

**Department of Computer Science**  
**Assam University, Silchar**  
**Curriculum for Post Graduate Diploma in Artificial Intelligence**  
**w. e. f. 2024-25**

(a) Programme Structure

**SEMESTER I**

Sl. No.	Course Code	Course Title	Credit	L	T	P	Sessional Marks	End Semester Marks	Total Marks
1.	PDIPAI-500	Orientation	Nil	-	-	-	-	-	-
2.	PDIPAI -501	Fundamentals of Artificial Intelligence	4	4	-	-	30	70	100
3.	PDIPAI-502	Mathematical Foundations of Artificial Intelligence	4	4	-	-	30	70	100
4.	PDIPAI-503	Programming in Python	4	4	-	-	30	70	100
5.	PDIPAI-504	Database Management Systems	4	4	-	-	30	70	100
6.	PDIPAI-505	a) Lab on Python Programing	4	-	-	8	15	35	50
		b) Lab on Database management Systems					15	35	50
<b>Total</b>			20	24 (Hours/week)			150	350	500

**SEMESTER-II**

Sl. No.	Course Code	CoursesTitle	Credit	L	T	P	Sessional Marks	End Semester Marks	Total Marks
1.	PDIPAI -551	Data Structures	4	4	-	-	30	70	100
2.	PDIPAI -552	Fundamentals of Machine Learning and Data Mining	4	4	-	-	30	70	100
3.	PDIPAI -553	Data Science with Programming in R	4	4	-	-	30	70	100
4.	PDIPAI-554	AI and ML TOOLS – Open AI, Chat GPT, Chat Bot, Generative AI	3	3	-	-	30	70	100
5.	PDIPAI 555	Mini Project Using AI and ML Tools	3	-	-	6	30	70	100
6.	MCA-556	Cyber Security	2	2	-	-	30	70	100
<b>Total</b>			<b>20</b>	<b>23 (Hours/week)</b>			<b>180</b>	<b>420</b>	<b>600</b>
<b>SEMESTER-I+II Total Marks: 1100</b>							<b>Post-Graduate Diploma: 40 Credits</b>		

**(b) Detail Syllabus**

**SEMESTER I**

**Course Code: PDIPAI-500**  
**CREDIT: NIL**

**Course Title: Orientation**

**Course Code: PDIPAI-501**

**Course Title: Fundamentals of Artificial Intelligence**

**CREDIT: 4**

**L-T-P: 4-0-0**

**UNIT I:** Introduction to AI, History, Trends and Future Directions of AI, Types of Artificial Intelligence, Responsible AI, Intelligent Agents

**UNIT II:** Problem Solving by Search: AI problems, state space, state space search, breadth-first, depth-first, local search and optimization; Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Search in Complex Environments, Adversarial Search and Game Trees, Constraint Satisfaction Problems, Stochastic Search Methods

**UNIT III:** Knowledge Representation and Reasoning: Logic as form of expression (syntax and semantics of propositional logic and predicate logic), Reasoning under uncertainty: Notion of Uncertainty, Uncertain Knowledge and Reasoning

**UNIT IV:** Introduction to Machine Learning, Different forms of Learning: Supervised, Unsupervised Learning, & Reinforcement Learning, Learning Probabilistic Models, Deep Learning

**UNIT V:** Applications of AI: Introduction to Natural Language Processing, Image Processing and Computer Vision; AI today, AI Ethics, Introduction to AI languages and their important characteristics - Prolog/Python

**Books and references:**

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 4th Edition, Pearson Education
2. Artificial Intelligence, E. Rich, K. Knight, S. B. Nair, 3rd Edition, McGraw Hill
3. Artificial Intelligence, P. H. Winston, 3rd Edition, Pearson, Education
4. Introduction to Artificial Intelligence, E. Charniak & D. McDermott, A. Wesley
5. PROLOG Programming Techniques and Application, S. Garavaglia, Harper and Row
6. Introduction to Turbo PROLOG, Carl Townsend, Sybex Inc., U.S.
7. PROLOG: Programming for Artificial Intelligence, BRATKO, 3rd Edition, Pearson Education India
8. The Complete reference Python, Martin C. Brown, 4th Edition, McGraw-Hill
9. Problem Solving and Python Programming, E. Balagurusamy, McGraw-Hill
10. Core Python Programming, Dr. R. NageswaraRao, 3rd Edition, Dreamtech

**Course Code: PDIPAI-502**  
**CREDIT: 4**

**Course Title: Mathematical Foundations of Artificial Intelligence**  
**L-T-P: 4-0-0**

**UNIT I: SETS, RELATIONS and FUNCTIONS**

**Sets:** Representation of sets, The empty set, Finite and Infinite sets, Equal sets, subsets, Power set, Universal set, Venn Diagrams, Operations on sets, Complements of a set, Practical problems on operations on sets, De-Morgan's law, Cartesian Product.

**Relations and Functions:** Relations, Types of Relations, Types of Functions – one-one, onto, bijective, Compositions of Functions and Invertible Functions, Binary operations, Inverse Functions. Trigonometric Functions: Trigonometric Functions of sum and difference of two angles, Inverse Trigonometric Functions and their properties.

**UNIT II: MATRICES**

Introduction to Matrices, Types of Matrices, Operations on Matrices, Transpose of a Matrix, Symmetric and Skew Symmetric Matrices, Hamiltonian and Skew Hamiltonian Matrices, Minors and Cofactors, Orthogonal and Singular Matrix, Adjoint and Inverse of Matrices, Applications of Matrices for solving Linear System of Equations, Rank of a Matrix, Eigen values and Eigen vectors, Charistic Equation of a Matrix. Concept of Vectors and Products of Vectors.

**UNIT III: BOOLEAN ALGEBRA and STATISTICS**

**BOOLEAN ALGEBRA:** Number Systems – Decimal and Binary, Introduction to Boolean functions, Logic Gates, Representation and Minimization of Boolean Functions.

**STATISTICS:** Introduction, Measures of Location, Dispersion, Skewness, Coefficient of Skewness, Range, Mean Deviation, Variance and Standard Deviation, Analysis of Frequency Distributions.

#### **UNIT IV: PROBABILITY**

Introduction to theory of Probability, Axiomatic approach to Probability, Random Experiment, Random Events, Addition and Multiplication Theorem on Probability, Conditional Probability, Independent Events, Pairwise Independent and Mutually Independent Events and Applications, Bayes' Theorem and Applications, Random Variable and its Probability Distributions. **Correlation:** Simple, Partial and Multiple Correlations; **Regression:** Simple and Complex Regressions, Lines of Regressions.

#### **UNIT V: MATHEMATICAL LOGIC**

Introduction, Propositional Logic, Truth Tables, The Propositional Calculus, Propositional Equivalence, Arguments, Predicates and Quantifiers, Nested Quantifiers, The Predicate Calculus, Rules of Inference, Inference Theory of Predicate Calculus. Using Inference Rules to Produce Predicate Calculus Expressions, Applications: A Logic Based Financial Advisor.

#### **BOOKS AND REFERENCES:**

1. Vector Algebra: Shanti Narayan and P. K. Mittal, S. Chand and Co., Latest Edition
2. Higher Algebra: Abstract and Linear: S. K. Mapa, Sarat Book House, Latest Edition
3. A Text Book of Matrices: Shanti Narayan and P. K. Mittal, S. Chand and Co., Latest Edition
4. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor S. Chand and Co., Latest Edition
5. Mathematical Statistics: J. N. Kapoor and H. C. Saxana, S. Chand and Co., Latest Edition
6. Fundamentals of Applied Statistics: S. C. Gupta and V. K. Kapoor S. Chand and Co., Latest Edition
7. Statistical Methods: S. P. Gupta, S. Chand and Co., Latest Edition
8. Discrete Mathematics and Its Applications: Kenneth H. Rosen, Tata McGraw Hill, Sixth or Latest Edition
9. Elements of Discrete Mathematics: C. L. Liu, McGraw Hill, Second or Latest Edition
10. Artificial Intelligence: G. F. Luger. Pearson Education, Latest Edition
11. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 4th Edition, Pearson Education

**Course Code: PDIPAI- 503**

**CREDIT: 4**

**Course Title: Python Programming**

**L-T-P: 4-0-0**

#### **Course Objectives:**

To understand why Python is a useful scripting language for developers; to learn how to use lists, tuples, and dictionaries, sets in Python programs; to learn how to use indexing and slicing to access data in Python programs ; to learn how to write loops and decision statements in Python; to learn how to write functions and pass arguments in Python; to learn how to build and package Python modules for reusability; to learn how to read and write files in Python; to learn how to design object-oriented programs with Python classes ; to learn how to use class inheritance in Python for reusability; to learn how to use exception handling in Python applications for error handling; to learn how to use Higher order functions on lists vizmap, filter, list comprehension; to learn to use Python for writing simple data

structure programs; to learn to use Matplotlib.

**Course Outcomes:**

At the end of the course it is expected that a student would be reasonably proficient in writing Python programs for solving various problems as the course covers topics ranging from basics of Python Programming to intermediate level.

**UNIT-I**

Introduction: Basic Elements of Python, Operators, Python Statements & Comments, Python Type Conversion, Indentation in Python, print() and input() functions, Strings, Python IDEs Python Flow Control: if...else , for loop, while loop, break and continue, Python Pass, range statement; Python memory model: names, mutable and immutable values.

**UNIT-II**

Python Functions: Python Functions, Function Arguments, Recursion, Inductive function definition, Anonymous Function, Lambda function, Passing functions as arguments, Python Global Keyword, Python Modules, Python Package.

**UNIT-III**

Python Collections: List, Tuple, Sets and Dictionary; String Manipulation: Basic Operations, Slicing, Python Regular expressions; Python iterators, Python Generators, Python Closure, Python Decorators, Higher order functions on lists: map, filter, list comprehension.

**UNIT IV**

Python Files: Python File Operation, Python Directory, Python Exception Handling, User defined exception; Assertions; Classes and objects in Python; MATPLOTLIB

**UNIT V**

Arrays vs lists, Scope in Python: local, global, nonlocal names, Nested functions, Binary Search, Data structures: stack, queue implementation in Python, Sorting: Merge sort , Quicksort, Stable sorting implementation in Python, Linked lists: find, insert, delete, Binary search trees: find, insert, delete

**Text Books:**

1. Introduction to Computation and Programming Using Python, John V. Guttag, PHI
2. Core Python Programming, Dr. R.NageswaraRao, Dreamtech Press

**Reference:**

1. Swayam course on “Programming, Data Structures and Algorithms Using Python” By Prof. MadhavanMukund, Chennai Mathematical Institute

**Course Code: PDIPAI- 504**  
**CREDIT: 4**

**Course Title: Data Base Management Systems**  
**L-T-P: 4-0-0**

**Course Objectives:**

- 1 To present necessary concepts for database designing.
2. Design conceptual, logical database model and physical model.
3. Evaluate set of queries using SQL and algebra.

4. Concepts of RDBMS, and learn Object oriented modelling.
5. To introduce transaction management and concurrency.
6. To introduce storage structure and file management.
7. To introduce query optimization and query processing.
8. To introduce data mining and data warehousing.

**Course Outcomes:**

1. Understand concepts of database system architecture.
2. Able to understand relational model and perform SQL operations.
3. Understand the importance of normal forms and learn query optimization.
4. Learns the importance of transaction processing and concurrency control.

**UNIT-I**

Data modeling for a database: records and files, abstraction and data integration, database management systems; the three levels architecture of a DBMS, components of a DBMS.

**UNIT-II**

Data models: Hierarchical, Network model, Relational; ER Diagrams, Extended ER Diagrams, Data base Schema, Keys, Relational Data base: manipulations; relational algebra.

**UNIT-III**

Relational calculus, SQL Queries, Relational database design

**UNIT-IV**

Normalization and Functional dependencies, findings keys, decomposition computing closures of a FD's  
Query processing: general strategies for query processing and query optimization, query processor.

**UNIT-V**

Transactions and Transaction Processing, ACID Properties, Introduction to Concurrency and Serialization, Concepts of Security and Recovery

**Text books/references:**

1. Fundamentals of Database System: R. Elmasri& S. Navathe (Benjamin Cummings).
2. Data Base Management System-Henry F. Korth& Abraham Silberschats, McGraw hills, 1991.
3. An introduction to data base management system vol I &II-Date C.J., Addison Wesley, 1981, 1983
4. Principles of data base system -Ullman J.D., computer science ,1982.

**Course Code: PDIPAI-505**

**Credits: 4**

**LTP: 0– 0 – 8**

**Course Title: (a) Lab on Python Programming**

**Course Objectives:**

The objective of the course is to make the students aware and proficient in Python Programming.

**Course Outcome:**

The outcome of the course is that the students should be able to execute the broad class of problems as outlined in the syllabus of the lab on python programming.

**Experiments:**

1. Problems related to if ... else structure of Python
2. Problems related to looping, break and continue
3. Problems to identify the usage of pass and range statements in python.
4. Problems related to usage of functions in Python, Global, local and Non local functions.
5. Problems related to Recursion, Anonymous Function, Lambda function, Python Modules and Python Package.
6. Problems related to File handling in Python, exception handling, usage of User defined exception and Assertions
7. Problems related to Python Collections: List, Tuple, Sets and Dictionary.
8. Problems related to String Manipulation, Basic Operations, Slicing, Python Regular expressions; Python iterators, Python Generators, Python Closure, Python Decorators, Map, filter and List Comprehension
9. Problems related to Python Object & Class, Problems on MATPLOTLIB Stack, queue implementation in Python, Implementing basic sorting algorithms like Merge Sort, Quick sort and stable sort.
10. Problems related to Binary Search, Linked List and Binary Search trees.

**Course Code: PDIPAI-505**

**Course Title: (b) Lab on Data Base Management Systems**

**Course Objectives:**

Database Management System design and implementation problems should form the laboratory assignments for this course.

**Course Outcome:**

Students should solve assignments by using the standard principles and practices of relational database design and then develop the appropriate schema for machine implementation on MySQL/SQL/SQLServer/PLSQL/Oracle etc. in Windows/Unix/Linux/Solaris operating systems environment on a network.

Following are some samples for laboratory programming assignments but the assignments should not be limited to these only. These programming assignments must be preceded by corresponding database design assignments.

**(i) Structured Query Language**

1. Creating Database: Creating a Database, Creating a Table, Specifying Relational algebraic constructs, Specifying Constraints, Creating Indexes.
2. Table and Record Handling: INSERT statement, Using SELECT and INSERT together, DELETE, UPDATE, TRUNCATE statements, DROP, ALTER statements.
3. Retrieving Data from a Database: The SELECT statement, Using the WHERE clause, Using Logical Operators in the WHERE clause, Using IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING clause, Using Aggregate Functions, Combining Tables Using JOINS, Sub queries.
4. Database Management: Creating Views, Creating Column Aliases, Creating Database Users, Using GRANT and REVOKE, Cursors in Oracle PL / SQL, Writing Oracle PL / SQL Stored Procedures.

## SEMESTER II

**Course Code: PDIPAI-551**  
**Credits: 4**

**Course Title: Data Structures**  
**LTP: 4- 0- 0**

### **Course Objectives:**

In this course, students will be able to learn the followings:

1. Understand the fundamentals of data and file structures and their operations.
2. Learn how to apply various data structures, including arrays, linked lists, stacks, queues, trees, and graphs, in real-time applications.

### **Course Outcome:**

1. Knowledge about fundamental of data structure and their implementation.
2. Design algorithms and perform various operations on linear and non-linear data structures.
3. Design algorithms for different real time applications using linear and non-linear data structures.
4. To develop skill to apply data structures in problem solving.

### **UNIT-I**

Introduction: Data Structures, Data Structures operation, Arrays, Multidimensional arrays, Representation of array in memory, address calculations, sparse arrays. Lists: sequential and linking structures, linked lists, operations on all these structures and applications.

### **UNIT-II**

Stacks and Queues: Operations on Stack and Queues and their implementations, Applications of Stacks: Polish Notation, Applications of Queues, and Types of Queues: Priority Queue, Circular queue, Double Ended Queue, Recursion.

### **UNIT-III**

Tree Structures: Introduction, binary trees, tree traversal algorithms, threaded trees, binary search trees.

### **UNIT-IV**

Sorting and Searching: Sequential Sort, Radix sort, Insertion Sort, Bubble Sort, Quick Sort, Merge Sort. Heap Sort Searching: Sequential Search and Binary Search.

### **UNIT-V**

Introduction to Graph and Graph Search Techniques, File Organization: serial, sequential, indexed sequential, direct inverted, multi-list, hashing and collision handling methods.

### **Text Books/ References:**

1. Data structures using C. by. Tenenbaum, PHI, 1996
2. Fundamentals of Data Structures- Horowitz Sahani, Computer Science Press, 1978
3. An introduction to data structures with applications Jean Paul Trembley and Paul Sorenson, McGrawHill, International Student Edition, 1985
4. Data structures and Algorithms Aefred V. Aho, Jhon E. Joperoft and J.E. Ullman
5. Data Structures, Seymour Lipschutz, Schaum&#39;s outlines, Tata McGraw Hill Education Private Ltd.



**Course Code: PDIPAI-552**  
**Credits: 4**

**Course Title: Fundamentals of Machine Learning and Data Mining**  
**LTP: 4- 0- 0**

**Course objectives:**

1. To introduce the concepts of Machine Learning and Data mining and its role in the process of Knowledge Discovery in large databases.
2. To explain the working of various algorithms for Classification, Clustering, and Mining Association Rules
3. To introduce the concepts of Sequence mining and Text mining

**Course outcome:** After successful completion of the course, the students will be able to

1. Learn the concepts of Machine Learning and Data Mining and its role in the process of Knowledge Discovery in databases.
2. Learn the principle and working of leading classification algorithms and apply it on datasets.
3. Learn the principle and working of leading Clustering algorithms and apply it on datasets to discover clusters and Clustering rules.
4. Learn the principle and working of the Association Rule Mining algorithms and apply it on datasets to discover association rules.
5. Learn the concepts of Sequence mining and Text mining.

**UNIT-I**

**Introduction to Machine Learning:** Types of Learning – Learning from observations, Inductive Learning, Concept Learning, Explanation Based Learning (EBL), Supervised Learning and Unsupervised Learning, Machine Learning using PYTHON – PYTHON tools and libraries.

**Introduction to Data Mining and KDD process:** Multidimensional data model and applications, Data Mining techniques, using PYTHON – PYTHON tools and libraries, Applications of Data Mining and challenges.

**Interconnection of Data Mining and Machine Learning – Objectives and Tasks**

**Data and its Types:** Open source Data sets and data preparation, Introduction to Feature Engineering, Dimension reduction, noisy data, missing values, Principal Component Analysis (PCA), Singular Value Decomposition (SVD). Data Visualization – Heat map, Box Plot, Training data, Test data and Validation data, model accuracy and selection, PYTHON/WEKA implementation.

**UNIT-II:**

**Supervised Machine Learning and Data Mining by Classification and prediction - I:** Introduction to supervised machine learning and classification by decision tree and its PYTHON/WEKA implementation; Classifier accuracy, Regression – Logistic regression and linear regression, regression versus classification, problem of over fitting, Classification and Regression Tree (CART); PYTHON/WEKA implementations.

**UNIT-III:**

**Supervised Machine Learning and Data Mining by Classification and prediction - II:** Bayesian Classification, Naïve Bayes, k-Nearest Neighbor (kNN) Classification, Support Vector Machine (SVM), Ensemble method of Classification – Random Forest, PYTHON/WEKA implementations; Classification using Neural Networks – Overview of Back Propagation and Deep Neural Networks.

**UNIT-IV:**

**Unsupervised Machine Learning and Data Mining through Clustering:** Introduction and types of Clustering techniques, Numerical clustering methods - k-Means algorithm, k-medoid algorithms and their PYTHON/WEKA implementation; Hierarchical Clustering algorithms –(a) Density based clustering- DBSCAN and (b)

Agglomerative clustering– BIRCH; Categorical Clustering Algorithms – overview; Introduction to Text Clustering.

#### **UNIT-V:**

**Unsupervised Machine Learning and Data Mining through Association Rule Mining:** Association Rule Mining in large data bases, Transaction datasets, Itemset Lattice, Frequent Itemsets – Definition, types and properties; Association Rule Mining by candidate generation: Apriori and Partition Algorithms; Mining Association Rules without candidate generation – FP Tree Growth Algorithm; PYTHON/WEKA implementation; Discussion on different Algorithms, Advances in Association rule mining – Overview of Sequence Mining and Spatial Mining

#### **Text Books:**

1. Data Mining Techniques: Arun Kumar Pujari, Universites Press, Third Edition, 2013 or latest edition
2. Data Mining: Concepts and Techniques: Jiawei Han and MichelineKamber, Morgan Kaufmann Publishers, Third edition, 2011 or latest edition.
3. TomM.Mitchell:MachineLearning,McGrawHillEducation,IndianEdition,2017

#### **Reference Books:**

- 1.Data Mining: Introductory and Advanced Topics: Margaret H Dunham, Pearson Education, 2008 or latest edition.
2. Introduction to Data Mining: Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education, 2009 or latest edition.
3. Learning Data Mining with Python: Robert Layton, PACKT Publishing, 2015 or latest edition.

**Course Code: PDIPAI-553**  
**Credits: 4**

**Course Title: DataScience with Programming in R**  
**LTP: 4- 0– 0**

#### **Course Objectives:**

1. To explain the basics of data science and syntax, execution,and programs in R.
2. To explain the use of matrices and arrays in R.
3. To explain the use of non-numeric values in vectors.
4. To explain the use of data frame and list in R.
5. To explain the graph plotting using ggplot2.

#### **Course Outcomes:**

Upon completion of this course, the students will be able to:

1. Understand the concept of datascience and execute basics syntax programs in R.
2. Perform the Matrix operations using R built in functions.
3. Apply non numeric values in vectors.
4. Createthelistanddata frames.
5. Exploit the graph using ggplot2.

#### **UNIT- I**

Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data

Science Project–Applications of Data Science in various fields– Data Security Issues.

History and Overview of R- Basic Features of R-Design of the R System- Installation of R-Console and Editor Panes- Comments- Installing and Loading R Packages- Help Files andFunctionDocumentationSavingWork and Exiting R- Conventions- R for Basic Math-Arithmetic-LogarithmsandExponentialsE-Notation-AssigningObjects-Vectors-Creating a Vector- Sequences, Repetition, Sorting, and Lengths- Sub setting and ElementExtraction-Vector-OrientedBehaviour.

## **UNIT-II**

Defining a Matrix–Defining a Matrix- Filling Direction- Row and Column Bindings-Matrix Dimensions Sub setting- Row, Column, and Diagonal Extractions- Omitting andOverwriting- Matrix Operations and Algebra- Matrix Transpose- Identity Matrix- MatrixAdditionandSubtraction-MatrixMultiplicationMatrixInversion-MultidimensionalArrays- Subsets, Extractions, and Replacements.

## **UNIT-III**

LogicalValues-RelationalOperators-Characters-CreatingaString-Concatenation-Escape Sequences Substrings and Matching- Factors- Identifying Categories- Defining andOrderingLevels- Combining and Cutting.

## **UNIT-IV**

Lists of Objects-Component Access-Naming-Nesting-Data Frames-Adding Data ColumnsandCombiningDataFrames-LogicalRecordSubsets-SomeSpecialValues-Infinity-NaN-NA-NULL Attributes-Object-Class-Is-Dot Object-Checking Functions-As-Dot Coercion Functions.

## **UNIT-V**

Using plot with Coordinate Vectors-Graphical Parameters-Automatic Plot Types-Title andAxisLabelsColor-LineandPointAppearances-PlottingRegionLimits-Adding Points, Lines, and Text to an Existing Plot-ggplot2 Package-QuickPlotwithqplot-SettingAppearance Constants with Geoms--READING AND WRITING FILES- R-Ready DataSets- Contributed Data Sets - Reading in External Data Files - Writing Out Data Files and Plots-Ad Hoc Object Read/WriteOperations.

## **TEXT BOOKS**

1.Tilman M.Davies,“THE BOOK OF R- A FIRST PROGRAMMING AND STATISTICS” Library of Congress Cataloging-in-Publication Data,2016.

## **REFERENCE BOOKS**

1. Roger D.Peng,“R Programming for Data Science” Lean Publishing,2016.
2. Hadley Wickham, Garrett Grolemond,“ R for Data Science”,OREILLYPublication,2017
3. Steven Keller, “R Programming for Beginners”, Create Space Independent

Publishing Platform 2016.

4. Kun Ren, "Learning R Programming", Packt Publishing, 2016

E – BOOKS 1. [https://web.itu.edu.tr/~tokerem/The\\_Book\\_of\\_R.pdf](https://web.itu.edu.tr/~tokerem/The_Book_of_R.pdf)

## MOOCs

1. <https://online-learning.harvard.edu/subject/>
2. <https://www.udemy.com/course/r-basics/>
3. <https://www.datacamp.com/courses/free-introduction-to-r>

**Course Code: PDIPAI-554 Course Title: AI and ML Tools - Open AI, Chat GPT, Chat Bot, Generative AI**  
**Credits: 3 LTP: 3- 0– 0**

### Course Objectives:

Generative AI to embark on a transformative learning journey, engage with leading experts in the field, and become a proficient practitioner in the exciting realm of generative artificial intelligence and tools.

### Course Outcomes:

By the end of the syllabus, students will have gained a comprehensive understanding of generative AI principles and techniques, obtained hands-on experience through practical exercises and projects, and developed the ability to apply generative AI in real-world scenarios.

### UNIT I

Introduction to Generative AI Definition and scope of Generative AI, Overview of generative models and their applications Importance of Generative AI in various domains Brief discussion on ethical Considerations and challenges. Language Models and LLM Architectures: Introduction To language models and their role in AI, Traditional approaches to language modeling, Deep learning-based language models and their advantages Overview of popular LLM Architectures: rnns, lstms, and Transformers.

### UNIT II

Introduction to GPT and its significance, Pre-training and fine-tuning processes in GPT, Architecture and working of GPT models, Overview of GPT variants and their use cases, ChatGPT: A Practical Application of GPT, Introduction to ChatGPT and its purpose Training data and techniques for ChatGPT, Handling user queries and generating responses, Tips for improving ChatGPT's performance.

### UNIT III

Introduction to LangChain and its objectives, Overview of the LangChain framework and its components, streamlining application development using LangChain, Examples of applications built with LangChain

### UNIT IV

Understanding the concept and significance of prompt engineering, Strategies for designing effective prompts, Techniques for controlling model behavior and output, quality best practices for prompt engineering in generative AI.

### UNIT V

Understanding the ethical implications of generative models, addressing bias and fairness in generative AI

systems, ensuring responsible use and deployment of generative models, Use Cases of Generative AI: Overview of various domains and industries benefiting from Generative AI, use cases in natural language processing, content, generation, and creative applications, Case studies highlighting successful implementations Potential future applications and emerging trends. Hands-on Exercise and Q&A students engage in a practical exercise using GPT or ChatGPT Guided step-by-step exercise on prompt engineering and customization.

#### Text/Reference Books:

- [ 1] Generative AI Art: A Beginner's Guide to 10x Your Output with Killer Text Prompts (Midjourney, DALL-E 2, Craiyon) by Oliver Theobald, Publisher: Scatterplot Press , ISBN-10: B0BNWJGS7G
- [ 2] Modern Generative AI with ChatGPT and OpenAI Models, Author(s): Valentina Alto, Publisher: Packt Publishing Pvt. Ltd., Year: 2023, ISBN: 9781805123330

#### Reference:

- [1] L. R. Varshney, F. Pinel, K. R. Varshney, D. Bhattacharjya, A. Schoergendorfer, and Y.-M. Chee, "A Big Data Approach to Computational Creativity: The Curious Case of Chef Watson," IBM Journal of Research and Development, vol. 63, no. 1, pp. 7:1-7:18, Jan./Feb. 2019.
- [2] X. Ge, R. T. Goodwin, J. R. Gregory, R. E. Kirchain, J. Maria, and L. R. Varshney, "Accelerated Discovery of Sustainable Building Materials," in Proceedings of the AAAI Spring Symposium, March 2019.
- [3] A. Papoulis and S. U. Pillai, Probability, Random Variables, and Stochastic Processes, McGraw-Hill, 2002.
- [4] B. Hajek, Probability with Engineering Applications, ECE 313 Course Notes, Aug. 2021.
- [5] A. Orlitsky, N. P. Santhanam, and J. Zhang, "Always Good Turing: Asymptotically Optimal Probability Estimation," Science, vol. 302, no. 5644, pp. 427-431, Oct. 2003.
- [6] I. J. Good, "The Population Frequencies of Species and the Estimation of Population Parameters," Biometrika, vol. 40, no. 3/4, pp. 237-264, Dec. 1953.
- [7] D. P. Kingma and M. Welling, "An Introduction to Variational Autoencoders," Foundations and Trends in Machine Learning, vol. 12, no. 4, pp. 307-392, 2019.
- [8] S. Zhao, J. Song, and S. Ermon, "InfoVAE: Balancing Learning and Inference in Variational Autoencoders," in Proceedings of the AAAI Conference on Artificial Intelligence, pp. 5885-5892, 2019.
- [9] A. van den Oord, O. Vinyals, and K. Kavukcuoglu, "Neural Discrete Representation Learning," in Proceedings of the 30th Conference on Neural Information Processing Systems, Dec. 2017.
- [10] L. Reynolds and K. McDonell, "Prompt Programming for Large Language Models: Beyond the Few-Shot Paradigm," in Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems, May 2021.
- [11] B. Lester, R. Al-Rfou, and N. Constant, "The Power of Scale for Parameter-Efficient Prompt Tuning," in Proceedings of the 2021 Conference on Empirical Methods in Natural Language Processing, pp. 3045-3059, Nov. 2021.
- [12] S. Basu, G. S. Ramachandran, N. S. Keskar, and L. R. Varshney, "Mirostat: A Neural Text Decoding Algorithm That Directly Controls Perplexity," in Proceedings of the 9th International Conference on Learning Representations (ICLR), May 2021.

#### MOOCS:

- [ 1.] <https://www.coursera.org/learn/generative-ai-with-llms#about>
- [ 2.] <https://www.coursera.org/learn/prompt-engineering>
- [ 3.] <https://openai.com/blog/chatgpt>

**PDIPAI-555**  
**Credits: 3**

**Course Title: Mini Project Using AI and ML**  
**LTP: 0- 0– 6**

**Course Code: PDIPAI-556**  
**Credits: 2**

**Course Title: Cyber Security**  
**LTP: 2- 0– 0**

### **Course Objectives:**

The exposure of the students to Cyber Security program at Graduate level should lead to the following:

- (a) Learn the foundations of Cyber security and threat landscape.
- (b) To equip students with the technical knowledge and skills needed to protect and defend against cyber threats.
- (c) To develop skills in students that can help them plan, implement, and monitor cyber security mechanisms to ensure the protection of information technology assets.
- (d) To expose students to governance, regulatory, legal, economic, environmental, social and ethical contexts of cyber security.
- (e) To expose students to responsible use of online social media networks.
- (f) To systematically educate the necessity to understand the impact of cyber crimes and threats with solutions in a global and societal context.
- (g) To select suitable ethical principles and commit to professional responsibilities and human values and contribute value and wealth for the benefit of the society.

### **Course Outcomes:**

- (a) Understand the cyber security threat landscape.
- (b) Develop a deeper understanding and familiarity with various types of cyber attacks, cyber crimes, vulnerabilities and remedies thereto.
- (c) Analyse and evaluate existing legal framework and laws on cyber security.
- (d) Analyse and evaluate the digital payment system security and remedial measures against digital payment frauds.
- (e) Analyse and evaluate the importance of personal data its privacy and security.
- (f) Analyse and evaluate the security aspects of social media platforms and ethical aspects associated with use of social media.
- (g) Analyse and evaluate the cyber security risks.
- (h) Based on the Risk assessment, plan suitable security controls, audit and compliance.
- (i) Evaluate and communicate the human role in security systems with an emphasis on ethics, social engineering vulnerabilities and training.
- (j) Increase awareness about cyber-attack vectors and safety against cyber-frauds.
- (k) Take measures for self-cyber-protection as well as societal cyber-protection.

### **UNIT I**

Introduction to Cyber security-Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.

### **UNIT II**

Cyber crime and Cyber law- Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi, Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organizations dealing with Cyber crime and Cyber security in India, Case studies.

### **UNIT III**

Social Media Overview and Security- Introduction to Social networks, Types of Social media, Social media platforms, Social media monitoring, Hash tag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.

### **UNIT IV**

E-Commerce and Digital Payments- Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorized banking transactions. Relevant provisions of Payment Settlement Act, 2007.

### **UNIT V**

Digital Devices Security, Tools and Technologies for Cyber Security- End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Anti-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.

### **References**

1. Cyber Crime Impact in the New Millennium, by R. C Mishra ,Auther Press. Edition 2010.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. (Pearson, 13<sup>th</sup> November, 2001)
4. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd.
5. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers.
6. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd.
7. Fundamentals of Network Security by E. Maiwald, McGraw Hill.