks:

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, DebasisSamanta, MonalisaSarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4<sup>th</sup> Edition, Pearson.

### Reference Books:

1. The complete Reference Java, 11<sup>th</sup> edition, Herbert Schildt, TMH
2. Introduction to Java programming, 7<sup>th</sup> Edition, Y Daniel Liang, Pearson

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23A0533T.1      | 3                     | 3                | 2                               | 2                                          | 2                 | -                        | -                              | -      | -                        | 1             | -                              | 2                  | 3    | 3    | -    |
| 23A0533T.2      | 3                     | 3                | 3                               | 3                                          | 3                 | -                        | -                              | -      | -                        | 1             | -                              | 2                  | 3    | 3    | 2    |
| 23A0533T.3      | 3                     | 3                | 3                               | 3                                          | 3                 | -                        | -                              | -      | 2                        | 1             | -                              | 2                  | 3    | 3    | 3    |
| 23A0533T.4      | 3                     | 3                | 3                               | 3                                          | 3                 | -                        | -                              | -      | 2                        | 1             | -                              | 2                  | 3    | 3    | 3    |
| 23A0533T.5      | 3                     | 3                | 3                               | 3                                          | 3                 | 2                        | -                              | -      | 2                        | 1             | 2                              | 2                  | 3    | 3    | 3    |

## Department of Computer Science and Engineering (Data Science)

### ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET (An Autonomous Institution)

|                             |                  |
|-----------------------------|------------------|
| <b>Title of the Course:</b> | Data Science Lab |
| <b>Category:</b>            | PC               |
| <b>Couse Code:</b>          | 23A3231L         |
| <b>Branch/es:</b>           | CSE(DS)          |
| <b>Semester:</b>            | II B Tech I Sem  |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 0                    | 0                     | 3                     | 1.5            |

#### Course Objective:

- The main objective of the course is to inculcate the basic understanding of Data Science and its practical implementation using Python.

#### Course Outcomes:

At the end of the course, the student will be able to

1. Understand and create various types of NumPy arrays and perform basic operations on them. (L2)
2. Manipulate the shape and structure of NumPy arrays through reshaping, flattening, and transposing.(L3)
3. Utilize Pandas for data manipulation, including creating DataFrames and handling missing values. (L3)
4. Implement data preprocessing techniques for machine learning using Python libraries. (L4)
5. Apply data visualization techniques using Matplotlib and develop insights from visualized data. (L5)

#### Experiment 1

Creating a NumPy Array

- a. Basic ndarray
- b. Array of zeros
- c. Array of ones
- d. Random numbers in ndarray
- e. An array of your choice
- f. Imatrix in NumPy
- g. Evenly spaced ndarray

#### Experiment 2

The Shape and Reshaping of NumPy Array

- a. Dimensions of NumPy array
- b. Shape of NumPy array
- c. Size of NumPy array
- d. Reshaping a NumPy array
- e. Flattening a NumPy array
- f. Transpose of a NumPy array

## Department of Computer Science and Engineering (Data Science)

|                                                                                                                                                  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Experiment 3</b>                                                                                                                              |  |  |
| Expanding and Squeezing a NumPy Array                                                                                                            |  |  |
| <ul style="list-style-type: none"><li>a. Expanding a NumPy array</li><li>b. Squeezing a NumPy array</li><li>c. Sorting in NumPy Arrays</li></ul> |  |  |

|                                                                                                                                                                                                 |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Experiment 4</b>                                                                                                                                                                             |  |  |
| Indexing and Slicing of NumPy Array                                                                                                                                                             |  |  |
| <ul style="list-style-type: none"><li>a. Slicing 1-D NumPy arrays</li><li>b. Slicing 2-D NumPy arrays</li><li>c. Slicing 3-D NumPy arrays</li><li>d. Negative slicing of NumPy arrays</li></ul> |  |  |

|                                                                                                                                                |  |  |
|------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Experiment 5</b>                                                                                                                            |  |  |
| Stacking and Concatenating Numpy Arrays                                                                                                        |  |  |
| <ul style="list-style-type: none"><li>a. Stacking ndarrays</li><li>b. Concatenating ndarrays</li><li>c. Broadcasting in Numpy Arrays</li></ul> |  |  |

|                                                                                                                                                        |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Experiment 6</b>                                                                                                                                    |  |  |
| Perform following operations using pandas                                                                                                              |  |  |
| <ul style="list-style-type: none"><li>a. Creating dataframe</li><li>b. concat()</li><li>c. Setting conditions</li><li>d. Adding a new column</li></ul> |  |  |

|                                                                                                                                           |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Experiment 7</b>                                                                                                                       |  |  |
| Perform following operations using pandas                                                                                                 |  |  |
| <ul style="list-style-type: none"><li>a. Filling NaN with string</li><li>b. Sorting based on column values</li><li>c. groupby()</li></ul> |  |  |

|                                                                                                                                 |  |  |
|---------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Experiment 8</b>                                                                                                             |  |  |
| Read the following file formats using pandas                                                                                    |  |  |
| <ul style="list-style-type: none"><li>a. Text files</li><li>b. CSV files</li><li>c. Excel files</li><li>d. JSON files</li></ul> |  |  |

|                                                                 |  |  |
|-----------------------------------------------------------------|--|--|
| <b>Experiment 9</b>                                             |  |  |
| Read the following file formats                                 |  |  |
| <ul style="list-style-type: none"><li>a. Pickle files</li></ul> |  |  |

## Department of Computer Science and Engineering (Data Science)

- b. Image files using PIL
- c. Multiple files using Glob
- d. Importing data from database

### Experiment 10

Demonstrate web scraping using python

### Experiment 11

Perform following preprocessing techniques on loan prediction dataset

- a. Feature Scaling
- b. Feature Standardization
- c. Label Encoding
- d. One Hot Encoding

### Experiment 12

Perform following visualizations using matplotlib

- a. Bar Graph
- b. Pie Chart
- c. Box Plot
- d. Histogram
- e. Line Chart and Subplots
- f. Scatter Plot

### Experiment 13

Getting started with NLTK, install NLTK using PIP

### Experiment 14

Python program to implement with Python Sci Kit-Learn & NLTK

### Experiment 15

Python program to implement with Python NLTK/Spacy/Py NLPI.

### Web References:

1. <https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/>
2. <https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes-guide-to-key-concepts/>
3. <https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/>
4. <https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/>
5. <https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-data-visualization-exploration-python/6>.
6. <https://www.nltk.org/book/ch01.html>

## Department of Computer Science and Engineering (Data Science)

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23A3231L.1      | 3                     | 3                | 3                               | 2                                          | 3                 | -                        | -                              | -      | 1                        | 1             | -                              | 2                  | 3    | 3    | 2    |
| 23A3231L.2      | 3                     | 3                | 3                               | 3                                          | 3                 | -                        | -                              | -      | 2                        | 1             | 1                              | 2                  | 3    | 3    | 3    |
| 23A3231L.3      | 3                     | 3                | 3                               | 3                                          | 3                 | -                        | -                              | -      | 2                        | 1             | 1                              | 2                  | 3    | 3    | 3    |
| 23A3231L.4      | 3                     | 3                | 3                               | 2                                          | 3                 | -                        | -                              | -      | 2                        | 1             | 1                              | 2                  | 3    | 3    | 3    |
| 23A3231L.5      | 3                     | 3                | 3                               | 3                                          | 3                 | 2                        | -                              | -      | 2                        | 2             | 1                              | 3                  | 3    | 3    | 3    |

## Department of Computer Science and Engineering (Data Science)

### ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET (An Autonomous Institution)

|                             |                                              |
|-----------------------------|----------------------------------------------|
| <b>Title of the Course:</b> | Object-Oriented Programming through JAVA Lab |
| <b>Category:</b>            | PC                                           |
| <b>Couse Code:</b>          | 23A0533L                                     |
| <b>Branch/es:</b>           | CSE, CSE(DS), CSE(AI), AI&DS and AI&ML       |
| <b>Semester:</b>            | II B Tech I Sem                              |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| <b>0</b>             | <b>0</b>              | <b>3</b>              | <b>1.5</b>     |

#### Course Objectives:

The aim of this course is to

1. Practice object-oriented programming in the Java programming language
2. implement Classes, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
3. Illustrate inheritance, Exception handling mechanism, JDBC connectivity
4. Construct Threads, Event Handling, implement packages, Java FX GUI

#### Course Outcomes:

At the end of the course, the student will be able to

1. Understand and apply Java's primitive data types, control structures, and basic I/O operations.(L2)
2. Implement algorithms using searching and sorting techniques in Java.(L3)
3. Utilize object-oriented programming concepts, including classes, methods, and inheritance in Java.(L4)
4. Demonstrate exception handling mechanisms and create user-defined exceptions in Java applications.(L4)
5. Develop multi-threaded applications and connect to databases using JDBC for data manipulation.(L5)

#### Exercise:1

- a) Write a JAVA program to display default value of all primitive data type of JAVA
- b) Write a java program that display the roots of a quadratic equation  $ax^2+bx=0$ . Calculate the discriminate D and basing on value of D, describe the nature of root.

#### Exercise:2

- a) Write a JAVA program to search for an element in a given list of elements using binary search mechanism.
- b) Write a JAVA program to sort for an element in a given list of elements using bubble sort
- c) Write a JAVA program using StringBuffer to delete, remove character.

#### Exercise:3

- a) Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.
- b) Write a JAVA program implements method overloading.
- c) Write a JAVA program to implement constructor.
- d) Write a JAVA program to implement constructor overloading.

## Department of Computer Science and Engineering (Data Science)

### Exercise:4

- a) Write a JAVA program to implement Single Inheritance
- b) Write a JAVA program to implement multi-level Inheritance
- c) Write a JAVA program for abstract class to find areas of different shapes

### Exercise:5

- a) Write a JAVA program give example for “super” keyword.
- b) Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?
- c) Write a JAVA program that implements Runtime polymorphism

### Exercise:6

- a) Write a JAVA program that describes exception handling mechanism
- b) Write a JAVA program Illustrating Multiple catch clauses
- c) Write a JAVA program for creation of Java Built-in Exceptions
- d) Write a JAVA program for creation of User Defined Exception

### Exercise:7

- a) Write a JAVA program that creates threads by extending Thread class. First thread display “Good Morning “every 1 sec, the second thread displays “Hello “every 2 seconds and the third display “Welcome” every 3 seconds, (Repeat the same by implementing Runnable)
- b) Write a program illustrating **is Alive** and **join ()**
- c) Write a Program illustrating Daemon Threads.
- d) Write a JAVA program Producer Consumer Problem

### Exercise:8

- a) Write a JAVA program that import and use the user defined packages
- b) Without writing any code, build a GUI that display text in label and image in an ImageView (use JavaFX)
- c) Build a Tip Calculator app using several JavaFX components and learn how to respond to user interactions with the GUI

### Exercise:9

- a) Write a java program that connects to a database using JDBC
- b) Write a java program to connect to a database using JDBC and insert values into it.
- c) Write a java program to connect to a database using JDBC and delete values from it.

### Prescribed Textbooks:

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.

### Reference Books:

1. The complete Reference Java, 11<sup>th</sup> edition, Herbert Schildt, TMH

## Department of Computer Science and Engineering (Data Science)

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PS01 | PS02 | PS03 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23A0533L.1      | 3                     | 3                | 2                               | 1                                          | 2                 | -                        | -                              | -      | 1                        | 1             | 1                              | 2                  | 2    | 1    | -    |
| 23A0533L.2      | 3                     | 3                | 3                               | 2                                          | 3                 | -                        | -                              | -      | 1                        | 1             | 1                              | 2                  | 2    | 2    | -    |
| 23A0533L.3      | 3                     | 3                | 3                               | 3                                          | 3                 | -                        | -                              | -      | 2                        | 1             | 2                              | 3                  | 3    | 3    | -    |
| 23A0533L.4      | 3                     | 3                | 3                               | 3                                          | 3                 | 2                        | -                              | -      | 2                        | 1             | 2                              | 3                  | 3    | 3    | 2    |
| 23A0533L.5      | 3                     | 3                | 3                               | 3                                          | 3                 | 2                        | 2                              | -      | 2                        | 2             | 2                              | 3                  | 3    | 3    | 3    |

## Department of Computer Science and Engineering (Data Science)

### ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET (An Autonomous Institution)

|                             |                                        |
|-----------------------------|----------------------------------------|
| <b>Title of the Course:</b> | The Joy of Computing Using Python      |
| <b>Category:</b>            | SEC                                    |
| <b>Couse Code:</b>          | 23A0534L                               |
| <b>Branch/es:</b>           | CSE, CSE(DS), CSE(AI), AI&DS and AI&ML |
| <b>Semester:</b>            | II B Tech I Sem                        |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 0                    | 1                     | 2                     | 2              |

#### Course Objectives:

The main objectives of the course are to

1. To learn basics of computational problem solving, python programming and basic control structures.
2. To understand python programming basic constructs like lists, dictionaries, sets and functions
3. To apply module design and usage of text files in python programming

#### Course Outcomes:

At the end of the course, the student will be able to

1. Understand computational problem solving and basic elements of python programming.(L2)
2. Construct python programming basic constructs like lists, tuple, dictionaries, and sets. (L3)
3. Implement string processing and exception handling in programming (L5)
4. Analyze string processing and exception handling in programming.(L4)
5. Reframe programs using class and object in python programming.(L5)

|               |                                                    |  |
|---------------|----------------------------------------------------|--|
| <b>Unit 1</b> | <b>Introduction to python programming language</b> |  |
|---------------|----------------------------------------------------|--|

Introduction to python programming language, literals, variables and identifiers, operators, expressions and data types. Control Structures: Boolean expressions, selection control, and iterative control.

|               |              |  |
|---------------|--------------|--|
| <b>Unit 2</b> | <b>Lists</b> |  |
|---------------|--------------|--|

Lists: List structures, lists in python, iterating over lists in python, more on python lists. Dictionaries and sets, tuple.

|               |                  |  |
|---------------|------------------|--|
| <b>Unit 3</b> | <b>Functions</b> |  |
|---------------|------------------|--|

Functions: Program routines, more on functions, Module Design: Modules, Top-Down design, python modules

|               |                   |  |
|---------------|-------------------|--|
| <b>Unit 4</b> | <b>Text Files</b> |  |
|---------------|-------------------|--|

Text Files: Text File, Using Text files, string processing, exception handling

## Department of Computer Science and Engineering (Data Science)

|                                                                                                                                                                                                                                                                             |                                                    |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|--|
| <b>Unit 5</b>                                                                                                                                                                                                                                                               | <b>Introduction to Object oriented programming</b> |  |
| Introduction to Object oriented programming: class, three fundamental features of object oriented programming, encapsulation-what is encapsulation, defining classes in python.<br>Inheritance: subtypes, defining subclasses in python, Polymorphism: use of polymorphism. |                                                    |  |

### Prescribed Textbooks:

1. Introduction to Computer Science Using Python: A Computational Problem-Solving Focus, Charles Dierbach.

### Reference Books:

1. Python Programming using problem solving approach, ReemaThareja, Oxford University press
2. Python Programming: An Introduction to Computer Science, John Zelle, Franklin,Beedle & Associates Inc.,3rd Edition
3. Think Python: How to think like a computer Scientist, Allen Downey 2nd Edition O'Reilly Publications.

### Online Learning Resources/Virtual Labs:

1. <https://www.coursera.org/learn/python-for-applied-data-science-ai>
2. <https://www.coursera.org/learn/python?specialization=python#syllabus>

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23A0534L.1      | 3                     | 3                | 3                               | 3                                          | 2                 | -                        | -                              | -      | -                        | -             | -                              | 2                  | 2    | 2    | -    |
| 23A0534L.2      | 3                     | 3                | 3                               | 3                                          | 2                 | -                        | -                              | -      | -                        | -             | -                              | 2                  | 2    | 2    | -    |
| 23A0534L.3      | 2                     | 2                | 3                               | 3                                          | 2                 | -                        | -                              | -      | -                        | -             | -                              | -                  | 2    | 2    | -    |
| 23A0534L.4      | 2                     | 3                | 3                               | 3                                          | 2                 | -                        | -                              | -      | -                        | -             | -                              | -                  | 2    | 2    | -    |
| 23A0534L.5      | 2                     | 2                | 3                               | 3                                          | 2                 | -                        | -                              | -      | -                        | -             | -                              | 2                  | 2    | 2    | -    |

## Department of Computer Science and Engineering (Data Science)

### ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET (An Autonomous Institution)

|                             |                             |
|-----------------------------|-----------------------------|
| <b>Title of the Course:</b> | Environmental science       |
| <b>Category:</b>            | MC                          |
| <b>Course Code:</b>         | 23AHS39T                    |
| <b>Branch/es:</b>           | CE, ME, ECE, CSE (DS), AIDS |
| <b>Semester:</b>            | II B Tech I Sem             |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 2                    | 0                     | 0                     | -              |

#### Course Objectives:

1. To make the students to get awareness on environment.
2. To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life.
3. To save earth from the inventions by the engineers.

#### Course Outcomes:

At the end of the course, the student will be able to

1. Explain how natural resources should be utilised with a focus on sustainability.
2. Describe the need to protect ecosystems and biodiversity for future generations.
3. Comprehend major pollution problems related to ecosystems.
4. Apply quantitative reasoning skills in the proper utilization of goods and services.
5. Explain the interconnectedness of human dependence on the earth's ecosystems.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                          |          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------|
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Natural Resources</b> | <b>7</b> |
| Multidisciplinary nature of environmental studies: Definition, Scope and Importance – Need for public awareness. Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems – Forest resources: Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and their effects on forest and tribal people – Water resources: Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, case studies – Energy resources. |                          |          |

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|----------|
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Ecosystems, Biodiversity and its conservation</b> | <b>7</b> |
| Ecosystems: Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).<br>Biodiversity and its conservation: Introduction - Definition: Genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. |                                                      |          |

## Department of Computer Science and Engineering (Data Science)

|                                                                                                                                                                                                                                                                                                                                                                                                                           |                                |          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|----------|
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Environmental Pollution</b> | <b>6</b> |
| Definition, causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards.<br>Solid waste management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: Floods, earthquake, cyclone and landslides. |                                |          |

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|----------|
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Social Issues and the Environment</b> | <b>5</b> |
| From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people: Its problems and concerns, case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies – Wasteland reclamation – Consumerism and waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act– Issues involved in enforcement of environmental legislation – Public awareness. |                                          |          |

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|----------|
| <b>Unit 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Human Population and the Environment</b> | <b>5</b> |
| Population growth, variation among nations, Population explosion – Family welfare programmes – Environment and human health – Human rights – Value education – HIV/AIDS – Women and child welfare – Role of information technology in environment and human health – Case studies.<br>Field Work: Visit to a local area to document environmental assets – River/forest/grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural, Study of common plants, insects and birds –Study of simple ecosystems - river, hill slopes etc.. |                                             |          |

### Prescribed Text books:

1. Text book of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, “Environmental Studies”, Pearson Education.
3. S. Azeem Unnisa, “Environmental Studies” Academic Publishing Company.
4. K. Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications (India) Pvt. Ltd.

### Reference Books:

1. Deeksha Dave and E. Sai Baba Reddy, “Textbook of Environmental Science”, Cengage Publications.
2. M. Anji Reddy, “Text book of Environmental Sciences and Technology”, BS Publication.
3. J.P. Sharma, “Comprehensive Environmental Studies”, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”, Prentice Hall of India Private Limited.
5. G.R. Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House.

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23AHS39T.1      | 2                     | 2                | -                               | -                                          | -                 | -                        | 3                              | -      | -                        | -             | -                              | 2                  | -    | -    | -    |
| 23AHS39T.2      | 2                     | 2                | -                               | -                                          | -                 | -                        | 3                              | -      | -                        | -             | -                              | 2                  | -    | -    | -    |
| 23AHS39T.3      | 2                     | 2                | -                               | -                                          | -                 | -                        | 3                              | -      | -                        | -             | -                              | 2                  | -    | -    | -    |
| 23AHS39T.4      | 3                     | 2                | -                               | -                                          | -                 | -                        | 3                              | -      | -                        | -             | -                              | 3                  | -    | -    | -    |
| 23AHS39T.5      | 2                     | 2                | -                               | -                                          | -                 | -                        | 3                              | -      | -                        | -             | -                              | 2                  | -    | -    | -    |

## Department of Computer Science and Engineering (Data Science)

### ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET (An Autonomous Institution)

|                             |                                             |
|-----------------------------|---------------------------------------------|
| <b>Title of the Course:</b> | Managerial Economics and Financial Analysis |
| <b>Category:</b>            | HSSM                                        |
| <b>Couse Code:</b>          | 23AHS46T                                    |
| <b>Branch/es:</b>           | ME, CE, CSE(DS), AI&DS                      |
| <b>Semester:</b>            | II B Tech II Sem                            |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 2                    | 0                     | 0                     | 2              |

#### Course Objectives:

1. To inculcate the basic knowledge of microeconomics and financial accounting
2. To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost
3. To Know the Various types of market structure and pricing methods and strategy
4. To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
5. To provide fundamental skills on accounting and to explain the process of preparing financial statements.

#### Course Outcomes:

At the end of the course, the student will be able to

1. Define the concepts related to Managerial Economics, financial accounting and management(L2)
2. Understand the fundamentals of Economics viz., Demand, Production, cost, revenue and markets (L2)
3. Apply the Concept of Production cost and revenues for effective Business decision (L3)
4. Analyze how to invest their capital and maximize returns (L4)
5. Evaluate the capital budgeting techniques. (L5)
6. Develop the accounting statements and evaluate the financial performance of business entity (L5)

|                                                                                                                                                                                                                                                                                      |                             |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------|
| <b>Unit 1</b>                                                                                                                                                                                                                                                                        | <b>Managerial Economics</b> | <b>12</b> |
| Introduction – Nature, meaning, significance, functions, and advantages. Demand-Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting- Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management. |                             |           |

|                                                                                                                                                                                                                                                                                                                                           |                                     |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------|
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                             | <b>Production and Cost Analysis</b> | <b>8</b> |
| Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least- cost combination– Short run and long run Production Function- Isoquants and Is costs, Cost & Break-Even Analysis - Cost concepts and Cost behaviour- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems). |                                     |          |

|                                                                                                                                                                                                                                                                                                                                     |                                           |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|----------|
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                       | <b>Business Organizations and Markets</b> | <b>8</b> |
| Introduction – Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly- Monopolistic Competition–Oligopoly-Price-Output Determination - Pricing Methods and Strategies |                                           |          |

## Department of Computer Science and Engineering (Data Science)

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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------|
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                     | <b>Capital Budgeting</b> | <b>10</b> |
| Introduction – Nature, meaning, significance. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting– Features, Proposals, Methods and Evaluation. Projects – Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems) |                          |           |

|                                                                                                                                                                                                                                                                                                                                                                |                                          |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-----------|
| <b>Unit 5</b>                                                                                                                                                                                                                                                                                                                                                  | <b>Financial Accounting and Analysis</b> | <b>10</b> |
| Introduction – Concepts and Conventions- Double-Entry Bookkeeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). Introduction to Financial Analysis - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability. |                                          |           |

### Prescribed Textbooks:

1. Varshney & Maheswari: Managerial Economics, Sultan Chand.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH.

### Reference Books:

1. Ahuja HI Managerial economics Schand.
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage.

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23AHS46T.1      | 2                     | -                | -                               | -                                          | 2                 | -                        | 2                              | -      | 2                        | -             | -                              | -                  | -    | 2    | 2    |
| 23AHS46T.2      | -                     | 3                | 2                               | 3                                          | -                 | -                        | -                              | -      | -                        | 1             | 2                              | -                  | 2    | -    | -    |
| 23AHS46T.3      | 2                     | -                | 2                               | -                                          | 2                 | -                        | 2                              | 2      | -                        | 1             | 3                              | 2                  | -    | 2    | 2    |
| 23AHS46T.4      | -                     | 2                | -                               | 2                                          | -                 | -                        | -                              | -      | 2                        | -             | -                              | -                  | 1    | -    | -    |
| 23AHS46T.5      | 2                     | 2                | -                               | 2                                          | -                 | -                        | 2                              | -      | -                        | -             | -                              | 1                  | -    | -    | 2    |

## Department of Computer Science and Engineering (Data Science)

### ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET (An Autonomous Institution)

|                             |                                      |
|-----------------------------|--------------------------------------|
| <b>Title of the Course:</b> | Statistical methods for Data science |
| <b>Category:</b>            | BS                                   |
| <b>Couse Code:</b>          | 23AHS43T                             |
| <b>Branch/es:</b>           | CSE(DS), AI&DS                       |
| <b>Semester:</b>            | II B Tech II Sem                     |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 3                    | 0                     | 0                     | 3              |

#### Course Objectives:

1. Gain knowledge and skills to analyze data, make decisions based on statistical evidence.
2. Introduce the Maximum Likelihood method as a powerful technique for estimating parameters.
3. Interpret the results of interval estimation for drawing conclusions about population parameters based on sample data.
4. Define the concept of uniformly most powerful tests and its significance in hypothesis testing.
5. Gain proficiency in selecting and applying appropriate small sample tests for different types of data.

#### Course Outcomes:

At the end of the course, the student will be able to

1. Apply probability theorems and probability distributions in real life problems.
2. Analyze the data and draw conclusions about collection of data under study using Point estimation.
3. Analyze data and draw conclusions about collection of data under study using Interval estimation.
4. Estimate population parameters and make inferences about them based on sample data.
5. Apply the different testing tools like t-test, F-test, chi-square test to analyze the relevant real-life problems.

|                                                                                                                                                                                                                                                                                                                                                                                                                                       |                       |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----|
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Basic Concepts</b> | 10 |
| Introduction to probability, random variables (discrete and continuous), probability density functions, properties, mathematical expectation. Probability distributions: Binomial, Poisson and Normal-their properties. Population, sample, parameter and statistic; characteristics of a good estimator; Consistency – Invariance property of Consistent estimator, Sufficient condition for consistency; Unbiasedness; Sufficiency. |                       |    |

|                                                                                                                                                                                                                                                                                                                                                                                                          |                         |   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---|
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                            | <b>Point Estimation</b> | 8 |
| Point Estimation- Estimator, Estimate, Methods of point estimation – Maximum likelihood method (the asymptotic properties of ML estimators are not included), Large sample properties of ML estimator (without proof)- applications, Method of moments, method of least squares, method of minimum chi-square and modified minimum chi-square-Asymptotic Maximum Likelihood Estimation and applications. |                         |   |

|                                                                                                                                                                                                                                                                                                                                                                                                           |                            |   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---|
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                             | <b>Interval Estimation</b> | 8 |
| Confidence limits and confidence coefficient; Duality between acceptance region of a test and a confidence interval; Construction of confidence intervals for population proportion (small and large samples) and between two population proportions (large samples); Confidence intervals for mean and variance of a normal population; Difference between the mean and ratio of two normal populations. |                            |   |

## Department of Computer Science and Engineering (Data Science)

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----------|
| <b>Unit 4</b>                                                                                                                                                                                                                                                | <b>Testing of hypotheses</b> | <b>8</b> |
| Types of errors, power of a test, most powerful tests; Neyman-Pearson Fundamental Lemma and its applications; Notion of Uniformly most powerful tests; Likelihood Ratio tests: Description and property of LR tests - Application to standard distributions. |                              |          |

|                                                                                                                                                                                                                                                                                           |                           |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------|
| <b>Unit 5</b>                                                                                                                                                                                                                                                                             | <b>Small sample tests</b> | <b>8</b> |
| Student's t-test, test for a population mean, equality of two population means, paired t-test, F-test for equality of two population variances, Chi-square test for goodness of fit and test for independence of attributes, $\chi^2$ test for testing variance of a normal distribution. |                           |          |

### Prescribed Textbooks:

1. Miller and Freunds, Probability and Statistics for Engineers, 7/e, Pearson, 2008.
2. Manoj Kumar Srivastava and Namita Srivastava, Statistical Inference – Testing of Hypotheses, Prentice Hall of India, 2014

### Reference Books:

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.
2. S. Ross, a First Course in Probability, Pearson Education India, 2002.
3. W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.
4. Robert V Hogg, Elliot A Tannis and Dale L. Zimmerman, Probability and Statistical Inference, 9th edition, Pearson publishers, 2013.

### Online Learning Resources:

1. [https://onlinecourses.nptel.ac.in/noc21\\_ma74/preview](https://onlinecourses.nptel.ac.in/noc21_ma74/preview)
2. [https://onlinecourses.nptel.ac.in/noc22\\_mg31/preview](https://onlinecourses.nptel.ac.in/noc22_mg31/preview)

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23AHS43T.1      | 3                     | 2                | 1                               | 2                                          | -                 | -                        | -                              | -      | -                        | -             | -                              | 1                  | -    | -    | -    |
| 23AHS43T.2      | 3                     | 3                | 2                               | 2                                          | -                 | -                        | -                              | -      | -                        | -             | -                              | 1                  | -    | -    | -    |
| 23AHS43T.3      | 3                     | 3                | 2                               | 2                                          | -                 | -                        | -                              | -      | -                        | -             | -                              | 1                  | -    | -    | -    |
| 23AHS43T.4      | 3                     | 3                | 2                               | 3                                          | -                 | -                        | -                              | -      | -                        | -             | -                              | 1                  | -    | -    | -    |
| 23AHS43T.5      | 3                     | 2                | 1                               | 2                                          | -                 | -                        | -                              | -      | -                        | -             | -                              | 1                  | -    | -    | -    |

## Department of Computer Science and Engineering (Data Science)

### ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET (An Autonomous Institution)

|                             |                  |
|-----------------------------|------------------|
| <b>Title of the Course:</b> | Data Engineering |
| <b>Category:</b>            | PC               |
| <b>Couse Code:</b>          | 23A3241T         |
| <b>Branch/es:</b>           | CSE(DS)          |
| <b>Semester:</b>            | II B Tech II Sem |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 3                    | 0                     | 0                     | 3              |

#### Course Objectives:

1. Explain basic concepts of Data Engineering
2. Discuss bout Data Engineering Life Cycle
3. How to design Good Data Architecture

#### Course Outcomes:

At the end of the course, the student will be able to

1. Understand the fundamental concepts of data engineering (L2)
2. Comprehend the data engineering life cycle and its components (L2)
3. Design effective data architectures(L3)
4. Analyze and implement data storage and ingestion strategies(L4)
5. Develop and optimize queries, data models, and transformations (L6)

|                                                                                                                                                                                                                                                                                                                                                            |                                         |           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------|
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                              | <b>Introduction to Data Engineering</b> | <b>12</b> |
| <b>Introduction to Data Engineering:</b> Definition, Data Engineering Life Cycle, Evolution of Data Engineer, Data Engineering Versus Data Science, Data Engineering Skills and Activities,Data Maturity, Data Maturity Model, Skills of a Data Engineer, Business Responsibilities, Technical Responsibilities, Data Engineers and Other Technical Roles. |                                         |           |

|                                                                                                                                                                                                                                                                                                                                        |                                    |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-----------|
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                          | <b>Data Engineering Life Cycle</b> | <b>10</b> |
| <b>Data Engineering Life Cycle:</b> Data Life Cycle Versus Data Engineering Life Cycle, Generation: Source System, Storage, Ingestion, Transformation, Serving Data.<br><b>Major undercurrents across the Data Engineering Life Cycle:</b> Security, Data Management, DataOps, Data Architecture, Orchestration, Software Engineering. |                                    |           |

|                                                                                                                                                                                                                                                                                                                                                                               |                                         |           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------|
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                 | <b>Designing Good Data Architecture</b> | <b>12</b> |
| <b>Designing Good Data Architecture:</b> Enterprise Architecture, Data Architecture, Principles of Good Data Architecture, Major Architecture Concepts.<br><b>Data Generation in Source Systems:</b> Sources of Data, Files and Unstructured Data, APIs, Application Databases (OLTP), OLAP, Change Data Capture, Logs, Database Logs, CRUD, Source System Practical Details. |                                         |           |

## Department of Computer Science and Engineering (Data Science)

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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----|
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                           | <b>Storage</b> | 10 |
| <b>Storage:</b> Raw Ingredients of Data Storage, Data Storage Systems, Data Engineering Storage Abstractions, Data warehouse, Data Lake, Data Lakehouse.<br><b>Ingestion:</b> Data Ingestion, Key Engineering considerations for the Ingestion Phase, Batch Ingestion Considerations, Message and Stream Ingestion Considerations, Ways to Ingest Data. |                |    |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                              |    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----|
| <b>Unit 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Queries, Modelling and Transformation</b> | 10 |
| <b>Queries, Modelling and Transformation:</b> Queries, Life of a Query, Query Optimizer, Queries on Streaming Data, Data Modelling, Modelling Streaming Data, Transformations, Streaming Transformations and Processing.<br><b>Serving Data for Analytics, Machine Learning and Reverse ETL:</b> General Considerations for serving Data, Business Analytics, Operational Analytics, Embedded Analytics, Ways to serve data for analytics and ML, Reverse ETL. |                                              |    |

### Prescribed Textbooks:

1. Joe Reis, Matt Housley, Fundamentals of Data Engineering, O'Reilly Media, Inc., June 2022, ISBN: 9781098108304

### Reference Books:

1. Paul Crickard, Data Engineering with Python, Packt Publishing, October 2020.
2. Ralph Kimball, Margy Ross, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, Wiley, 3rd Edition, 2013
3. James Densmore, Data Pipelines Pocket Reference: Moving and Processing Data for Analytics, O'Reilly Media, 1st Edition, 2021

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23A3241T.1      | 3                     | 2                | 2                               | 1                                          | 2                 | -                        | -                              | -      | 1                        | 1             | 1                              | 2                  | 3    | -    | -    |
| 23A3241T.2      | 3                     | 3                | 3                               | 2                                          | 2                 | -                        | -                              | -      | 2                        | 1             | 1                              | 3                  | 3    | -    | -    |
| 23A3241T.3      | 3                     | 3                | 3                               | 2                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 3                  | 3    | 3    | -    |
| 23A3241T.4      | 3                     | 3                | 3                               | 3                                          | 3                 | 2                        | -                              | -      | 2                        | 2             | 2                              | 3                  | 3    | 3    | 2    |
| 23A3241T.5      | 3                     | 3                | 3                               | 3                                          | 3                 | 2                        | 2                              | -      | 2                        | 2             | 2                              | 3                  | 3    | 3    | 3    |

## Department of Computer Science and Engineering (Data Science)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET  
(An Autonomous Institution)

|                             |                              |
|-----------------------------|------------------------------|
| <b>Title of the Course:</b> | Database Management Systems  |
| <b>Category:</b>            | PC                           |
| <b>Couse Code:</b>          | 23A0542T                     |
| <b>Branch/es:</b>           | CSE, CSE(DS), CSE(AI), AI&ML |
| <b>Semester:</b>            | II B Tech II Sem             |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 3                    | 0                     | 0                     | 3              |

### Course Objectives:

The main objectives of the course is to

1. Introduce database management systems and to give a good formal foundation on the relational model of data and usage of Relational Algebra
2. Introduce the concepts of basic SQL as a universal Database language
3. Demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
4. Provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques

### Course Outcomes:

At the end of the course, the student will be able to

1. Understand the characteristics and advantages of database systems compared to file systems (L2)
2. Apply basic SQL commands to create and manipulate database schemas (L3)
3. Construct complex SQL queries using joins and aggregate functions (L3)
4. Explain the purpose of normalization and apply it to design relational schemas (L3)
5. Analyze transaction states and ACID properties in database systems (L4)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----|
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Introduction</b> | 12 |
| <b>Introduction:</b> Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.<br><b>Entity Relationship Model:</b> Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams. |                     |    |

|                                                                                                                                                                                                                                                                                                                                                                                                        |                         |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----|
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                          | <b>Relational Model</b> | 10 |
| <b>Relational Model:</b> Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus. BASIC SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update). |                         |    |

## Department of Computer Science and Engineering (Data Science)

|                                                                                                                                                                                                                                                                                                                                                                                                                               |            |           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>SQL</b> | <b>10</b> |
| <b>SQL:</b> Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions(Date and Time, Numeric, String conversion).Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(updatable and non-updatable), relational set operations. |            |           |

|                                                                                                                                                                                                                                                                                                                                                                   |                                          |           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-----------|
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                     | <b>Schema Refinement (Normalization)</b> | <b>11</b> |
| <b>Schema Refinement (Normalization):</b> Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form(BCNF), MVD, Fourth normal form(4NF), Fifth Normal Form (5NF). |                                          |           |

|                                                                                                                                                                                                                                                                                                                                            |                            |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-----------|
| <b>Unit 5</b>                                                                                                                                                                                                                                                                                                                              | <b>Transaction Concept</b> | <b>10</b> |
| <b>Transaction Concept:</b> Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm. |                            |           |
| <b>Introduction to Indexing Techniques:</b> B+ Trees, operations on B+Trees, Hash Based Indexing                                                                                                                                                                                                                                           |                            |           |

### Prescribed Textbooks:

1. Database Management Systems, 3<sup>rd</sup> edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)
2. Database System Concepts, 5<sup>th</sup> edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter 1 and Chapter 5)

### Reference Books:

1. Introduction to Database Systems, 8<sup>th</sup> edition, C J Date, Pearson.
2. Database Management System, 6<sup>th</sup> edition, RamezElmasri, Shamkant B. Navathe, Pearson
3. Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

### Web-Resources:

1. <https://nptel.ac.in/courses/106/105/106105175/>
2. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_01275806667282022456\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview)

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23A0542T.1      | 3                     | 2                | 2                               | 1                                          | 1                 | -                        | -                              | -      | 1                        | 1             | 1                              | 2                  | 3    | -    | -    |
| 23A0542T.2      | 3                     | 3                | 3                               | 2                                          | 2                 | -                        | -                              | -      | 2                        | 1             | 2                              | 3                  | 3    | 2    | -    |
| 23A0542T.3      | 3                     | 3                | 3                               | 2                                          | 3                 | 2                        | -                              | -      | 2                        | 2             | 2                              | 3                  | 3    | 3    | 2    |
| 23A0542T.4      | 3                     | 3                | 3                               | 3                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 3                  | 3    | 3    | 3    |
| 23A0542T.5      | 3                     | 3                | 3                               | 3                                          | 3                 | 2                        | 2                              | -      | 2                        | 2             | 2                              | 3                  | 3    | 3    | 3    |

## Department of Computer Science and Engineering (Data Science)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET  
(An Autonomous Institution)

|                             |                                        |
|-----------------------------|----------------------------------------|
| <b>Title of the Course:</b> | Computer Organization and Architecture |
| <b>Category:</b>            | PC                                     |
| <b>Couse Code:</b>          | 23A3242T                               |
| <b>Branch/es:</b>           | CSE(DS)                                |
| <b>Semester:</b>            | II B Tech II Sem                       |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 3                    | 0                     | 0                     | 3              |

### Course Objectives:

The purpose of the course is

1. Discuss about principles of computer organization and the basic architectural concepts.
2. Explain in depth understanding of basic organization, design, programming of a simple digital computer, computer arithmetic, instruction set design, micro programmed control unit, pipelining and vector processing, memory organization and I/O systems.

### Course Outcomes:

At the end of the course, the student will be able to

1. Understand data representation methods and number systems, including error detection and correction (L2)
2. Design and implement combinatorial and sequential circuits using logic gates (L3)
3. Apply arithmetic algorithms for addition, subtraction, and multiplication in digital computers (L3)
4. Analyze the architecture and operation of micro programmed control units and CPUs (L4)
5. Evaluate memory organization and input-output systems in computer architecture (L5)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 12 |
| <b>Digital Computers and Data Representation:</b> Introduction, Numbering Systems, Decimal to Binary Conversion, Binary Coded Decimal Numbers, Weighted Codes, Self-Complementing Codes, Cyclic Codes, Error Detecting Codes, Error Correcting Codes, Hamming Code for Error Correction, Alphanumeric Codes, ASCII Code<br><b>Data Representation:</b> Data types, Complements, Fixed Point Representation, Floating Point Representation.<br><b>Boolean Algebra and Logical gates:</b> Boolean Algebra :Theorems and properties, Boolean functions, canonical and standard forms, minimization of Boolean functions using algebraic identities; Karnaugh map representation and minimization using two and three variable Maps ;Logical gates ,universal gates and Two-level realizations using gates : AND-OR, OR-AND, NAND-NAND and NOR-NOR structures |    |

|                                                                                                                                                                                                                                                                                                                                                                          |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                            | 10 |
| <b>Digital logic circuits:</b> Combinatorial Circuits: Introduction, Combinatorial Circuit Design Procedure, Implementation using universal gates, Multi-bit adder, Multiplexers, De-multiplexers, Decoders<br>Sequential Switching Circuits: Latches and Flip-Flops, Ripple counters using T flip-flops;<br><b>Synchronous counters:</b> Shift Registers; Ring counters |    |

## Department of Computer Science and Engineering (Data Science)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------|
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  | <b>11</b> |
| <b>Computer Arithmetic:</b> Addition and subtraction, multiplication Algorithms, Booth multiplication algorithm, Division Algorithms, Floating – point Arithmetic Operations.<br><b>Register Transfer language and microinstructions:</b> Bus memory transfer, arithmetic and logical micro-operations, shift and rotate micro-operations<br><b>Basic Computer Organization and Design:</b> Stored program concept, computer Registers, common bus system, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input–Output configuration and program Interrupt. |  |           |

|                                                                                                                                                                                                                                                                                                                      |  |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------|
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                        |  | <b>10</b> |
| <b>Microprogrammed Control:</b> Control memory, Address sequencing, microprogram example, design of control unit.<br><b>Central Processing Unit:</b> General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation<br><b>Program Control:</b> conditional Flags and Branching |  |           |

|                                                                                                                                                                                                                                                                   |  |           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------|
| <b>Unit 5</b>                                                                                                                                                                                                                                                     |  | <b>10</b> |
| <b>Memory Organization:</b> Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.<br><b>Input-Output Organization:</b> Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt Direct memory Access. |  |           |

### Prescribed Textbooks:

1. Digital Logic and Computer Design, Moriss Mano, 11<sup>th</sup> Edition, Pearson.
2. Computer System Architecture, 3<sup>rd</sup> Edition, M. Morris Mano, PHI

### Reference Books:

1. Digital Logic and Computer Organization, Rajaraman, Radhakrishnan, PHI, 2006
2. Computer Organization, 5<sup>th</sup> Edition, Hamacher, Vranesic, Zaky, TMH, 2002
3. Computer Organization & Architecture: Designing for Performance, 7<sup>th</sup> Edition, William Stallings, PHI, 2006

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23A3242T.1      | 3                     | 2                | 2                               | 1                                          | 1                 | -                        | -                              | -      | 1                        | 1             | 1                              | 2                  | 3    | 2    | -    |
| 23A3242T.2      | 3                     | 3                | 3                               | 2                                          | 2                 | -                        | -                              | -      | 2                        | 1             | 2                              | 3                  | 3    | 3    | 1    |
| 23A3242T.3      | 3                     | 3                | 3                               | 2                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 3                  | 3    | 2    | 3    |
| 23A3242T.4      | 3                     | 3                | 3                               | 3                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 3                  | 3    | 3    | 2    |
| 23A3242T.5      | 3                     | 3                | 3                               | 3                                          | 3                 | 2                        | 2                              | -      | 2                        | 2             | 2                              | 3                  | 3    | 2    | 3    |

## Department of Computer Science and Engineering (Data Science)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET  
(An Autonomous Institution)

|                             |                      |
|-----------------------------|----------------------|
| <b>Title of the Course:</b> | Data Engineering Lab |
| <b>Category:</b>            | PC                   |
| <b>Couse Code:</b>          | 23A3241L             |
| <b>Branch/es:</b>           | CSE(DS)              |
| <b>Semester:</b>            | II B Tech II Sem     |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 0                    | 0                     | 3                     | 1.5            |

### Course Objective:

- The main objective of this course is to teach how build data engineering infrastructure and data pipelines.

### Course Outcomes:

At the end of the course, the student will be able to

1. Build our Data Engineering Infrastructure (L6)
2. Demonstrate Reading and Writing files (L3)
3. Build Data Pipelines and integrate with Dashboard (L6)
4. Deploy the Data Pipeline in production (L5)

### Experiment 1

Installing and configuring Apache NiFi, Apache Airflow

### Experiment 2

Installing and configuring Elasticsearch, Kibana, PostgreSQL, pgAdmin 4

### Experiment 3

Reading and Writing files

- a. Reading and writing files in Python
- b. Processing files in Airflow
- c. NiFi processors for handling files
- d. Reading and writing data to databases in Python
- e. Databases in Airflow
- f. Database processors in NiFi

### Experiment 4

Working with Databases

- a. Inserting and extracting relational data in Python
- b. Inserting and extracting NoSQL database data in Python
- c. Building database pipelines in Airflow
- d. Building database pipelines in NiFi

### Experiment 5

Cleaning, Transforming and Enriching Data

## Department of Computer Science and Engineering (Data Science)

|                                                                                                                                                                                              |  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <ul style="list-style-type: none"><li>a. Performing exploratory data analysis in Python</li><li>b. Handling common data issues using pandas</li><li>c. Cleaning data using Airflow</li></ul> |  |  |
| <b>Experiment 6</b>                                                                                                                                                                          |  |  |
| Building the Data Pipeline                                                                                                                                                                   |  |  |

|                              |  |  |
|------------------------------|--|--|
| <b>Experiment 7</b>          |  |  |
| Building a Kibana Dash Board |  |  |

|                                                                                                                                                                                                         |  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Experiment 8</b>                                                                                                                                                                                     |  |  |
| Perform the following operations <ul style="list-style-type: none"><li>a. Staging and validating data</li><li>b. Building idempotent data pipelines</li><li>c. Building atomic data pipelines</li></ul> |  |  |

|                                                                                                                                                                                                                                                                                |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Experiment 9</b>                                                                                                                                                                                                                                                            |  |  |
| Version Control with the NiFi Registry <ul style="list-style-type: none"><li>a. Installing and configuring the NiFi Registry</li><li>b. Using the Registry in NiFi</li><li>c. Versioning your data pipelines</li><li>d. Using git-persistence with the NiFi Registry</li></ul> |  |  |

|                                                                                                                                                                                                             |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Experiment 10</b>                                                                                                                                                                                        |  |  |
| Monitoring Data Pipelines <ul style="list-style-type: none"><li>a. Monitoring NiFi in the GUI</li><li>b. Monitoring NiFi using processors</li><li>c. Monitoring NiFi with Python and the REST API</li></ul> |  |  |

|                                                                                                                                                                                                                |  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Experiment 11</b>                                                                                                                                                                                           |  |  |
| Deploying Data Pipelines <ul style="list-style-type: none"><li>a. Finalizing your data pipelines for production</li><li>b. Using the NiFi variable registry</li><li>c. Deploying your data pipelines</li></ul> |  |  |

|                                                                                                                                                                                                                                     |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Experiment 12</b>                                                                                                                                                                                                                |  |  |
| Building a Production Data Pipeline <ul style="list-style-type: none"><li>a. Creating a test and production environment</li><li>b. Building a production data pipeline</li><li>c. Deploying a data pipeline in production</li></ul> |  |  |

### Reference Books:

1. Paul Crickard , Data Engineering with Python, Packt Publishing, October 2020.

## Department of Computer Science and Engineering (Data Science)

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23A3241L.1      | 2                     | 2                | 2                               | 1                                          | 3                 | -                        | -                              | -      | 1                        | 1             | 1                              | 1                  | 3    | 3    | 2    |
| 23A3241L.2      | 3                     | 3                | 3                               | 2                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 2                  | 3    | 3    | 2    |
| 23A3241L.3      | 2                     | 3                | 3                               | 2                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 2                  | 3    | 3    | 2    |
| 23A3241L.4      | 2                     | 3                | 3                               | 3                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 2                  | 3    | 3    | 3    |
| 23A3241L.5      | 3                     | 3                | 3                               | 3                                          | 3                 | 2                        | 2                              | -      | 3                        | 2             | 3                              | 3                  | 2    | 3    | 3    |

## Department of Computer Science and Engineering (Data Science)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET  
(An Autonomous Institution)

|                             |                                 |
|-----------------------------|---------------------------------|
| <b>Title of the Course:</b> | Database Management Systems Lab |
| <b>Category:</b>            | PC                              |
| <b>Couse Code:</b>          | 23A0542L                        |
| <b>Branch/es:</b>           | CSE, CSE(DS), CSE(AI), AIML     |
| <b>Semester:</b>            | II B Tech II Sem                |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 0                    | 0                     | 3                     | 1.5            |

### Course Objectives:

This Course will enable students to

1. Populate and query a database using SQL DDL/DML Commands
2. Declare and enforce integrity constraints on a database
3. Writing Queries using advanced concepts of SQL
4. Programming PL/SQL including procedures, functions, cursors and triggers

### Course Outcomes:

At the end of the course, the student will be able to

1. Understand and apply SQL commands for creating, altering, and managing database tables and constraints. (L3)
2. Construct complex SQL queries using various conditions, aggregate functions, and subqueries. (L4)
3. Develop PL/SQL programs utilizing control structures, exception handling, and transaction management. (L4)
4. Implement stored procedures, functions, and triggers to enhance database operations and integrity. (L5)
5. Create Java applications that connect to databases using JDBC for data manipulation and retrieval.(L3)

### Experiment 1

Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.

### Experiment 2

Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSET, Constraints. Example:- Select the roll number and name of the student who secured fourth rank in the class.

### Experiment 3

Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.

### Experiment 4

Queries using Conversion functions (to\_char, to\_number and to\_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next\_day, add\_months, last\_day, months\_between, least, greatest, trunc, round, to\_char, to\_date)

## Department of Computer Science and Engineering (Data Science)

|                                                                                                                                                                                                                                                                                                                                                                                |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Experiment 5</b>                                                                                                                                                                                                                                                                                                                                                            |  |  |
| a) Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)<br>b) Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block. |  |  |
| <b>Experiment 6</b>                                                                                                                                                                                                                                                                                                                                                            |  |  |
| Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.                                                                                                                                                                                                                         |  |  |
| <b>Experiment 7</b>                                                                                                                                                                                                                                                                                                                                                            |  |  |
| Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISE- APPLICATION ERROR.                                                                                                                                                                                                           |  |  |
| <b>Experiment 8</b>                                                                                                                                                                                                                                                                                                                                                            |  |  |
| Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.                                                                                                                                                                                                                                                                                |  |  |
| <b>Experiment 9</b>                                                                                                                                                                                                                                                                                                                                                            |  |  |
| Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.                                                                                                                                                                                                                                                        |  |  |
| <b>Experiment 10</b>                                                                                                                                                                                                                                                                                                                                                           |  |  |
| Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.                                                                                                                                                                                                                                                       |  |  |
| <b>Experiment 11</b>                                                                                                                                                                                                                                                                                                                                                           |  |  |
| Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers                                                                                                                                                                                                                                                                           |  |  |
| <b>Experiment 12</b>                                                                                                                                                                                                                                                                                                                                                           |  |  |
| Create a table and perform the search operation on table using indexing and non-indexing techniques.                                                                                                                                                                                                                                                                           |  |  |
| <b>Experiment 13</b>                                                                                                                                                                                                                                                                                                                                                           |  |  |
| Write a Java program that connects to a database using JDBC                                                                                                                                                                                                                                                                                                                    |  |  |
| <b>Experiment 14</b>                                                                                                                                                                                                                                                                                                                                                           |  |  |
| Write a Java program to connect to a database using JDBC and insert values into it                                                                                                                                                                                                                                                                                             |  |  |
| <b>Experiment 15</b>                                                                                                                                                                                                                                                                                                                                                           |  |  |
| Write a Java program to connect to a database using JDBC and delete values from it                                                                                                                                                                                                                                                                                             |  |  |

## Department of Computer Science and Engineering (Data Science)

### Text Books/Suggested Reading:

1. Oracle: The Complete Reference by Oracle Press
2. Nilesh Shah, "Database Systems Using Oracle", PHI, 2007
3. Rick F Vander Lans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23A0542L.1      | 2                     | 3                | 3                               | 2                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 1                  | 3    | 2    | 1    |
| 23A0542L.2      | 2                     | 3                | 3                               | 2                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 1                  | 3    | 2    | 2    |
| 23A0542L.3      | 2                     | 3                | 3                               | 3                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 2                  | 3    | 2    | 2    |
| 23A0542L.4      | 2                     | 3                | 3                               | 3                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 3                  | 3    | 3    | 2    |
| 23A0542L.5      | 2                     | 2                | 2                               | 1                                          | 2                 | -                        | -                              | -      | 2                        | 1             | 2                              | 1                  | 1    | 2    | 3    |

## Department of Computer Science and Engineering (Data Science)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET  
(An Autonomous Institution)

|                             |                                       |
|-----------------------------|---------------------------------------|
| <b>Title of the Course:</b> | Exploratory Data Analysis with Python |
| <b>Category:</b>            | SEC                                   |
| <b>Couse Code:</b>          | 23A3242L                              |
| <b>Branch/es:</b>           | CSE(DS)                               |
| <b>Semester:</b>            | II B Tech II Sem                      |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 0                    | 1                     | 2                     | 2              |

### Course Objectives:

1. This course introduces the fundamentals of Exploratory Data Analysis
2. It covers essential exploratory techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods.

### Course Outcomes:

At the end of the course, the student will be able to

1. Enumerate the fundamentals of Exploratory Data Analysis. (L2)
2. Visualize the data using basic graphs and plots. (L3)
3. Apply different Data Transformation Techniques. (L3)
4. Summarize the data using descriptive statistics. (L2)
5. Evaluate the Models and select the best model (L5)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Theory Hours: 3, Practice Sessions: 6</b> |
| <b>Exploratory Data Analysis Fundamentals:</b> 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.<br><b>Sample Experiments:</b> <ol style="list-style-type: none"><li>1. a) Download Dataset from Kaggle using the following link :<br/><a href="https://www.kaggle.com/datasets/sukhmanibedi/cars4u">https://www.kaggle.com/datasets/sukhmanibedi/cars4u</a><br/>b) Install python libraries required for Exploratory Data Analysis (numpy, pandas, matplotlib,seaborn)</li><li>2. Perform Numpy Array basic operations and Explore Numpy Built-in functions.</li><li>3. Loading Dataset into pandas dataframe</li><li>4. Selecting rows and columns in the dataframe</li></ol> |                                              |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Theory Hours: 3, Practice Sessions: 6</b> |
| <b>Visual Aids for EDA:</b> Technical requirements, Line chart, Bar charts, Scatter plot using seaborn, Polar chart, Histogram, Choosing the best chart<br><b>Case Study:</b> EDA with Personal Email, Technical requirements, Loading the dataset, Data transformation, Data cleansing, Applying descriptive statistics, Data refactoring, Data analysis.<br><b>Sample Experiments:</b> <ol style="list-style-type: none"><li>5. Apply different visualization techniques using sample dataset</li></ol> |                                              |

## Department of Computer Science and Engineering (Data Science)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>a) Line Chart b) Bar Chart c) Scatter Plots d) Bubble Plot</p> <p>6. Generate Scatter Plot using seaborn library for iris dataset</p> <p>7. Apply following visualization Techniques for a sample dataset</p> <p>a) Area Plot b) Stacked Plot c) Pie chart d) Table Chart</p> <p>8. Generate the following charts for a dataset.</p> <p>a) Polar Chart b) Histogram c) Lollipop chart</p> <p>9. Case Study: Perform Exploratory Data Analysis with Personal Email Data</p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| Unit 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Theory Hours: 3, Practice Sessions: 6 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| <p><b>Data Transformation:</b> Merging database-style data frames, 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.</p> <p><b>Sample Experiments:</b></p> <p>10. Perform the following operations</p> <p>a) Merging Data frames</p> <p>b) Reshaping with Hierarchical Indexing</p> <p>c) Data Deduplication</p> <p>d) Replacing Values</p> <p>11. Apply different Missing Data handling techniques</p> <p>a) NaN values in mathematical Operations</p> <p>b) Filling in missing data</p> <p>c) Forward and backward filling of missing values</p> <p>d) Filling with index values</p> <p>e) Interpolation of missing values</p> <p>12. Apply different data transformation techniques</p> <p>a) Renaming axis indexes</p> <p>b) Discretization and Binning</p> <p>c) Permutation and Random Sampling</p> <p>d) Dummy variables</p> |                                       |

| Unit 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Theory Hours: 3, Practice Sessions: 6 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| <p><b>Descriptive Statistics:</b> 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</p> <p><b>Sample Experiments:</b></p> <p>13. Study the following Distribution Techniques on a sample data</p> <p>a) Uniform Distribution</p> <p>b) Normal Distribution</p> <p>c) Gamma Distribution</p> <p>d) Exponential Distribution</p> <p>e) Poisson Distribution</p> <p>f) Binomial Distribution</p> |                                       |

## Department of Computer Science and Engineering (Data Science)

14. Perform Data Cleaning on a sample dataset.
15. Compute measure of Central Tendency on a sample dataset
  - a) Mean b)Median c)Mode
16. Explore Measures of Dispersion on a sample dataset
  - a) Variance b) Standard Deviation c) Skewness d) Kurtosis
17.
  - a) Calculating percentiles on sample dataset
  - b) Calculate Inter Quartile Range(IQR) and Visualize using Box Plots
18. Perform the following analysis on automobile dataset.
  - a) Bivariate analysis b)Multivariate analysis
19. Perform Time Series Analysis on Open Power systems dataset

| Unit 5                                                                                                                                                                                                                                                    | Theory Hours: 3, Practice Sessions: 6 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| <b>Model Development and Evaluation:</b> Unified machine learning workflow, Data preprocessing, Data preparation, Training sets and corpus creation, Model creation and training, Model evaluation, Best model selection and evaluation, Model deployment |                                       |
| <b>Case Study:</b> EDA on Wine Quality Data Analysis                                                                                                                                                                                                      |                                       |
| <b>Sample Experiments:</b>                                                                                                                                                                                                                                |                                       |
| 20. Perform hypothesis testing using stats models library <ol style="list-style-type: none"><li>a) Z-Test b)T-Test</li></ol>                                                                                                                              |                                       |
| 21. Develop model and Perform Model Evaluation using different metrics such as prediction score, R2 Score, MAE Score, MSE Score.                                                                                                                          |                                       |
| 22. Case Study: Perform Exploratory Data Analysis with Wine Quality Dataset                                                                                                                                                                               |                                       |

### Prescribed Textbooks:

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

### Reference Books:

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

### Web References:

1. <https://github.com/PacktPublishing/Hands-on-Exploratory-Data-Analysis-with-Python>
2. <https://www.analyticsvidhya.com/blog/2022/07/step-by-step-exploratory-data-analysis-eda-using-python/#h-conclusion>
3. <https://github.com/PacktPublishing/Exploratory-Data-Analysis-with-Python-Cookbook>

## Department of Computer Science and Engineering (Data Science)

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PSO1 | PSO2 | PSO3 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23A3242L.1      | 2                     | 3                | 3                               | 2                                          | 2                 | -                        | -                              | -      | 1                        | 2             | 1                              | 1                  | 3    | 2    | 1    |
| 23A3242L.2      | 2                     | 3                | 3                               | 2                                          | 3                 | -                        | -                              | -      | 1                        | 2             | 1                              | 1                  | 3    | 3    | 1    |
| 23A3242L.3      | 2                     | 3                | 3                               | 2                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 2                  | 3    | 2    | 2    |
| 23A3242L.4      | 2                     | 3                | 3                               | 2                                          | 3                 | -                        | -                              | -      | 2                        | 2             | 2                              | 2                  | 3    | 2    | 3    |
| 23A3242L.5      | 2                     | 2                | 2                               | 1                                          | 3                 | -                        | -                              | -      | 2                        | 1             | 2                              | 1                  | 2    | 2    | 3    |

## Department of Computer Science and Engineering (Data Science)

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|                             |                                                           |
|-----------------------------|-----------------------------------------------------------|
| <b>Title of the Course:</b> | Design Thinking & Innovation                              |
| <b>Category:</b>            | ES                                                        |
| <b>Couse Code:</b>          | 23AHS4AT                                                  |
| <b>Branch/es:</b>           | CE, EEE, ME, ECE, CSE, CSE(DS), CSE(AI), AI&DS, and AI&ML |
| <b>Semester:</b>            | II B Tech II Sem                                          |

|                      |                       |                       |                |
|----------------------|-----------------------|-----------------------|----------------|
| <b>Lecture Hours</b> | <b>Tutorial Hours</b> | <b>Practice Hours</b> | <b>Credits</b> |
| 1                    | 0                     | 2                     | 2              |

### Course Objectives:

The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.

### Course Outcomes:

At the end of the course, the student will be able to

1. Comprehend the fundamentals of Design Thinking and innovation
2. Apply the design thinking techniques for solving problems in various sectors.
3. Analyse to work in a multidisciplinary environment
4. Evaluate the value of creativity
5. Formulate specific problem statements of real time issues

|                                                                                                                                                                                                                                            |                                        |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|--|
| <b>Unit 1</b>                                                                                                                                                                                                                              | <b>Introduction to Design Thinking</b> |  |
| Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry. |                                        |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|--|
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Design Thinking Process</b> |  |
| Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development<br><b>Activity:</b> Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development. |                                |  |

|                                                                                                                                                                                                                                                                                                                                                          |                   |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|--|
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                            | <b>Innovation</b> |  |
| Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity.<br><b>Activity:</b> Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation. |                   |  |

## Department of Computer Science and Engineering (Data Science)

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--|
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                | <b>Product Design</b> |  |
| Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies<br><b>Activity:</b> Importance of modelling, how to set specifications, Explaining their own product design. |                       |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                              |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--|
| <b>Unit 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Design Thinking in Business Processes</b> |  |
| Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs- Design thinking for Startups- Defining and testing Business Models and Business Cases- Developing & testing prototypes.<br><b>Activity:</b> How to market our own product, About maintenance, Reliability and plan for startup. |                                              |  |

### Prescribed Textbooks:

1. Tim Brown, Change by design, Harper Bollins (2009)
2. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.

### Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shruti N Shetty, Design the Future, Norton Press
3. William Lidwell, Universal Principles of Design- Kritinaholden, Jill Butter.
4. Chesbrough. H, The Era of Open Innovation – 2013

### CO-PO Mapping:

| Course Outcomes | Engineering Knowledge | Problem Analysis | Design/Development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | PS01 | PS02 | PS03 |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------------------|-------------------|--------------------------|--------------------------------|--------|--------------------------|---------------|--------------------------------|--------------------|------|------|------|
| 23AHS4AT.1      | 1                     | -                | -                               | -                                          | -                 | -                        | -                              | -      | -                        | -             | -                              | 1                  | -    | -    | -    |
| 23AHS4AT.2      | -                     | 2                | 2                               | -                                          | 1                 | 1                        | -                              | -      | -                        | -             | 1                              | 1                  | -    | -    | -    |
| 23AHS4AT.3      | -                     | 1                | 2                               | -                                          | -                 | -                        | -                              | -      | 1                        | 1             | -                              | 1                  | -    | -    | -    |
| 23AHS4AT.4      | -                     | 3                | -                               | -                                          | -                 | -                        | -                              | -      | 1                        | 1             | -                              | 1                  | -    | -    | -    |
| 23AHS4AT.5      | -                     | 3                | 3                               | 3                                          | -                 | -                        | -                              | -      | -                        | -             | 1                              | 1                  | -    | -    | -    |