Semester I
Paper Code- BDA 101
Computational Thinking and Problem Solving with Python

Credits: 4
Maximum marks: 100
Contact Hrs/Week: 4
Paper Type: Theory
Total Hrs: 60

Course Objective: This module introduces students to
1. Computational Thinking and Problem Solving Concepts in analytics.
2. Programming concepts and Python programming language for analytics.

Course Outcomes (COs): At the end of this course, a student should be able to:

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 1. Analyze the mathematical concepts of data science to frame and compute an abstract of the business problem.	**Approach in teaching:** Interactive Lectures, Group Discussion, Tutorials, Case Study, Demonstration	Class test, Semester end examinations, Quiz, Assignments, Presentation, Peer Review
BDA 101	**Computational Thinking and Problem Solving with Python**	CO 2. Install and run the Python interpreter. CO 3. Write python programs using programming and looping constructs to tackle any decision-making scenario. CO 4. Identify and resolve coding errors in a program. CO 5. Illustrate the process of structuring the data using lists, dictionaries, tuples and sets. CO 6. Design and develop real-life applications using python.	**Learning activities for the students:** Self-learning assignments, presentations, practical exercise	

Contents:

Unit	Content	Lectures
I	**Computational Thinking:** Basics: Introduction, Information and data, Data encoding. Logic: Boolean logic, Applications of propositional logic. Problem definition, Logical reasoning, Problem decomposition, Algorithm and Flowcharts **Python** : Introduction to analytics ,Why Python for analytics, Jupyter Installation for Python, Features of Python, Pandas and npumy library, Python Applications. Problem Solving and Algorithmic Thinking: Flowchart based on simple computations, iterations.	12 **hrs**
II	**Basics of Python**: variables, data types, operators & expressions, decision statements. Loop control statements.	12 **hrs**
III	**Functions and String**: Functions & string manipulation. Introduction to list: Need, creation and accessing list. Inbuilt functions for lists.	12 **hrs**

| IV | **Tuples:** Introduction to tuples, sets and dictionaries: Need, Creation, Operations and in-built functions. | 12 **hrs** |
| V | **File handling**: Introduction to File Handling: need, operations on a text file (creating, opening a file, reading from a file, writing to a file, closing a file). Reading and writing from a CSV file.
Descriptive statistics: mean, mode, median, standard deviation, missing values and outliers. | 12 **hrs** |

BOOKS RECOMMENDED:

- Madhavan, "*Mastering Python for Data Science*", Packt, 2015.
- McKinney, *Python for Data Analysis*. O' Reilly Publication, 2017.
- Curtis Miller, "Hands-On Data Analysis with NumPy and Pandas",Packt, 2015

Credits: 4
Maximum marks: 100
Contact Hrs/Week: 4
Paper Type: Theory
Total Hrs: 60

Course Objective: This module introduces students to
1. Data science, analytics and knowledge discovery process
2. Fundamental of Artificial Intelligence, concept of learning and problem solving approach.

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 7. Analyze the concepts of data science to frame the problem.	**Approach in teaching:** Interactive Lectures, Group Discussion, Tutorials, Case Study, Demonstration	Class test, Semester end examinations, Quiz, Assignments, Presentation, Peer Review
BDA 102	**Introduction to Data Analytics and AI**	CO 8. Identify the various steps of knowledge discovery process.		
		CO 9. Analyze different problems and identify role of data mining in resolving these problems.		
		CO 10. Design search space and state tree using AI concepts to solve real life problems.	**Learning activities for the students:** Self-learning assignments, presentations, practical exercise	
		CO 11. Identify the role of Learning in AI software systems		

Contents:

Unit	Content	Lectures
I	Data-Analytic Thinking What is Data Science? – The core problems and solutions. Extracting Intelligence from Data – formulating problems, The Data Pipeline Types of Data in various practical Data Science scenarios. Data Wrangling, Cleaning and Preparation.	12 **hrs**
II	Data Presentation Basic concepts in Statistics and Exploratory Data Analysis. Data Exploration and Data Visualization. Case Studies involving Structured and Unstructured Data	12 **hrs**
III	Data extracting, pattern recognition, Data mining and its task classification, prediction, association, clustering and dimension reduction. Application of data mining	12 **hrs**
IV	Artificial Intelligence What is Artificial Intelligence? – History and State-of-Art. Principles of problem solving and the State Space Search. Case Studies for State Space Search and Search Algorithms	12 **hrs**

V	Reinforcement Learning and AI : Learning in AI, Introduction to Reinforcement Learning in context of AI. Fundamentals of Markov Processes and Q-Learning. Ethics in DS&AI Ethical considerations and the idea of responsible DS&AI.	12 **hrs**

BOOKS RECOMMENDED:

- Vijay Kotu,Bala Deshpande, *Data Science Concepts and Practice* 2018.
- McKinney, *Python for Data Analysis*. O' Reilly Publication, 2017.
- Russell and Norvig, *Artificial Intelligence: A Modern Approach*: (3 rd edition)

Credits: 4
Maximum marks: 100
Contact Hrs/Week: 4
Paper Type: Theory
Total Hrs: 60

Course Objective: This module introduces students to
1. Make familiar with the basics of mathematics.
2. This module is introductory in nature and focuses on numerical aspects, keeping those students in mind those did not have mathematics at 10+2 level.

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 12. Build a foundation of basic mathematical concepts needed for general computations.	**Approach in teaching:** Interactive Lectures, Group Discussion, Tutorials, Case Study, Demonstration	Class test, Semester end examinations, Quiz, Assignments, Presentation, Peer Review
BDA 103	**Foundation of Mathematics**	CO 13. Analyse, solve, and compute real-world applications of mathematics.		
		CO 14. Solve applied problems using matrices, differentiation and integration.	**Learning activities for the students:** Self-learning assignments, presentations, practical exercise	
		CO 15. Demonstrate a working knowledge of set notation and elementary set theory.		
		CO 16. Compute limits, derivatives, and definite & indefinite integrals of algebraic, logarithmic and exponential functions.		
		CO 17. Solve discrete mathematics problems that involve: computing permutations and combinations of a set..		

Contents:

Unit	Content	Lectures
I	Matrices, Types of Matrices, Operations of addition, Scalar Multiplication and Multiplication of Matrices, Determinant of a Square Matrix, Minors and Cofactors. Transpose, adjoint and inverse of a	12 **hrs**

	matrix. Solving system of linear equations in two or three variables using the inverse of a matrix.	
II	Sets, Relation & Functions: Definition of Set, Type of Sets, Operations on Sets, Venn diagram, Cartesian Product, Relations, Functions, Types of function, Some elementary functions with their graphs (Exponential, logarithmic, modulus, floor, ceiling). Limit & continuity of a function (Simple Problems).	12 **hrs**
III	Differentiation: Derivative and its meaning, Differentiation of algebraic, trigonometric, exponential & logarithmic functions, Rules of Differentiation, Second order differentiation, Maxima and Minima of polynomials.	12 **hrs**
IV	Integration: - Indefinite Integrals, Rules of Integration, Integration by substitution, Integration by Partial Fractions(Linear Factors only), Definite Integration, Properties of Definite Integral, finding areas of simple closed curves.	12 **hrs**
V	Permutation and Combination: Fundamental Principles of Counting, Addition Principle, Factorial, Permutations, Combinations. Coordinate Geometry: - 2D Cartesian Co-ordinate system. Straight line (Equation & Slope of a line). Circle: Equation of Circle, Equation to Tangent.	12 **hrs**

BOOKS RECOMMENDED:
- G. C. Sharma & Madhu Jain, "Mathematics for BCA", Oscar Publication.
- R.D. Sharma, "Mathematics for class 12 part-1", Dhanpat Rai and Co. New Delhi.
- R.D. Sharma, "Mathematics for class 12 Part-2", Dhanpat Rai and Co. New Delhi.
- S. L. Loney, "The Elements of Co-ordinate Geometry Part-I", Book Palace, New Delhi.

REFERENCES:

- Tom M. Apostol, "Calculus Volume II", Second edition, John-Wiley & Sons, 2002.
- S. Balachandra Rao, C.K. Shantha, "Differential Calculus",New Age International(P) Ltd.
- Frank Ayres Jr., Elliot Mendelson, "Calculus", fourth edition, Mc-Graw Hill International Edition.

Credits: 4
Maximum marks: 100
Contact Hrs/Week: 4
Paper Type: Theory
Total Hrs: 60

Course Objective: This module introduces students to
1. The fundamental statistical techniques.
2. To understand the role of statistics for analyzing and interpreting data meaningfully.

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code **BDA 104**	**Paper Title** **Descriptive Statistics and Probability**	CO 18. Ability to define and use the basic terminology of statistics. CO 19. Able to classify the data and prepare various diagrams and graph. CO 20. Students will demonstrate the use of descriptive data analysis. CO 21. Students will learn the concept of elementary probability theory and its application. CO 22. Ability to identify the problem and apply appropriate laws of probability and Bayes theorem.	**Approach in teaching:** Interactive Lectures, Group Discussion, Tutorials, Case Study, Demonstration **Learning activities for the students:** Self-learning assignments, presentations, practical exercise	Class test, Semester end examinations, Quiz, Assignments, Presentation, Peer Review

Contents:

Unit	Content	Lectures
I	Qualitative and Quantitative classification, discrete and continuous classification, Geographical and Chronological classification. Construction of frequency tables, frequency distribution for continuous and discrete data, cumulative frequency distributions (inclusive and exclusive methods).	12 **hrs**
II	Graphical presentation of data: Histogram, Frequency Polygon, Frequency curve and Ogives. Measures of Central Tendency – Definition, different measures of Central Tendency, merits and demerits. Partition Values.	12 **hrs**
III	Measure of Dispersion- Definition, different measures of Dispersion, merits and demerits. Coefficient of variation. Relative dispersions	12 **hrs**

IV	Correlation, Scatter Diagram, Karl Pearson's Coefficient of Correlation and its properties. Spearman's Rank Correlation Coefficient. Regression-Fitting of Regression Lines, Regression Coefficients with properties.	12 **hrs**
V	Random Experiment, Trial, Events and their types. Classical, Statistical and Axiomatic definition of probability and its properties (simple). Addition and Multiplication theorems of Probability and their application, Conditional Probability and Independent events. Baye's theorem and its application (simple questions).	12 **hrs**

BOOKS RECOMMENDED:

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (1991): Fundamentals of Statistics, Volume I, The World Press PvtLtd , Calcutta
- Gupta, S.C. and Kapoor, V.K.: (2000) Fundamentals of Mathematical Statistics, S Chand & Company, New Delhi, tenth edition.
- Mood Alexander M., Graybill Frankline and Boes Duane C. (2007): Introduction to Theory of Statistics, McGraw Hill & Company Third Edition
- Gupta, O.P.: Mathematical Statistics, Kedarnath Publication, Meerut
- Yule, G. Udny and Kendall, M.G. (1999): An Introduction to the theory of Statistics,14th Edition.
- Hooda, R.P. (2002): Introduction to Statistics: Macmillan India Ltd. 1st edition.
- Speigel M.R., (1967): Theory and Problem of Statistics, Schaum's Series.
- Meyer, P.L.(1970) : Introductory Probability and Statistical Application, Addision Wesley.
- Rohatgi, V.K. and Saleh, A.K. Md. Ehsanes (2009): An Introduction to ProbabilityTheory and Statistics, Second Edition, John Wiley and Sons.
- Bhat, B.R (1981): Modern Probability Theory, New Age Publishers, Third edition.
- Kingman, J.F. & Taylor, S.J. (1996): Introduction to Measure and Probability, Cambridge Univ. Press.

Paper Code- BDA 105
Problem solving with Python Programming Lab

Credits: 6
Maximum marks: 100
Paper Type: Practical
Contact Hrs/Week: 6
Total Hrs: 90

Course Objective: This module introduces students to
1. Define the basic concepts of python programming.
2. Understand the concepts of python functions and its uses.
3. Demonstrate the Modules and packages used in Python Programming.

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 23. Install and run the Python interpreter.	**Approach in teaching:** Interactive Lectures, Group Discussion, Tutorials, Case Study, Demonstration **Learning activities for the students:** Self-learning assignments, presentations, practical exercise	Class test, Semester end examinations, Quiz, Assignments, Presentation, Peer Review
BDA 105	**Problem solving with Python Programming Lab**	CO 24. Write python programs using programming and looping constructs to tackle any decision-making scenario. CO 25. Identify and resolve coding errors in a program CO 26. Illustrate the process of structuring the data using lists, dictionaries, tuples and sets. CO 27. Design and develop real-life applications using python.		

Contents:

Exercises given will be covering entire syllabi as follows:
- Jupyter Installation for Python, Features of Python, Python Applications
- Basics of Python: variables, data types, operators & expressions, decision statements.
- Loop control statements.
- Functions
- Understand the difference between a function and an object.
- String manipulation
- Tuples, sets and dictionaries: Need, Creation, Operations and in-built functions

BOOKS RECOMMENDED:

- Madhavan, "*Mastering Python for Data Science"*, Packt, 2015.
- McKinney, *Python for Data Analysis*. O' Reilly Publication, 2017.

Credits: 6
Maximum marks: 100
Paper Type: Practical
Contact Hrs/Week: 6
Total Hrs: 90

Course Objective: This module introduces students to
1. Study the concept of working with MS Excel right from basics to Tables,
2. Understand the working on advanced data manipulation with spreadsheets

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 28. Effectively use spreadsheets to perform statistical computations and display numerical and graphical summaries of data sets.	**Approach in teaching:** Interactive Lectures, Discussion, Demonstrations, Group activities, Teaching using advanced IT audio-video tools	**Assessment Strategies** Class test, Semester end examinations, Quiz, Practical Assignments, Individual and group projects
BDA 106	**Data Analysis using Spreadsheet**	CO 29. Perform sensitivity analysis on data.		
		CO 30. Compute and interpret the descriptive statistics for different problems.		
		CO 31. Explain the usage of predefined functions in analysis of datasets.	**Learning activities for the students:** Effective assignments, Giving tasks.	
		CO 32. Develop advanced data management skills for industry		

Contents:

	Content	Lectures
	Data Tabulation in Excel Creating a Table, Adding, Deleting new rows or columns, Moving a Table, Removing duplicate rows from a table. Sorting and filtering a table, auto filter, advanced filter, formatting of table. Series, auto fill series, Cell referencing (Relative, Absolute, Mixed). **Data from other sources**: Importing external data from different database files. Creating Custom Views of your Worksheet.	

Functions: Functions and its parts, some useful mathematical and statistical Functions in spreadsheet (eg. SUM, COUNT, MAX, MIN, IF, COUNTIF, CEILING, FLOOR, TRUNC, ABS, FACT, INT, LOG, MOD, POWER, ROUND, EXP), logical functions(IF,AND,OR).Date & Time functions (NOW, DATE, TIME, DAY, MONTH, YEAR, HOUR, MINUTE, SECOND).

Decision Making & Advance Spread-Sheet Tools: Financial Functions (PV, NPV, IPR, Rate, FV, PMT, NPER)**,** VLookup, HLookup. What if analysis (Data tables, Scenario, Goal seek, Sub-totals, Pivot Table), Macros, Protection.

Advanced Graphing and Charting: line graph, bar graph, pie chart, histogram, scatter plot.

Descriptive Statistics (mean, median, mode, standard deviation, sample variance, Range).

BOOKS RECOMMENDED:
- Winston ,"Microsoft Excel 2013: Data Analysis and Business Modeling", PHI
- Denise Etheridge,"Excel Data Analysis",WileyPublication,Third Edition
- Hector Guerrero ,"Excel Data Analysis - Modeling and Simulation", Springer
- Financial Analysis and Modeling using Excel and VBA: ChandanSengupta, Wiley

Semester I
Paper Code- BDA 107
ICT Lab

Credit: 4
Maximum marks: 100
Paper Type: Practical
Contact Hrs/Week: 4
Total Hrs: 60

Course Objective: This module introduces students to
1. Introduction to Fundamental of Information Communication technology.
2. Use productivity software like Word, and Power Point.
3. Use of Google Drive to save, store, share and access files and folders from anywhere.

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 33. Solve problems on Number System and compare data representation techniques		
BDA 107	**ICT Lab**	CO 34. Characterize concepts related to Data Communication and Internet.	**Approach in teaching:** Interactive Lectures, Discussion, Tutorials, Demonstration, Learning activities for the students: Self-learning assignments, Practical questions	Class test, Semester end examinations, Quiz, Presentation, Individual and group Assignments
		CO 35. Create well formatted documents using various features of word processor tool.		
		CO 36. Identify importance of IPR in Software and Data Analytics.		
		CO 37. Infer the features of presentation software and design effective presentation.		
		CO 38. Apply the concepts of storing and accessing files and folders on the cloud and demonstrate the ability to work on google drive.		

Contents:

Unit	Content	Lectures
I	**Information & Software:** Data Representation: Number Systems (Binary, Octal, Decimal, Hexadecimal), Computer Arithmetic, '+', '−', '*', '/'. Signed and Unsigned Number Representation in Binary Form, Code: BCD, ASCII, Extended Binary Coded Decimal Interchange Code. Types of Software: System Software, Application Software, Proprietary Software, Freeware Software, Public Domain Software, Open Source Software, Simulation Software, and Mobile Applications Introduction to Text Editors, Word Processors, Spreadsheets, Presentation and Database Software.	6
II	**Introduction to Data Communication and Internet:** Definition of Computer Network, Type of Networks, Network Topologies, Types of transmission media. Introduction to WWW, HTML, Web Page and its elements, hyperlinks, Web Applications, Web Browsers, Web Servers. Introduction to Cloud Computing: - Concept, Cloud Types-IAAS, SAAS, PAAS, Services and Applications, Introduction to Cloud Services like Google Drive. Introduction to Computer Viruses, Malicious Software, Antivirus, Anti-Spyware Software, Firewall, Browser Hijack, Hacking.	5
III	Word Processor: Features Of Word Processors, Shortcut Keys, Formatting Documents: Selecting Text, Copying & Moving Data, Formatting Characters, Changing Cases, Paragraph Formatting, Indents, Drop Caps, Using Format Painter, Page Formatting, Header & Footer, Bullets & Numbering, Tabs, Creating Tables, Styles And Templates. Finding & Replacing Text, Goto (F5) Command, Text Proofing Features, Macros, Inserting Pictures, Hyperlinks, Mail Merge, Printing.	6
IV	Introduction To Presentation Software: Presentation Tips, Components Of Slide, Slide Templates, Master Slide, Header And Footer, Images And Auto Shapes, Presentation Views, Transition And Animations, Inserting Audio, Video, Action Buttons And Hyperlinks, Rehearse Timings, Printing Slides.	8
V	**Introduction and History of Intellectual Property Right (IPR):** Concept and Kinds. IPR in India and World: TRIPS, WIPO.Copyrights, Patents: Objectives and Rights Computer Software and Intellectual Property, Database and Data Protection, Protection of Semi-Conductor Chips, Domain Name Protection.	

BOOKS RECOMMENDED:

- Alexis Leon and Mathews Leon, "Internet for Everyone", Vikas Publishing House Pvt. Ltd., New Delhi.
- Toby Velte, Anthony Velte, Robert C. Elsenpeter, "Cloud Computing: A Practical Approach", McGraw Hill, 2010.
- V. Rajaraman, "Fundamentals of Computers", 4th Edition, Prentice Hall India Pvt., Limited 2010.
- Mahapatra & Sinha, "Essentials of Information Technology", Dhanpat Rai Publishing, 2002

Credit: 02
Maximum marks: 100
Paper Type: Practical
Contact Hrs/Week: 2
Total Hrs: 30

Course Objective: This module introduces students to
1. Expose students to presentation skills, and working on Organization Research by helping them identify time sinkers and time wasters.
2. Enable students to identify their stress behavior and manage conflicts, learning the way conversations are done to reduce stress and conflict.

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 39. Practice self-analysis and grooming.	**Approach in teaching:** Interactive Lectures, Discussion, Power Point Presentations, Informative videos, Group Discussions.	Presentations, group discussions, personal interview, Resume Building, cover letter, quiz, public speaking
BDA 108	**Self-Analysis, Communication Skills and GD-PI**	CO 40. Learn the basics of group discussion and master the same through mock practice sessions. CO 41. Answer confidently in interviews. CO 42. Practice mock interviews which will help them in final interviews. CO 43. Build strong verbal and written communication skills.	**Learning activities for the students:** Self learning assignments, Presentations, Group Discussions.	

Contents:

Unit	Content	Lectures
1	**Self-Analysis and Personal Grooming** Internal external motivation, Visual image, Grooming, business formals, business casuals, accessories, Indian women executives, Mental Models (Inversion, Entropy), SWOT Analysis and Johari Window.	**6**
2	**Listening, Verbal and Non-verbal communication skills, Public Speaking** Asking the right questions, Voice modulations, listening habits, Building reading habit (Fiction and Non-Fiction). Extempore, Debate, JAM sessions. **Written communication, Assertiveness.** Formal letter writing, e-mail writing, Netiquette, using e-mail elements, How and when to say No	**6**
3	**Group Discussion**	**6**

	Body language, Skills required, Importance, Types, Process of GD, Evaluation Criteria, Preparing for GD, Do's and Don'ts of GD, FAQs. **Mock GD**	
4	**Personal Interview** Answering the most common Interview questions, Body Language, Document filing, Be the autobiographer, Grooming, Mirroring, FAQs. **Mock PI**	**6**
5	**Seminar and Industry Expert session** Question answer and experience sharing session	**6**

BOOKS RECOMMENDED:

- David Riklan (2003), Self-Improvement the Top 101 Experts Who Help Us Improve Our Lives.

- Bruce Patton, Douglas Stone, and Sheila Heen, Difficult Conversations

- Dr. K. Alex (2009), Soft skills know yourself and know the world, Sultan Chand & Sons.
- Kelly McGonigal (2011), The Willpower Instinct: How Self-Control Works, Why It Matters, and What You Can Do to Get More of It.
- Mahadevan Ramesh and Gopalaswamy Ramesh (2010), The ACE of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson publishers.

Credits: 4
Maximum marks: 100
Contact Hrs/Week: 4
Paper Type: Theory
Total Hrs: 60

Course Objective: This module introduces students to
1. Learn the concepts of data organization in effective manner.
2. Understand Data Structures, Arrays, Sets and Maps Stack, Queue, Algorithms & their implementation.

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 44. Analyze algorithm and its complexity while examining Arrays,List and Abstract Data Types.	**Approach in teaching:** Interactive Lectures, Group Discussion, Tutorials, Case Study, Demonstration	Class test, Semester end examinations, Quiz, Assignments, Presentation, Peer Review
BDA 201	**Data Structure and Algorithms with Python**	CO 45. Explain and Compare various sorting and searching algorithms. CO 46. Implementation of Sets and Maps. CO 47. Investigate various LinkedLists and their implementations CO 48. Implement Stack Operations and evaluate mathematical expressions using stack.	**Learning activities for the students:** Self-learning assignments, presentations, practical exercise	

Contents:

Unit	Content	Lectures
I	**Abstract Data Types:** Abstractions, Abstract Data Types, Data Structures The Date Abstract Data Type: Defining the ADT, Using the ADT, Preconditions and Postconditions, Implementing the ADT. Bags: The Bag Abstract Data Type, Selecting a Data Structure, List-Based Implementation. Iterators, designing an Iterator and Using Iterators. **Complexity Analysis**: Big-O Notation, Evaluating Python Code, Evaluating the Python List.	12 **hrs**
II	**Arrays:** The Array Abstract Data Type, Implementing the Array, Two-Dimensional Arrays, The Array2D Abstract Data Type, Implementing the 2-D, The Matrix Abstract Data Type, Matrix Operations, Implementing the Matrix. Basic concept of sparse matrix. **Searching:** linear search and binary search, **Sorting:** bubble sort, insertion sort and selection sort. Sorted list.	12 **hrs**
III	**Sets and Maps:** Sets, The Set Abstract Data Type, selecting a Data Structure, List-Based Implementation, Maps, The Map Abstract Data Type, List-Based Implementation.	12 **hrs**

	Link list: Single link list and implementation and Applications.	
IV	**Stack:** Implementing the Stack: Using a Python List and Using a Linked List. Stack Applications: Balanced Delimiters.	12 **hrs**
V	**Queue:** Implementing the Queue: Using a Python List and Using a Linked List. Queue Applications: Airline Ticket Counter. Priority queue.	12 **hrs**

BOOKS RECOMMENDED:

- Madhavan, "*Mastering Python for Data Science*", Packt, 2015.
- McKinney, *Python for Data Analysis*. O' Reilly Publication, 2017.
- Curtis Miller, "Hands-On Data Analysis with NumPy and Pandas",Packt, 2015

Credits: 4
Maximum marks: 100
Contact Hrs/Week: 4
Paper Type: Theory
Total Hrs: 60

Course Objective: This module introduces students to
1. Demonstrate the relations between Data elements.
2. Test the applicability of queries to extract the data.
3. Select appropriate methods to extract the right data as may be required by the user.
4. Design codes for apt storage, retrieval and representations of data from databases.

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 49. Compare various data models and schemas used in database management systems.	**Approach in teaching:** Interactive Lectures, Group Discussion, Tutorials, Case Study, Demonstration	Class test, Semester end examinations, Quiz, Assignments, Presentation, Peer Review
BDA 202	**Database Management Systems**	CO 50. Use the fundamental concepts, data definitions and query processing tasks in relational query languages.		
		CO 51. Analyze functional dependencies and normal forms in databases.	**Learning activities for the students:** Self-learning assignments, presentations, practical exercise	
		CO 52. Evaluate the operations of transaction and concurrent query processing tasks to obtain correct results.		
		CO 53. Design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.		

Contents:

Unit	Content	Lectures
I	**Introduction:** Overview of DBMS, Advantages of DBMS, Basic DBMS terminology, Database System v/s File System, Data Independence, Architecture of DBMS, Introduction to data models: Relational Model, Network Model, Hierarchical Model, Entity-Relationship Model, Comparison of network, hierarchical and relational models.	12 **hrs**
II	**Data modeling using the Entity Relationship Model:** ER model concepts, Types of Relationships, notation for ER diagram, Reduction of ER-Diagrams to Relational Model,	12 **hrs**

	mapping constraints, Generalization, Aggregation, Specialization, Extended ER model, relationships of higher degree.	
III	**Relational model:** Storage Organizations for Relations, Relational Algebra, Set Operations, Relational Calculus, and Concepts of Alternate key, Candidate key, Primary key, Foreign key, Integrity Rules, and Data Dictionary.	10 **hrs**
IV	**Normalization:** Functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion dependencies, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design. Transactions: Transaction Concept, State, ACID properties, basic understanding of Concurrency & Recovery.	10 **hrs**
V	**Introduction to SQL:** Characteristics of SQL, Advantages of SQL, SQL data types and literals, Types of SQL commands: DDL, DML, TCL, DCL, SQL operators, Tables, Views and Indexes, Constraints, Group By and Having Clause, Order By Clause, Queries and sub queries, Aggregate Functions, Numeric Functions, String Functions, Date & Time Functions, Insert, Update and Delete operations, Unions, Intersection, Minus, Joins: Equi-Join, Natural Join, Self-Join, Inner Join, Outer Join.	16 **hrs**

BOOKS RECOMMENDED:

- Madhavan, "*Mastering Python for Data Science*", Packt, 2015.
- McKinney, *Python for Data Analysis*. O' Reilly Publication, 2017.
- Curtis Miller, "Hands-On Data Analysis with NumPy and Pandas",Packt, 2015

Credits: 4
Maximum marks: 100
Contact Hrs/Week: 4
Paper Type: Theory
Total Hrs: 60

Course Objective: This module introduces students to

1. Acquaint students with the basic concepts of discrete mathematics that are useful in studying and describing objects and problems in all branches of computer science.
2. Use mathematically correct terminology and notation

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code **BDA 203**	**Paper Title** **Discrete Mathematics**	CO 54. Understand partially ordered sets, lattices and their types. CO 55. Analyse and compute problems related to Boolean algebra and Boolean functions. CO 56. Assimilate various graph theoretic concepts and familiarize with their applications. CO 57. Solve problems related to Pigeonhole Principle, Principles of Inclusion-Exclusion, Mathematical induction, Recurrence relation. CO 58. Explain set theory and its applications.	**Approach in teaching:** Interactive Lectures, Group Discussion, Tutorials, Case Study, Demonstration **Learning activities for the students:** Self-learning assignments, presentations, practical exercise	Class test, Semester end examinations, Quiz, Assignments, Presentation, Peer Review

Contents:

Unit	Content	Lectures
I	Introduction of sets, Set Identities. Mathematical Induction, inclusion and Exclusion, pigeon-hole principle. Introduction to recurrence relations and generating functions.	12 **hrs**
II	Partitions and Diagraph, Equivalence relation, Posets, lattice, One-to-One and onto functions-One to one correspondence-Inverse functions and compositions of functions.	12 **hrs**
III	Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers. Finite Boolean	12 **hrs**

	algebra, functions of Boolean algebra, Boolean function as Boolean polynomials.		
IV	Definition of graph-paths, circuits, cycles and sub graphs, induced sub graphs, degree of a vertex, connectivity, Euler graphs, Hamiltonian paths and circuits, planar graphs and their properties. Euler's formula for connected planar graph, bipartite graphs, kurtowski's theorem	12 **hrs**	
V	Definition of tree, labelled tree, spanning tree, cut set, minimal spanning tree, kruskal's algorithm, matrix representation of graphs, indegree and outdegree of a vertex, weighted graph, dijkstra's algorithm.	12 **hrs**	

BOOKS RECOMMENDED:
ESSENTIAL READINGS:

- Bernard Kolmann, Robert C. Busby and Sharon Ross, Discrete Mathematical Structures, PHI Delhi, 1997.
- K. H. Rosen- Discrete Mathematics and its Applications- 7th ed. McGraw – Hill2012
- Floyd- Thomas L: Digital Computer Fundamentals- 11th Edition-Pearson International- 2015.

REFERENCES:

- R.P. Grimaldi and B.V. Ramana- Discrete and Combinatorial Mathematics- An applied introduction- 5th ed.- Pearson Education- 2007.
- R.P. Grimaldi- Discrete and Combinatorial Mathematics- Addison Wesley, 5th ed., 2004.
- J. P. Tremblay and R. Manohar- Discrete Mathematical Structures with Application To Computer Science- Reprint- India: Tata McGraw Hill Education- 2008.

Paper Code- BDA 204
Random Variable and Probability Distribution

Credits: 4
Maximum marks: 100
Contact Hrs/Week: 4
Paper Type: Theory
Total Hrs: 60

Course Objective: This module introduces students to
    1 Random Variable Concepts.
    2 Fundamental of Probability Distribution.

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code **BDA 204**	**Paper Title** **Random Variable and Probability Distribution**	CO 59. Able to obtain the moments from moment generating function of various discrete and continuous distribution which helps them to study the population deeply. CO 60. Able to identify the behaviour of the population. CO 61. Learn how to derive the probability distribution function of random variables. CO 62. Analyse the behaviour of the data by Fitting discrete and continuous distributions.	**Approach in teaching:** Interactive Lectures, Group Discussion, Tutorials, Case Study, Demonstration **Learning activities for the students:** Self-learning assignments, presentations, practical exercise	Class test, Semester end examinations, Quiz, Assignments, Presentation, Peer Review

Contents:

Unit	Content	Lectures
I	Random Variable: Definition and types of random variables. Probability mass function and Probability density function. Distribution function with properties (without proof). Joint, Marginal and Conditional probability distributions. Independence of two variable, definition and application of Jacobian transformation for one and two variables.	12 **hrs**
II	Expectation of a random variable and its simple properties. Addition and Multiplication theorems of Expectations. Variance and covariance and their properties. Central moments and Non-central moments and their computation from data. Measure of Skewness and Kurtosis.	12 **hrs**

III	Chebychev's inequality with simple applications. Moment generating functions and their properties. Cumulant generating functions. Characteristic function and their properties (without proof)	12 **hrs**
IV	Binomial, Poisson, Geometric Distribution with simple properties and applications.	12 **hrs**
V	Uniform Distribution, Normal Distribution, Properties of Normal Curve, and Exponential Distribution with properties.	12 **hrs**

BOOKS RECOMMENDED:

- Goon, A.M., Gupta, M.K. and Gupta, B. Das (1991): Outline of Statistics, Volume I, The World Press PvtLtd , Calcutta
- Gupta, S.C. and Kapoor ,V.K.: (2000) Fundamentals of Mathematical Statistics, S Chand & Company, New Delhi
- Gupta, O.P.:Mathematical Statistics, Kedarnath Publication, Meerut.
- Mood Alexander M., GraybillFrankline and Boes Duane C.:(2007) Introduction to Theory of Statistics, McGraw Hill & Company Third Edition
- Paul Mayor L. (1970): Introductory Probability and Statistical Application, Oxford & IBM Publishing Company Pvt Ltd, Second Edition.
- Yule Udny G., and Kendall,M.G. (1999): An Introduction to the theory of Statistics,14th Edition
- Speigel M.R., (1967): Theory and Problem of Statistics, Schaum's Series.
- Johnson Norman L., Kotz Samuel and Kemp Adriene W.: (2005) Univariate Discrete Distributions, Second Edition.
- Kingman, J.F. & Taylor, S.J. (1996): Introduction to Measure and Probability, Cambridge Univ. Press.
- Johnson, S. and Kotz. (1972): Distribution in Statistics, Vol.I, II. And III, Houghton and Muffin.

Credits: 6
Maximum marks: 100
Contact Hrs/Week: 6
Paper Type: Practical
Total Hrs: 90

Course Objectives:

The course will enable the students to

1. Understand basic data structures, and algorithms for manipulating them

2. Learn to design algorithms and apply the algorithm analysis techniques.

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 63. Design and execute basic operations of different data structures.	**Approach in teaching:** Interactive Lectures, Group Discussion, Tutorials, Case Study, Demonstration	Class test, Semester end examinations, Quiz, Assignments, Presentation, Peer Review
BDA 205	**Data Structure and Algorithms Lab**	CO 64. Solve specific problems using Arrays,Sets,Maps and linked list.		
		CO 65. Write and execute programs based on Sorting and Searching Algorithms.		
		CO 66. Implement Stack and Analyze the Applications of Stack.	**Learning activities for the students:** Self-learning assignments, presentations, practical exercise	
		CO 67. Implement Queues and analyze their Applications.		

Contents:

Practical based on implementation of following different data structures & related operations on them:

- One-dimensional & Two-dimensional Arrays

- Sets and Maps.

- Linked Lists

- Queues

- Stacks

- Sorting & searching Techniques

Credits: 6
Maximum marks: 100
Contact Hrs/Week: 6
Paper Type: Practical
Total Hrs: 90

Course Objectives:

The course will enable the students to

1. Apply the query for the modification of the system.
2. Formulate a conceptual design which allows to avoid anomalies in superior's data.
3. Review a system which allows restricting the uncontrolled exaction and providing rigorous variation of the task.
4. Evaluate the viability of Conceptual Design

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 68. Apply query processing tasks in relational query languages.	**Approach in teaching:** Interactive Lectures, Group Discussion, Tutorials, Case Study, Demonstration	Class test, Semester end examinations, Quiz, Assignments, Presentation, Peer Review
BDA 206	**MySQL Lab**	CO 69. Design databases using concepts of functional dependencies and normal forms		
		CO 70. Formulate the operations of transaction and concurrent query processing tasks to obtain the correct results even under strict time constraints.	**Learning activities for the students:** Self-learning assignments, presentations, practical exercise	
		CO 71. Detect the foundational concepts of distributed databases.		
		CO 72. Prepare several techniques related to transaction management and query processing in distributed database management systems.		

Contents:

1. SQL data types, Operators, Literals, Constraints
2. DDL Commands: Create Tables/Create Synonym /Create index /Views / Alter / Drop/Truncate/Comment/Rename/DBCC (Database Console Commands)
3. DML Commands: Insert / Update / Delete / Merge/Lock Table
4. TCL Commands: Commit / Rollback / Save-Points /Set Transaction

5. DCL Commands: Grant / Revoke/Deny
6. Simple Queries: Select / From / Where
7. Group By/Having Clause
8. Order By clause
9. SQL Operators: Arithmetic / Logical /In / Like / Between
10. Functions: Aggregate / Numeric / String / Date & Time / Logical
11. Joins: Equi-Join / Natural Join / Self Join / Inner Join / Outer Join
12. Unions / Intersection / Minus
13. Subqueries or Nested Queries

Credit: 2
Maximum marks: 100
Contact Hrs/Week: 2
Paper Type: Theory
Total Hrs: 30

Course Objective: This module introduces students to
1. Develop a comprehensive understanding of various environmental issues.
2. Recognize the consequences of human actions on the environment and to prevent deterioration of environment

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 73. Develop a comprehensive understanding of various ecological processes and environmental issues	**Approach in teaching:** Interactive Lectures, Group Discussion, Tutorials, Case Study, Demonstration	Class test, Semester end examinations, Quiz, Assignments, Presentation, Peer Review
BDA 207	**Environment Science**	CO 74. Develop critical thinking for shaping strategies for environmental protection and conservation of biodiversity, social equity and sustainable development		
		CO 75. Evaluate the consequences of human actions on the environment and ways to prevent deterioration of environment	**Learning activities for the students:** Self-learning assignments, presentations, practical exercise	
		CO 76. Reflect critically on theor roles, responsibilities and identifies as citizens, consumers and environmental actors in a complex, interconnected world		

Contents:

Unit	Content	Lectures
I	**Introduction to Environment and Ecosystem** o Scope of Environmental Studies and its applications o Relationship of Environmental Studies with other subjects (Multidisciplinary nature of Environment) o Concept of sustainability and sustainable development. o Environmentally important dates and abbreviations o Types of Ecosystems and their general characteristics o Producers, consumers and decomposers o Energy flow in the ecosystem o Food chains, food webs and ecological pyramids o Ecological Succession	6
II	**Natural Resources: Renewable and Non-renewable Resources** o Land resources and land use change; Land degradation, soil erosion and desertification. o Deforestation: Causes and impacts due to mining, dam building on the environment, forests, biodiversity and tribal populations. o Water: Use and over-exploitation of surface and groundwater, floods, droughts o Energy resources: Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies	5
III	**Biodiversity and Conservation** o Levels of biological diversity: genetic, species and ecosystem diversity o India as a mega-biodiversity nation; Biogeographic zones of India o Biodiversity patterns and global biodiversity hot spots o Endangered and endemic species of India o Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions o Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity o Names of International and National agencies related to biodiversity conservation	6
IV	**Environmental Pollution** o Types, Causes, effects and control measures of : Air pollution; Water pollution; Soil pollution; Noise pollution o Pollution case studies o Solid waste management: Control measures of urban and industrial waste. o Nuclear hazards and human health risks o Global environmental issues: Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture o Environment Laws: Environment Protection Act,1986; Air (Prevention & Control of Pollution) Act, 1981; Water (Prevention and control of Pollution) Act, 1974; Wildlife Protection Act, 1972; Forest Conservation Act, 1980	8

	o International agreements: Montreal protocol, Kyoto protocol and Convention on Biological Diversity (CBD)		
V	**Human Communities and the Environment** o Human population growth: Impacts on environment, human health and welfare o Resettlement and rehabilitation of project affected persons; case studies o Disaster management: floods, earthquake, cyclones and landslides o Environmental movements:Chipko, Silent valley, Bishnois of Rajasthan o Environmental ethics: Role of Indian and other religions and cultures in environmental conservation o Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi)		

BOOKS RECOMMENDED:

- Agarwal, K. C. (2001). *Environmental Biology.* Bikaner: Nidhi Publication Ltd.
- Barucha, E. (2004). The Biodiversity of India. Ahmedabad: Mapin Publishing Pvt. Ltd.
- Begon, C. a. (2006). Essentials of Ecology. Blackwell.
- Belsare, D. K. (2007). Introduction to Biodiversity. APH Publishing Corporation.
- Bhatia, A. L., &Kohli, K. S. (2015). Ecology and Environmental Biology. RBD publishing house.
- De, A. K. (2003). Environmental Chemistry (5th Ed.). New Age Intl. (p) Ltd.
- Miller, G. T. (2013). Environmental Science. Cengage Larning.
- Odum, E. (1971). Fundamentals of Ecology. W.B. Saunders Co. USA.
- Prabu, P. (2009). Ecology and environmental Science. Avinash Paperbacks.
- Rajagopalan, R. (2005). Environmetnal Studies. Oxford University Press.
- Santra, S. (2011). Environmental Science. New Central Book Agency Pvt. Ltd.
- Sharma, P. D. (2008). Ecology and Environment. Rastogi Publications.
- Singh, S. (1991). Environmental Geography. PrayagPustakBhawan.
- Srivastava, K. (2002). *An Introduction to Environmental Studies.* Kalyani Publishers.

Credit: 2
Maximum marks: 100
Contact Hrs/Week: 2
Paper Type: Practical
Total Hrs: 30

Course Objectives:

The course will enable the students to

Work in team building, and Leadership qualities,

1 Helping students with leadership skills and working on their body language.
2 Give students in depth knowledge of the various aspects concerning Personal branding, creating online resume on various platforms, learning to work on writing online and offline content.
3 Emphasis is also given on public speaking, and working amongst different groups and with cultural diversity.

Course Outcomes (COs): At the end of this course, a student should be able to:.

Course		Course outcome (at course level)	Learning and teaching strategies	Assessment Strategies
Paper Code	**Paper Title**	CO 77. Learn how to create industry specific resume.	**Approach in teaching:** Interactive Lectures, Discussion, Power Point Presentations, Informative videos, Group Discussions. **Learning activities for the students:** Self learning assignments, presentations, Public Speaking.	Personal Interview- Extempore-1- minute speech game -Elevator Pitch -Small Talk – 1 miswritten assignment, quiz, resume building, semester end examination
BDA 208	**Public Speaking, Team Work and Communication Skills**	CO 78. Learn aspects of personal branding, creating online resume at various platforms, such as Naukri and LinkedIn CO 79. Overcome public speaking fear. CO 80. Overcome the fear of group discussion through various public speaking activities, group discussions. CO 81. Understand the business etiquette, how to behave in a social setting and learn aspects of team work.		

Unit	Contents	Lectures
1	**Understanding Resume making** Resume Rubric, know your industry, some key notes about LinkedIn, Using LinkedIn and Naukri and networking, preparing career statement. Resume writing Guidelines and formatting. Common Resume Mistakes, Cover letter- Key components and guidelines.	6
2	**Public speaking Sills** Case study in public speaking and personal branding, overcoming public speaking fear, Extempore, Public Speaking, One-minute talk	6
3	**Etiquette** **Business Etiquette:** Grooming, Positive impression, Communication, Social Imaging. **E-Mail Etiquette:** Professional Behaviour at work, Subject line, CC-BCC, professional e mail address and other basic do's and don'ts. **Phone etiquette:** Tone of voice, receiving and dialling, phone language, eliminating distraction, basic etiquette and do's and don'ts. Whatsapp/messaging etiquette, social etiquette, Business meeting etiquette, cubicle manners, dining etiquette, social media etiquette	6
4	**Team Building** Activities, team building games, team processes. **Laws of teamwork** Case study approach to team work, The law of the significance, the law of the big picture, the law of the niche. **Work ethics** Work ethic. Relationship management, receiving and giving positive and negative feedback, body language.	6
5	**Seminar and Industry Expert session** Question answer and experience sharing session	6

Reference Books:

1. Dale Carnegie, the Leader in you.

2. John C. Maxwell (2001), The 17 Indisputable Laws of Teamwork: Embrace Them and Empower Your Team.
3. Paul Gustavson and Stewart Liff (2014), A Team of Leaders: Empowering Every Member to Take Ownership, Demonstrate Initiative, and Deliver Results.
4. ShitalKakkarMehra (2012), Business etiquette – A Guide for the Indian Professional, Harper Collins Publishers.