(Annex-2)

MADHYA PRADESH BHOJ (OPEN) UNIVERSITY,
Raja Bhoj Marg Kolar Road, BHOPAL (M.P.)

PG DIPLOMA IN
ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

MADHYA PRADESH BHOJ (OPEN) UNIVERSITY,
Raja Bhoj Marg Kolar Road, BHOPAL (M.P.)

S. No.	Name of Subject	Assignment		Theory		Total Marks	
		Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks
1	FUNDAMENTALS OF ARTIFICIALINTELLIGENCE	30	12	70	28	100	40
2	RELATIONAL DATABASE MANAGEMENT SYSTEM (RDBMS)	30	12	70	28	100	40
3	R PROGRAMMING	30	12	70	28	100	40
4	R PROGRAMMING LAB					100	40

Second Year

S. No.	Name of Subject	Assignment		Theory		Total Marks	
		Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks
1	FUNDAMENTALS OF MACHINE LEARNING	30	12	70	28	100	40
2	PRINCIPLES OF SOFT COMPUTING	30	12	70	28	100	40
3	PYTHON PROGRAMMING	30	12	70	28	100	40
4	MACHINE LEARNING USING PYTHON LAB					100	40

Detailed Syllabi
1st Year

Title of the Course	Credits
FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE	6

Unit 1:

AI - Problems and Search: Introduction: The Artificial Intelligence (AI) Problem – What is an AI technique - Criteria for success. Problems, Problem Spaces, Search: Defining Problems, Problem Spaces, Search State space search - Production Systems – Problem characteristics - Production system characteristics – Application areas.

Unit 2 :

Heuristic Search techniques: Generate and Test - Hill Climbing- Best-First search – Problem reduction – constraint satisfaction - Means-end analysis.

Unit 3:

AI - Knowledge Representation: Knowledge representation issues: Representations and mappings -Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem.

Unit 4 :

Using Predicate logic: Representing simple facts in logic – Representing Instance and ISA relationships - Computable functions and predicates -Resolution. Representing knowledge using rules: Procedural Vs Declarative knowledge –Logic programming - Forward Vs Backward reasoning - Matching – Control knowledge.

Unit 5 :

AI –Learning : What is learning – Rote learning - Learning by taking advice – learning in problem solving.

Unit 6 :

Learning from examples: Induction - Explanation-based learning – discovery – analogy – formal learning theory – Neural Net Learning and Genetic Learning.

Reference and text books:

1. Dan W. Patterson, "*Introduction to AI and ES*", Pearson Education.
2. Dheeraj Mehrotra(2019), *Basics of Artificial Intelligence & Machine Learning*, Notion Press.
3. Elaine Rich and Kevin Knight(1991)," *Artificial Intelligence*", Second Edition,Tata McGraw Hill, Publishers company Pvt Ltd.
4. Kevin Night, Elaine Rich, Nair B.(2008), "*Artificial Intelligence (SIE)*",McGraw Hill.
5. Stuart Russel, Peter Norvig (2007), "*AI – A Modern Approach*", 2nd Edition, Pearson Education.
6. Venugopal C.K(2019), *Artificial Intelligence and Machine Learning*, Pacific Books International.

Title of the Course	Credits
RELATIONAL DATABASE MANAGEMENT SYSTEM (RDBMS)	**6**

Unit 1 :

Data base System Applications, data base System VS file System – View of Data – Data Abstraction –Instances and Schemas – data Models – the ER Model - Relational Model – Other Models – Database Languages – DDL – DML – database Access for applications Programs – data base Users and Administrator – Transaction Management – data base System Structure – Storage Manager – the Query Processor.

\Unit 2

History of Data base Systems - Data base design and ER diagrams – Beyond ER Design Entities, Attributes and Entity sets – Relationships and Relationship sets – Additional features of ER Model – Concept Design with the ER Model – Conceptual Design for Large enterprises.

Unit 3 :

Relational Model: Introduction– Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data – Logical data base Design – Introduction to Views – Destroying / altering Tables and Views.

Unit 4 :

Relational Algebra – Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews - Relational calculus – Tuple relational Calculus – Domain

relational calculus – Expressive Power of Algebra and calculus.

Unit 5 :

Form of Basic SQL Query – Examples of Basic SQL Queries – Introduction to Nested Queries – Correlated Nested Queries Set – Comparison Operators – Aggregative Operators – NULL values – Logical connectivity's – AND, OR and NOT – Impact on SQL Constructs – joins- Outer Joins – Disallowing NULL values – Complex Integrity Constraints in SQL Triggers and Active Data bases. Schema refinement.

Unit 6 :
Normal forms:Problems Caused by redundancy – Decompositions – Problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF.

Reference and text Books:

1. Colin Ritchie (2004), *Relational Database Principles*,3rdEdition, Cengage Learning Business Press.
2. ElmasriNavrate ,*Fundamentals of Database Systems*, Pearson Education.
3. Peter Rob & Carlos Coronel, *Data base Systems design, Implementation, and Management*, 7th Edition.
4. Raghurama Krishnan, Johannes Gehrke(2003), Data base Management Systems, 3rd Edition, TATA McGrawHill.
5. Silberschatz, Korth(2011), Data Base System Concepts, 6th Edition, Tata McGraw Hill.
6. Sharad Maheswari and RuchinJain(2006), *Database management systems Complete Practical Approach*, Firewall media.

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Title of the Course	Credits
R PROGRAMMING	6

ourse objectives

- This course aims to provide a knowledge about R programming language.
- Student will learn how to use R for effective data analysis.
- By the end of the day-long course, the user will be comfortable operating in the R environment, including importing external data, manipulating data for specific needs, and running summary statistics, machine learning algorithms and visualizations.
- This course helps participants to have a good understanding of the methods, methodologies and techniques from the basics of statistics to obtain supporting evidence through data

Course outcome

By the end of this course, you should be able to:

- Download and install R
- Navigate and optimise the R integrated development environment (IDE) R Studio
- Install and load add-in packages
- Import external data into R for data processing and statistical analysis
- Learn the main R data structures
- Compute basic summary statistics
- produce data visualizations

Unit 1

Introduction to R – History of R - Features of R - Essentials of the R language – R-Environment setup – Basic syntax: command prompt, script file, comments. Data types - Variables – assigning, finding, deleting variables- operators: operator types – arithmetic operator – logical operators -assignment operators – logical operators -expressions.

Unit 2

Control statements – Decision making- if – if-else – nested if - switch– loops – repeat- while – for – loop control statements - break – next statement. Functions: function definition - function components –built-in functions – user defined function - calling function - Recursion - Strings: Rules of strings - string manipulation.

Unit 3

Objects in R: Vectors – Vector creation – Vector Manipulation – Lists: Creating a list,

naming, accessing, manipulating list elements- merge list -converting list to Vector – Arrays- Names columns and rows – Accessing array elements, manipulating array elements – operations of array elements.

Unit 4

Matrices – Accessing elements of Matrix – operations on matrix– Factors – Frames – Create data frames - getting the structure of data frame- Extract data from data frame. Packages – available R packages - install a new package – load package to library - Data reshaping – joining columns and rows in a data frame- merging dt frames – melting and casting

Unit 5

Working with files: CSV file – input CSV, read CSV, analyzing CSV, writing into CSV, Excel file: install, load, input, read excel files - Binary files: reading and writing – XML files: input and read XML files. mySQL package – connection R with mySQL – querying the table – table manipulation: create, insert, drop and update.

Unit 6

Visualizing: R charts and Graphs: R Pie charts: Pie chart title, color- slice percentages and chart legend – 3D Pie chart - Bar charts – Histograms – Line graphs – Scatter plots – creating scatterplot – scatterplot matrices.

Reference and text books:

1. Andrie de Vries, Joris Meys(2016), *R Programming for Dummies*, 2nd edition, Wiley.
2. Brett Lantz(2013), *Machine Learning with R*, Packt Publishing Ltd.
3. Mark Gardener(2013), *Beginning R The Statistical Programming Language*, Kindle edition.
4. Rajendra B. Patil,HirenDand& Rupali Dahake(2017), *A practical Approach to R*,Shroff/X-Team; First edition.
5. Scott Burger(2018), *Introduction to Machine Learning with R: Rigorous Mathematical Analysis*, Shroff/O'Reilly.
6. *UCI Machine Learning Repository* :http://archive.ics.uci.edu/ml/index.php

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Title of the Course	Credits
R Programming LAB	6

Experiments based on R Programming

- Simple R Programs
- Programs using conditional control statements
- Programs using functions and recursion.
- Problems based on Vectors, List, Arrays, Matrices, Factors and Frames.
- Experiments using packages.
- Problems using files and database.
- Experiments using charts and graphs.
- Experiments to perform statistics(mean, mode, median, normal distribution, binomial distribution) in R.
- Experiments for forecasting numeric data: Regression Methods.
- Experiments for data Visualizations.

Reference books:

- Andrie de Vries, Joris Meys(2016), *R Programming for Dummies*, 2nd edition, Wiley.
- Brett Lantz(2013), *Machine Learning with R*, Packt Publishing Ltd.
- Mark Gardener(2013), *Beginning R The Statistical Programming Language*, Kindle edition.
- Rajendra B. Patil,HirenDand& Rupali Dahake(2017), *A practical Approach to R*,Shroff/X-Team; First edition.
- Scott Burger(2018), *Introduction to Machine Learning with R: Rigorous Mathematical Analysis*, Shroff/O'Reilly.
- *UCI Machine Learning Repository* :http://archive.ics.uci.edu/ml/index.php

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Second Year

Title of the Course	Credits
FUNDAMENTALS OF MACHINE LEARNING	6

Course Objectives:

- To discover patterns in your data and then make predictions based on often complex patterns to answer business questions, detect and analyze trends and help solve problems.
- To introduce students to the state-of-the-art concepts and techniques of Machine Learning.

Course Outcome:

By the end of this course, you should be able to:

- Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc. ...
- Be able to design and implement various machine learning algorithms in a range of real-world applications.
- be capable of confidently applying common Machine Learning algorithms in practice and implementing their own.
- be capable of performing experiments in Machine Learning using real-world data.

Unit 1

Introduction: Basic definitions – Learning - Machine Learning vs AI - Machine Learning – features – samples – labels - Real-world applications and problems – hypothesis test - approaches of machine learning model - Data preprocessing.

Unit 2:

Representation of formal ML model: The statistical learning framework – training - testing – validation - cross validation - parametric and non parametric methods - Difference between Parametric and Non-Parametric Methods and examples.

Unit 3

Supervised learning Algorithms: Introduction – Approaches for classification – Decision Tree classification algorithm – Tree pruning - Rule based Classification –IF-THEN rules classification - Naïve Bayesian classification - Neural Network classification -Classification by Backpropagation algorithm. Support Vector Machines (SVM) - Lazy learners: k-Nearest Neighbor (k-NN) Algorithm – Case Based Reasoning (CBR) - Random Forest algorithm.

Unit 4

Unsupervised learning algorithms: Introduction– Defining Unsupervised learning – Cluster Analysis – Distance measures - Types of Clustering – Partition algorithms of clustering – Hierarchical clustering algorithms - Density based methods.

Unit 5

Reinforcement Learning and ELM: Introduction: Markov Decision process - Monte Carlo Prediction - case studies – Applications. Introduction to Extreme Learning Machine (ELM) - Software Tools: Introduction to Weka, Matlab, Rapidminer, tensorflow and keras –case studies.

Unit 6

Deep learning fundamentals: Introduction –Deep Belief Networks (DBN), A Restricted Boltzmann machine (RBM) - Recurrent Neural Networks (RNN) - Time series forecasting. Convolutional Neural Networks (CNN) - Auto-encoders: Auto-encoders and unsupervised learning - Regularization - Dropout and Batch normalization.

Reference and text Books.

1. Anuradha Srinivasaraghavan, Vincy Joseph (2019),*Machine Learning*, Wiley.
2. BalasKausikNatarajan(1991), "*Machine Learning: A Theoretical Approach*", Morgan Kaufmann
3. Dinesh Kumar U ManaranjanPradhan(2019), *Machine learning using Python*, Wiley.
4. EthamAlpaydin(2015), *Introduction to Machine Learning*, third edition, PHI Learning Pvt. Ltd.
5. Jiawei Han, Micheline Kamber, Jian Pei(2012), *Data mining concepts and techniques*, Morgan Kaufmann Publishers, Elsevier.
6. Lovelyn Rose S, Dr. L Ashok Kumar, Dr. D KarthikaRenuka(2019), *Deep Learning Using Python*,Wiley,
7. Rajiv Chopra(2018), *Deep Learning - A Practical Approach*, Khanna Books 2018.
8. Shai Shalev-Shwartz and Shai Ben-David(2014), *Understanding machine learning from theory to algorithms*,Cambridge university press.
9. UCI Machine Learning Repository :http://archive.ics.uci.edu/ml/index.php

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Title of the Course	Credits
PRINCIPLES OF SOFT COMPUTING	6

Course Objective:

- To learn the key aspects of Soft computing.
- To know about the components and building block hypothesis of Genetic algorithm.
- To study the fuzzy logic components.

Course Outcome:

- Write Genetic Algorithm to solve the optimization problem
- Understand fuzzy concepts and develop a Fuzzy expert system to derive decisions.

Unit 1

Introduction: Soft Computing Constituents – Soft Computing Vs Hard Computing – Characteristics – Applications - Artificial Neural Network (ANN): Fundamental Concept – Application Scope - Basic Terminologies – Neural Network Architecture – Learning Process.

Unit 2

Perceptron Network – Adaline and Madaline Networks – Back Propagation Network - Radial Basis Function Network. Associative Memory Networks – BAM - Hopfield Network - Boltzmann Machine.

Unit 3

Unsupervised Learning Networks: Kohonen Self Organizing Network – Counter Propagation Network – ART Network.

Unit 4

Fuzzy Sets: Basic Concept – Crisp Set Vs Fuzzy Set - Operations on Fuzzy Set – Properties of Fuzzy Sets. Fuzzy Relations: Concept – Fuzzy Composition – Fuzzy Equivalence and Tolerance Relation. Membership Functions: Features – Fuzzification – Methods of Membership value assignments – Defuzzification – Methods

Unit 5

Fuzzy Arithmetic – Extension Principle – Fuzzy Measures - Fuzzy Rules and Fuzzy Reasoning: Fuzzy Propositions – Formation of Rules – Decomposition of Rules – Aggregation of Rules – Approximate Reasoning - Fuzzy Inference and Expert Systems – Fuzzy Decision Making – Fuzzy Logic Control Systems.

Unit 6

Genetic Algorithm: Fundamental Concept – Basic Terminologies – Traditional Vs Genetic Algorithm - Elements of GA - Encoding - Fitness Function - Genetic Operators– Classification of Genetic Algorithm – Applications of GA.

Reference and Text Books:

1. Goldberg David E.(2003), "*Genetic Algorithms*", Pearson Education.
2. Haykin Simon (1999) , "*Neural Networks*", Prentice Hall, 1993/Pearson Education.
3. JangJ.S.R., C.T. Sun, E. Mizutani(2004), "*Neuro-Fuzzy and Soft Computing*", Prentice Hall India.
4. Kumar Satish, "*Neural Networks: Classroom Approach*", Tata McGraw Hill.
5. Koza J. (1993), "*Genetic Programming*", MIT Press.
6. KecmanVojislav(2001), "*Learning and Soft Computing*", MIT Press.
7. Konar Amit (2008), "*Artificial Intelligence and Soft Computing – Behavioural and CognitiveModeling of the Human Brain*", Special Indian Edition, CRC Press.
8. Rajasekaran S (2004), G.A.V. Pai, "*Neural Networks, Fuzzy Logic, Genetic Algorithms*", Prentice Hall India, 2004.
9. Rajase, Kharan S. and VijayalakshmiPai S. A.(2003), "*Neural Networks, Fuzzy Logic & Genetic Algorithms*", Prentice-Hall of India
10. Sivanandam, "*Introduction to Neural Networks with MATLAB 6.0*", Tata McGraw Hill Publications.
11. Sivanandam S.N, S.N. Deepa (2007), "*Principles of Soft Computing*", Wiley India.
12. Yen John and Langari Reza (2003), "*Fuzzy Logic, Intelligence, Control, and Information*", Pearson Education.

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Title of the Course	Credits
PYTHON PROGRAMMING	6

Course Objectives:

The learning objectives of this course are;

- To understand why Python is a useful scripting language for developers.
- To learn how to design and program Python applications.
- To learn how to use lists, tuples, and dictionaries in Python programs.
- To learn how to identify Python object types.
- To define the structure and components of a Python program.
- 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.

Course Requirements:

- Before studying this course, the student has knowledge about basic principles of programming
- Experience with a high-level language (C/C++, Java, MATLAB) is suggested. Prior knowledge of a scripting language (Perl, UNIX/Linux shells) and Object-Oriented concepts is helpful but not mandatory.

Course Outcome:

After the completion of this course, the student will able to;

- To write programs using structures, strings, arrays, pointers and strings for solving complex computational problem.
- Use if-else statements and switch-case statements to write programs in Python to tackle any decision-making scenario
- Master Object-oriented programming to create an entire Python project using objects and classes
- Store and retrieve information using variables
- Develop cost-effective robust applications using the latest Python trends and technologies

Unit I

Introduction – Overview of programming languages - History of Python – Installing Python – Executing Python programs – Comments - Python Character set – token core datatypes – printf()

function – Assigning value to variables – input() – eval() – formatting Number and strings – Inbuilt functions - Operators and Expressions.

Unit 2

Decision Statements: Introduction - if , if-else , nested if statements – multi-way if-elif statements. Loop Control Statements: Introduction – while loop – range() function – for loop = nested loops – break and continue statements.

Unit 3

Functions: Introduction – Syntax and basics of function – use of function – parameters and arguments in function – local and global variables – return statement. Strings: Introduction – The str class – built in functions for string – index[] operator - traversing string – immutable strings – string operators – string operations.

Unit 4

Lists : Introduction – creating lists – accessing the elements of a list – negative list indices – list slicing – built-in functions for list – list operator – list methods – passing list to a function – returning list from function.Introduction to tuples - creating – tuple() function – built-in functions for tuples - indexing -slicing – operators – list and tuples – sorting -traversing.

Unit 5

Introduction to tuples - creating – tuple() function – built-in functions for tuples - indexing -slicing – operators – list and tuples – sorting -traversing. Sets – creating – set in and not in operator – set classes - operations. Dictionaries: Introduction – creating, adding, replacing, retrieving values – formatting – deletion of items – comparing dictionaries – methods of dictionary class – nested dictionaries - traversing dictionaries

Unit 6

File Handling: Introduction – Need for file handling – Text input and output using file – seek() function. Introduction to Scientific computing with Scipy, Mathematical computing with Numpy, Scikit learn, Data visualization using Matplotlib, Data manipulation with pandas and sympy – Case studies.

Reference and text books:

1. Ashok NamdevKamthane(2018), Amit Ashok Kamthane, *Programming and Problem solving with Python*, Mc GrawHill Education.
2. Dinesh Kumar UManaranjanPradhan(2019), *Machine learning using Python*, Wiley
3. Manisha Bharambe(2019), *Python programming*, NiraliPrakashan.

4. Robert Sedgewick,Kevinwayne , Roberdondero(2016), *Introduction to Programming in Python: An Interdisciplinary Approach*, 1e , Pearson.
5. Wesley J. Chun(2009), "*Core Python Programming*", 2nd Edition, Prentice Hall.

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Title of the Course	Credits
MACHINE LEARNING USING PYTHON LAB	6

Course Objectives:

The learning objectives of this course are:

- To understand why Python is a useful scripting language for developers.
- To learn how to design and program Python applications.
- To learn how to use lists, tuples, and dictionaries in Python programs.
- To learn how to identify Python object types.
- To learn how to use indexing and slicing to access data in Python programs.
- To define the structure and components of a Python program.
- 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.

Course Requirements:

- Before studying this course, the student has knowledge about basic principles of programming.
- Experience with a high-level language (C/C++, Java, MATLAB) is suggested. Prior knowledge of a scripting language (Perl, UNIX/Linux shells) and Object-Oriented concepts is helpful but not mandatory.

Course Outcome:

After the completion of this course, the student will able to;

- To write programs using structures, strings, arrays, pointers and strings for solving complex computational problem.
- Use if-else statements and switch-case statements to write programs in Python to tackle any decision-making scenario.
- Master Object-oriented programming to create an entire Python project using objects and classes.
- Store and retrieve information using variables.
- Develop cost-effective robust applications using the latest Python trends and technologies.
- Write program to solve real-world machine learning problems.

Lab Experiments based on Python programming and machine learning problems.

Simple Python programs.
Experiments using decision control statements.
Exercises using functions and recursion.
Exercises using arrays and strings.
Experiments using list processing.
Object oriented Programming Lab Problems using Python.
Experiments using Tuples, sets and dictionaries.
Programs using file handling.
Programs using graphics programming.
Experiments for data visualization using Matplotlib.
Scientific computing with Scipy.
Data manipulation with pandas and sympy.
Mathematical computing with Numpy.
Programs to perform Supervised learning algorithms (k-NN algorithm.)
Programs to perform Unsupervised learning algorithms (k-means clustering.).

Reference Books:

1. Ashok NamdevKamthane(2018), Amit Ashok Kamthane, *Programming and Problem solving with Python*, Mc GrawHill Education.
2. Dinesh Kumar UManaranjanPradhan(2019), *Machine learning using Python*, Wiley
3. Manisha Bharambe(2019), *Python programming*, NiraliPrakashan.
4. Robert Sedgewick,Kevinwayne , Roberdondero(2016), *Introduction to Programming in Python: An Interdisciplinary Approach*, 1e , Pearson.
5. Wesley J. Chun(2009), "*Core Python Programming*", 2nd Edition, Prentice Hall.

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