B.Sc., Artificial Intelligence

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BAIA1	**DIGITAL LOGIC FUNDAMENTALS**	Elective	3	-	-	-	3	3	25	75	100

Course Objectives

1. To introduce the fundamentals of number systems and Digital logic.
2. To understand Boolean algebra, conversions and Binary arithmetic operations.
3. To get exposure to combinational logic circuits.
4. To understand the concept of sequential logic and flipflops
5. To study the design of counters and understand the memory types.

	Details
UNIT I	**NUMBER SYSTEMS AND DIGITAL LOGIC** Number Systems and Codes: Number System – Base Conversion – Binary Codes – Code Conversion. Digital Logic: Logic Gates – Truth Tables – Universal Gates.
UNIT II	**BOOLEAN ALGEBRA** Boolean Algebra: Laws and Theorems – SOP, POS Methods – Simplification of Boolean Functions – Using Theorems, K-Map, Prime – Implicant Method – Binary Arithmetic: Binary Addition – Subtraction – Various Representations of Binary Numbers – Arithmetic Building Blocks – Adder – Subtractor.
UNIT III	**COMBINATIONAL LOGIC** Combinational Logic: Multiplexers – Demultiplexers – Decoders – Encoders – Code Converters – Parity Generators and Checkers.
UNIT IV	**SEQUENTIAL LOGIC** Sequential Logic: RS, JK, D, and T Flip-Flops – Master-Slave Flip-Flops. Registers: Shift Registers – Types of Shift Registers.
UNIT V	**COUNTERS AND MEMORY** Counters: Asynchronous and Synchronous Counters - Ripple, Mod, Up-Down Counters– Ring Counters. Memory: Basic Terms and Ideas –Types of ROMs – Types of RAMs.

Textbooks

1. D.P.Leach and A.P.Malvino, Digital Principles and Applications – TMH – Fifth Edition – 2002.

Reference Books

1. V.Rajaraman and T.Radhakrishnan, Digital Computer Design, Prentice Hall of India, 2001
2. M. Moris Mano, Digital Logic and Computer Design, PHI, 2001.
3. T.C.Bartee, Digital Computer Fundamentals, 6th Edition, Tata McGraw Hill, 1991.

Course Outcomes

1. Identify the logic gates and their functionality.
2. Perform number conversions from one system to another system.
3. Understand the functions of combinational circuits.
4. Perform number conversions.
5. Perform Counter design and learn its operations.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	S	M	M	S
CO2	S	S	S	M	S	S	M	S	S	S
CO3	S	S	S	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

PO – Programme Outcome, CO – Course outcome
S – Strong, M – Medium, L – Low

CC		Allied	L	T	P	C	H/W
Course code:	**23BAIAP1**	**DIGITAL ELECTRONICS LAB**	**2**	**-**	**-**	**2**	**2**

Objectives	● To Understand the Digital Electronics Practically ● To know how to solve gates and other functions.

1. AND, OR and NOT Gate using Truth Table
2. Universality of NAND & NOR gates.
3. Verification of Boolean laws using NAND gates (Associative, Commutative & Distributive Laws)
4. Verification of Boolean laws using NOR gates (Associative, Commutative & Distributive Laws)
5. Sum of Products using NAND gates and Product of Sums using NOR Gates.
6. 4-bit binary parallel adder and Subtractor IC 7483
7. Counter using IC 7473
8. Study of RS, D, T and JK Flip-Flops with IC's.
9. Study of Encoder & Decoder.
10. Study of Multiplexer & De-Multiplexer.
11. Half and Full Adder using Simple & NAND Gates.
12. Half and Full Subtractor using Simple & NAND Gates.

Outcomes	● Students were able to solve simple gate functions. ● Students were able to solve and Design circuits using IC.

Allied		THEORY – 2A	L	T	P	C	H/W
Course code:	23BAIA2	DATA SCIENCE AND ANALYTICS	3	-	-	3	3

Objectives	• Prepare professionals conversant with current and advanced technological tools to carry out Investigation, analysis and synthesis by identifying various computer oriented solutions. • To develop positive attitude and skills which enable them to become a multi facet personality. • To make them aware of effective machine learning and Artificial Intelligence based data analytics and inference required for Industrial Application
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.
Unit II	Data Collection and Data Pre-Processing Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.
Unit III	Exploratory Data Analytics Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map – Correlation Statistics – ANOVA.
Unit IV	Model Development Simple and Multiple Regression – Model Evaluation using Visualization – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Measures for In-sample Evaluation – Prediction and Decision Making.
Unit V	Model Evaluation Generalization Error – Out-of-Sample Evaluation Metrics – Cross Validation – Overfitting – Under Fitting and Model Selection – Prediction by using Ridge Regression – Testing Multiple Parameters by using Grid Search.

Text and Reference Books:

1. Jojo Moolayil, "Smarter Decisions: The Intersection of IoT and Data Science", PACKT, 2016.
2. Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly, 2015.
3. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013
4. Raj, Pethuru, "Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGI Global.

Outcomes	**On Completion of this Course, the students can be able to,** • **Data Science knowledge:** Application of Data Science knowledge in various fields. • **Nature of Data Science:** Understand the concise, precise and rigorous nature of Data Science. • **Critical thinking:** Develop the skill to think critically on abstract concepts of Data Science. • **Problem analysis:** Develop the ability to analyze a problem logically and dissect into micro-parts and thus resolving the problem to accessible components

Allied		PRACTICAL – 2B	L	T	P	C	H/W
Course code:	23BAIAP2	SPSS LAB	-	-	2	2	2

Objectives

- To introduce the basic knowledge of SPSS programming fundamentals.
- To impart writing skill of SPSS programming to the students and solving problems.
- To implement the basic concepts of SPSS

Using SPSS implement the following.

1. Mean, Standard deviation, Variance.
2. Bar diagram, Line diagram, Pie chart and Histogram.
3. Coefficient of correlation.
4. Regression equation of X on Y.
5. Regression equation of Y on X.
6. Application of t-test for one sample problem.
7. Application of t-test for two sample problems.
8. Application of t-test for testing the significance of Correlation Coefficient.
9. One-tailed and Two-tailed tests.
10. Application of analysis of variance.

Text and Reference books:

1. Jesus Salcedo and Keith McCormick, "SPSS Statistics for Data Analysis and Visualization", Wiley, June 2017.
2. K. Kalyanaraman;Hareesh N. Ramanathan;P.N. Harikumar, "Statistical Methods for Research: A Step by Step Approach Using IBM SPSS", Atlantic, January 2021.

Outcomes

After Completing this course, the students are able to:

- Read, understand, and trace the execution of programs written in SPSS.
- Write the SPSS code for a given algorithm.
- Develop the programs to implement the concepts of SPSS.
- Work as a team player and strive for self-excellence.

Allied		THEORY – 3A	L	T	P	C	H/W
Course code:	23BAIA3	R PROGRAMMING	3	-	-	3	3

Objectives	• Understand the basics in R programming in terms of constructs, control statements, string functions • Understand the use of R for Big Data analytics • Appreciate and apply the R programming from a statistical perspective
Unit I	**Introduction :** Introducing to R – R Data Structures – Help Functions in R – Vectors – Scalars – Declarations – Recycling – Common Vector Operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Victoriesed if-then else – Vector Element names.
Unit II	**Matrices :** Creating matrices – Matrix Operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns - Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists
Unit III	**Data Frames :** Creating Data Frames – Matrix-like operations in frames – merging Data frames – Applying functions to Data Frames – Factors and Tables – Factors and levels – Common Functions used with factors – Working with tables – Other factors and table related functions – Control statements – Arithmetic and Boolean operators and values – Default Values for arguments – Returning Boolean Values – Functions are objects – Environment and scope issues – Writing Upstairs – Recursion – Replacement functions – Tools for Composing function code – Math and Simulation in R.
Unit IV	**Classes :** S3 Classes – S4 Classes – Managing your objects – Input/output – accessing keyboard and monitor – reading and writing files – accessing the internet – String Manipulation – Graphics – Creating Graphs – Customizing Graphs – Saving Graphs to files – Creating Three-Dimensional plots.
Unit V	**Interfacing R :** Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear models – Non-linear Models – Time Series and Auto-Correlation – Clustering.

Text Books:

1. Norman Matloff, ―The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, 2011.
2. Jared P. Lander, ―R for Everyone: Advanced Analytics and Graphics, Addison-Wesley Data & Analytics Series, 2013.

Books for Reference:

1. Mark Gardner, ―Beginning R – The Statistical Programming Language‖, Wiley, 2013.
2. Robert Knell, ―Introductory R: A Beginner‘s Guide to Data Visualisation, Statistical Analysis and programming in R‖, Amazon Digital South Asia Services Inc, 2013. Richard Cotton(2013). Learning R, O‘Reilly Media
3. Garret Grolemund (2014). Hands-on Programming with R. O‘Reilly Media, Inc.
4. Roger D.Peng (2018). R Programming for Data Science. Lean Publishing.

Outcomes	After completing this course the student will be able to • Understand the basics in R programming in terms of constructs, control statements, string functions • Understand the use of R for Big Data analytics • Apply the R programming from a statistical perspective

Allied		PRACTICAL – 3B	L	T	P	C	H/W
Course code:	**23BAIAP3**	**R PROGRAMMING LAB**	**-**	**-**	**2**	**2**	**2**

Objectives	• To provide Basic knowledge of R Programming

1. Write a program to Check if a Number is Positive, Negative or Zero.
2. Write a R Program to Make a Simple Calculator.
3. Write a program to find Sum of Natural Numbers Using Recursion.
4. Write a program to find Fibonacci Sequence Using Recursion in R.
5. Write a program to implement R Program for the Factors of a Number.
6. Write a program to Program to Add Two Vectors.
7. Write a function to Find Minimum and Maximum.
8. Write a program to Sort a Vector.
9. Write a R Program to Check for Leap Year.
10. Write a program to multiply two Matrices.

Outcomes	After Completing this course, the students are able to: • Get practical exposure on R • Develop simple programs using R language.

Allied		THEORY – 4A	L	T	P	C	H/W
Course code:	23BAIA4	MACHINE LEARNING BASICS	3	-	-	3	3

Objectives	• To understand the basics of Machine Learning • To acquire knowledge about different Machine Learning algorithms • Able to get knowledge about problem solving using Machine Learning
Unit I	**Introduction**: Machine Learning – Example of Machine Learning Applications. **Supervised Learning**: Learning a class examples, Vapnik – Chervonenkis Dimension, Noise, Learning Multiple Classes, Regression
Unit II	**Decision Tree Learning:** Introduction, The Basic Decision Tree Learning Algorithm, Hypothesis Space search in Decision tree Learning, Inductive bias in decision tree Learning, Issues in decision tree Learning
Unit III	**Neural Networks:** Introduction, Neural network representations, perceptions, Multilayer networks and the Backpropagation Algorithm, Remarks on the Backpropagation Algorithm, Face Recognition
Unit IV	**Clustering**: Introduction, Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Mixtures of Latent Variable Models, Supervised Learning after Clustering, Spectral Clustering, Hierarchical Clustering
Unit V	**Bayesian Learning:** Introduction, Bayes Theorem, Bayes Theorem and Concept Learning, Bayes Optimal Classifier, Naïve Bayes Classifier, Bayesian Belief Networks, The EM Algorithm

Text Book:

1. Mitchell M., T., Machine Learning, McGraw Hill (1997) 1stEdition.
2. Alpaydin E., Introduction to Machine Learning, MIT Press (2014) 3rdEdition

Books for Reference:

1. Bishop M., C., Pattern Recognition and Machine Learning, Springer-Verlag (2011) 2ndEdition.
2. Michie D., Spiegelhalter J. D., Taylor C. C., Campbell, J., Machine Learning, Neural and Statistical Classification. Overseas Press (1994)

Outcomes	• Students will understand the basic concepts of Machine Learning and its foundations. • Students will be able to apply basic principles of Machine Learning in solutions that require problem solving and learning.

Allied		PRACTICAL – 4B	L	T	P	C	H/W
Course code:	**23BAIAP4**	**MACHINE LEARNING LAB**	**-**	**-**	**2**	**2**	**2**

Objectives	• To get the practical exposures of implementation of machine learning algorithms

1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples
2. Implement and demonstrate the FIND-S algorithm for finding the hypothesis based on a given set of training data samples
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm
4. Write a python program to implement K-Means clustering Algorithm
5. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets
6. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file

Outcomes	After Completing this course, the students are able to: • Understand the implementation procedures for the machine learning algorithms. • Design Python programs for various Learning algorithms