ST. JOSEPH'S COLLEGE (AUTONOMOUS)

BENGALURU-27

Re-accredited with **'A++' GRADE with 3.79/4 CGPA** by NAAC
Recognized by UGC as College of Excellence

ST. JOSEPH'S INSTITUTE OF INFORMATION TECHNOLOGY

DEPARTMENT OF ADVANCED COMPUTING

SYLLABUS FOR UNDERGRADUATE PROGRAMME

SUMMARY OF CREDITS IN BCA(Data Analytics)

DEPARTMENT OF ADVANCED COMPUTING (UG)

(2020-2023)

Semester 1	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of Hours of teaching per week**	**Number of credits**	**Continuous Internal Assessment (CIA) Marks**	**End Semester Marks**	**Total marks**
Theory	BCADA 1121	Probability Theory and Exploratory Statistics	60	04	04	30	70	100
Theory	BCADA 1221	Discrete Mathematics in real world I	60	04	04	30	70	100
Theory	BCADA 1321	Basics of programming I	60	04	04	30	70	100
Theory	BCADA 1421	Principles and Practices of Data Science	60	04	04	30	70	100
Practical	BCADA 1P1	Quantitative I Lab	30	02	01	30	70	100
Practical	BCADA 1P2	Data Science I Lab	30	02	01	30	70	100
Practical	BCADA 1P3	Programming Lab	30	02	01	30	70	100
Total Number of credits:			**15**					
Semester 2	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of teaching hrs /week**	**Number of credits**	**Continuous Internal Assessment (CIA) Marks**	**End Semester Marks**	**Total marks**
Theory	BCADA 2121	Probability Distributions and Statistical Analysis	60	04	04	30	70	100
Theory	BCADA 2221	Discrete Mathematics in real world II	60	04	04	30	70	100
Theory	BCADA 2321	Python Programming	60	04	04	30	70	100
Theory	BCADA 2421	Modelling and Estimation in Data Science	60	04	04	30	70	100
Practical	BCADA 2P1	Quantitative II Lab	30	02	01	30	70	100
Practical	BCADA 2P2	Analytics II Lab	30	02	01	30	70	100
Practical	BCADA 2P3	Python Programming Lab	30	02	01	30	70	100
Total Number of credits:			**15**					

Semester 3	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of teaching hrs /week**	**Number of credits**	**Continuous Internal Assessment (CIA) Marks**	**End Semester Marks**	**Total marks**
Theory	BCADA 3121	Multivariate Statistics	60	04	04	30	70	100
Theory	BCADA 3221	Applications of Linear Algebra in various field	60	04	04	30	70	100
Theory	BCADA 3321	DBMS	60	04	04	30	70	100
Theory	BCADA 3421	Data Visualization	60	04	04	30	70	100
Practical	BCADA 3P1	DBMS Lab	30	02	01	30	70	100
Practical	BCADA 3P2	Data Visualization Lab	30	02	01	30	70	100
Practical	BCADA 3P3	Quantitative Lab	30	02	01	30	70	100
Total Number of credits:			**15**					
Semester 4	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of teaching hrs /week**	**Number of credits**	**Continuous Internal Assessment (CIA) Marks**	**End Semester Marks**	**Total marks**
Theory	BCADA 4121	Statistical Forecasting and Inference	60	04	04	30	70	100
Theory	BCADA 4221	Java Programming	60	04	04	30	70	100
Theory	BCADA 4321	Abstract algebra and ordinary differential of higher order	60	04	04	30	70	100
Theory		Open Elective III (Basic Economics)	30	02	00	30	70	100
Theory		Open Elective IV (Accounts)	30	02	00	30	70	100
Practical	BCADA 4P1	Java Lab	30	02	01	30	70	100
Practical	BCADA 4P1	Data Analytics II Lab	30	02	01	30	70	100
Practical	BCADA 4P1	Project Lab	30	02	01	30	70	100
Total Number of credits:			**12**					

Semester 5	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of teaching hrs /week**	**Number of credits**	**Continuous Internal Assessment (CIA) Marks**	**End Semester Marks**	**Total marks**
Theory	BCADA5121	Machine Learning	60	04	04	30	70	100
Theory	BCADA5221	Operations research	60	04	04	30	70	100
Theory	BCADA5321	Operating System	60	04	04	30	70	100
Theory	BCADA5421	Enabling Data Analytics	60	04	04	30	70	100
Theory	BCADA5521	Ethics in business environment	30	02	02	30	70	100
Theory	BCADA5621	Computer Networks	60	04	04	30	70	100
Practical	BCADA5P1	Machine Learning Lab	30	02	01	30	70	100
Practical	BCADA5P2	Hadoop Lab	30	02	01	30	70	100
Practical	BCADA5P3	Unix Lab	30	02	01	30	70	100
Total Number of credits:					**20**			

Semester 6	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of teaching hrs /week**	**Number of credits**	**Continuous Internal Assessment (CIA) Marks**	**End Semester Marks**	**Total marks**
Theory	BCADA6121	Projects/ Internship	300		14	30	70	100
Theory	BCADA6221	Cloud Computing	60	04	04	30	70	100
Theory	BCADADE6321	AI and Deep learning	60	04	04	30	70	100
Theory	BCADADE6421	AI and IoT	60	04	04	30	70	100
Total Number of credits:					**22**			

Course Outcomes and Course Contents

SEMESTER I

Semester	I
Paper Code	**BCADA 1121**
Paper Title	PROBABILITY THEORY AND EXPLORATORY STATISTICS
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVE:

The course aims to equip the students with statistical tools and concepts that help in decision making. The emphasis is on their application in business.

COURSE OUTCOMES:

CO1: To familiarize the students with the concept of Measures of Central Tendency

CO2: To get an insight into the meaning of dispersion or variation, the importance of studying the measures of location and measures of dispersion together.

CO3: To understand the concept of random variable and expectation of a random variable.

CO4: To create an awareness regarding the measurement of uncertainity. This can help gain an understanding of the probability concepts and its utility in data analytics. Probability can be used in analyzing games of chance, genetics, weather prediction, and a myriad of other everyday events.

CO5: Students can use hypothesis testing to understand whether any differences or effects discovered in the study exist in the population.

UNIT I: MEASURES OF CENTRAL TENDENCY **10 Hrs**

Objectives of Averaging, requisites of a measure of Central Tendency, Mathematical Averages : mean, median and mode and quartiles.

UNIT II: MEASURES OF DISPERSION **10 Hrs**

Significance of Measuring Dispersion , different measures of variation :range, variance, standard deviation, mean deviation, quartile deviation, skewness and kurtosis

UNIT III: RANDOM VARIABLES

10 Hrs

Definition of a random variable , discrete and continuous random variables , idea of dependent random variables, expectation and variance of random variables, , covariance and correlation of random variables.

UNIT IV: THEORY OF PROBABILITY **12 Hrs**

Probability concepts , the parallels between sets and events, Axioms of probability, Probability problems using permutations and combinations, The additive law, the idea of independence, Conditional probability,. Bayes Theorem (simple problems . Problems involving conditional probability and dependence)

UNIT V: HYPOTHESIS TESTING **13 Hrs**

Type I error, Type II Error , Steps in hypothesis Testing , parametric test like Z test, t –test, non-parametric statistics : advantages and limitations , the Chi Square Distribution , applications of Chi Square Test Statistic, Mann Whitney U-Test

SELF STUDY **5 Hrs**

TEXT BOOK:

1. Fundamental of Mathematical Statistics , S.C Gupta and V.K Kapoor

SUGGESTED BOOKS :

1. Statistics : David Freedman, Pobert Pisani& Roger Purves, W.W.Norten & Co. 4th Edition 2007.

BLUE PRINT

Code number: BCADA 1121

Title of the paper: PROBABILITY THEORY AND EXPLORATORY STATISTICS

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	12	31
Unit II	12	22
Unit III	16	22
Unit IV	15	35

Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

Semester	I
Paper Code	**BCADA 1221**
Paper Title	MATHEMATICS I
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVE

Introduce concepts of mathematical logic for analyzing propositions, concepts of set theory, relations and functions, concepts of calculus and its applications.

COURSE OUTCOME

CO1: Acquaint the students with mathematical/logical fundamentals including numerical techniques

CO2: Solve problems involving recurrence relations and generating functions.

CO3: Explain the relationship between the derivative and linear approximation.

CO4: Perform integration and other operations for certain types of functions and carry out the computation.

UNIT I: MATHEMATICAL LOGIC **10 Hrs**

Basic Connectives and Truth Tables, Logic Equivalence – The Laws of Logic, Logical Implication – Rules of Inference, Fundamentals of Logic, The Use of Quantifiers, Quantifiers

UNIT II: SET, RELATION AND FUNCTION **10 Hrs**

Sets and Subsets, Set Operations and the Laws of Set Theory, Cartesian Products and Relations, Function:One-to-One, Onto Functions, Function Composition and Inverse Functions, Countable and Uncountable Sets,

UNIT III: DIFFERENTIAL CALCULUS OF ONE VARIABLE 20 Hrs

Basic properties of Functions: Functions and Their Graphs, Shifting and Scaling Graphs, Limits and Continuity: Limit of a functions and Limit laws, One sided Limit continuity, Limits involving infinity, Asymptotes of Graphs, Derivatives - Tangent Lines and derivative at a Point, The derivative as a function, Differentiation rules, The Chain Rule, Implicit Differentiation, Application of Derivatives: Extreme values of a functions on Closed Intervals, The Mean Value Theorem, Monotonic Functions and First Derivative Test, Concavity and Curve Sketching.

UNIT IV: GRAPH THEORY 10 Hrs

Introduction to Graphs: Definition of Graph, Loop, Simple Graph, Graph as Models, Path and Cycle, Complete Graph, Bipartite Graph, Digraph, Tree, Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycle, Shortest path algorithms.

UNIT V: FORMAL LANGUAGES AND FINITE-STATE MACHINES 5 Hrs

Idea about formal languages, finite state machine

SELF STUDY 5 Hrs

TEXT BOOKS :

1. "Thomas's Calculus" Pearson, 14th Edition by Joel Hass, Christopher Heil, Maurice D Weir
2. "Introduction to Graph Theory" PHI Learning Pvt Ltd 2012, by Douglas B West
3. "Introduction to Real Analysis" Sarat Book Distributors, 2018, by S K Mapa

SUGGESTED BOOKS :

1. Discrete Mathematics with Applications By Thomas Koshy
2. Discrete Mathematics with Applications By Susanna S. Epp
3. Higher Engineering Mathematics by B.S.Grewal

BLUE PRINT

Code number: BCADA 1221

Title of the paper: MATHEMATICS I

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	10	21
Unit II	10	21
Unit III	20	32
Unit IV	10	31
Unit V	5	05
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

Semester	I
Paper Code	**BCADA 1321**
Paper Title	BASICS OF PROGRAMMING
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVE

The course is oriented to those who want to learn programming basics with using C programming language as an implementation tool. The major objective is to provide students with understanding of programming essentials, including algorithms, data types, elementary control structures and functions used within the framework of imperative and structural programming paradigms.

COURSE OUTCOMES

CO1: Understanding foundation concepts of information and information processing in computer systems: a matter of information, data representation, coding systems, Algorithm and Flowchart.

CO2: Understanding of a programming language syntax and its definition by example of C language with the knowledge of basic principles of imperative and structural programming.

CO3: To gain insight knowledge of Functions, Arrays, Structures and Unions.

CO4: Learn the basics of pointers and the process of software development lifecycle.

UNIT 1: BASICS OF PROGRAMMING **10 Hrs**

Introduction – The Problem-Solving aspect – Steps in Problem Solving – Types of Problems – Types of Programming Methodologies – Types of Computer Languages – Compiler – Interpreter – How to Write Algorithms – Implementation of Algorithms – Analysis of Algorithms – Flowchart – Pseudocode

UNIT 2: INTRODUCTION TO C LANGUAGE **15 Hrs**

Overview of C – Constants, Variables and Data Types – Operators and Expressions – Managing Input / Output Operations – Formatted I/O – Decision Making - Branching –- IF, Nested IF – Switch – goto - Looping- While, do, for statements.

UNIT 3: ARRAYS, FUNCTIONS, STRUCTURES AND UNIONS **15 Hrs**

Arrays – dynamic and multi-dimensional arrays - Character arrays and Strings – String handling Functions - User defined Functions – Categories of Functions – Recursion - Structures and Unions – Array of Structures – Structures and Functions

UNIT 4: POINTERS, SOFTWARE DEVELOPMENT LIFE CYCLE **15 Hrs**

Pointers – Declaration, Accessing a variable, character strings, pointers to functions and structures - Software Development Life Cycle - Software Development Life Cycle models

SELF STUDY **5 Hrs**

TEXTBOOKS:

1. Harry H. Chaudhary, “C Programming The ultimate way to learn the fundamentals of the C language”, MIT- Createspace Inc. O-D-Publishing, LLC USA.
2. Yashavant P. Kanetkar, “Let us C”, Fifth edition, BPB Publications

REFERENCES:

1. V. Anton Spraul, “Think Like a Programmer – An Introduction to Creative Problem Solving”, no starch press
2. Deitel and Deitel "C How to Program ", Sixth edition, Pearson

Code number: BCADA 1321

Title of the paper: BASICS OF PROGRAMMING

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	10	31
Unit II	10	17
Unit III	20	22
Unit IV	10	35
Unit V	5	05
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

Semester	I
Paper Code	**BCADA 1421**
Paper Title	PRINCIPLES OF DATA SCIENCE
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES

To make the students learn the process of working with data in large scale. Make the student understand the existence of data with its wilderness and make use of it.

COURSE OUTCOMES

CO1: Understand the fundamental concepts of data.

CO2: Understand the fundamental concepts of data science process.

CO3: Understand the fundamental concepts of Machine Learning

CO4: Fundamental concepts of large data & Data Visualization

UNIT 1: PREPARING AND GATHERING DATA AND KNOWLEDGE 10 Hrs.

Philosophies of data science - Data science in a big data world - Benefits and uses of data science and big data - facts of data: Structured data , Unstructured data, Natural Language, Machine generated data, Audio, Image and video streaming data - The Big data Eco system: Distributed file system, Distributed Programming framework, Data Integration frame work, Machine learning Framework, NoSQL Databases, Scheduling tools, Benchmarking Tools, System Deployment, Service programming and Security.

UNIT 2: THE DATA SCIENCE PROCESS 15 Hrs.

Overview of the data science process- Retrieving data –Data Preparation: Cleansing, integrating, and transforming data - Exploratory data analysis – Data Modeling: Model and variable selection, Model execution, Model diagnostic and model comparison - Presentation and automation: Presenting data, Automating data analysis.

UNIT 3: INTRODUCTION TO MACHINE LEARNING 15 Hrs.

Application for machine learning in data science- Tools used in machine learning- Modeling Process – Training model – Validating model – Predicting new observations –Types of machine learning Algorithm : Supervised learning algorithms, Unsupervised learning algorithms, Reinforcement Algorithm.- Semi supervised Learning.

UNIT 4: BIG DATA, GRAPH DATABASES, TEXT ANALYTICS & VISUALIZATION

15 Hrs.

Distributing data storage and processing with frameworks - Case study: Assessing risk when loaning money - Join the NoSQL movement - Introduction to NoSQL - Case Study

Introducing connected data and graph databases - Text mining and text analytics - text mining in real world - text mining techniques - Data visualization options – Filters – Map Reduce – Dashboard development tools.

SELF STUDY 5 Hrs

TEXT BOOKS

1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman and Mohamed Ali, Manning Publications, 2016.
2. Think Like a Data Scientist, Brian Godsey, Manning Publications, 2017.

REFERENCE BOOKS

1. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013.
2. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014
3. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013

Code number: BCADA 1421

Title of the paper: PRINCIPLES OF DATA SCIENCE

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	10	31
Unit II	15	17
Unit III	15	22
Unit IV	15	35
Unit V	5	05
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

SEMESTER II

Semester	II
Paper Code	**BCADA 2121**
Paper Title	PROBABILITY DISTRIBUTIONS AND STATISTICAL ANALYSIS
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES:

The course aims to equip the students with statistical tools and concepts that help in decision making . The emphasis is on their application in business. It aims to make students learn the application of study design and data collection, produce and interpret graphical summaries of data, describe the relation between two quantitative variables and the process of working with data in large scale.

COURSE OUTCOMES:

CO1: To familiarize the students with the concept of Probability distribution and its utility in decision making.

CO2: Calculate and interpret the correlation between two variables. Understand the concept of simple linear regression and its assumptions

CO3: To give an insight into the Analysis of Variance technique which examines a dependence relationship where the response (dependence) variable is metric and the factors are categorical in nature with a number of categories more than two. Students can also learn to forecast the value of a variable whose predicted value is influenced only by its current state, and not by any prior activity.

CO4: The aim is to give a working knowledge of queuing models, a description of the underlying theory and application in real life

UNIT 1: PROBABILITY DISTRIBUTION **20 Hrs**

The idea of a probability distribution: Shapes, area under the curve, Discrete distributions: finite and infinite : Binomial, Hypergeometric distributions, Poisson, Negative Binomial distributions.

Probability distribution function, cumulative distribution function, examples of applications, Continuous distributions, Normal, Standard Normal, Exponential, Chi square, t and F distributions, Central Limit Theorem , Fitting distributions to data, Tests for goodness of fit.

UNIT II: CORRELATION AND REGRESSION ANALYSIS **12 Hrs**

Correlation Analysis, Properties of Correlation Coefficient, Calculation of Coefficient of Correlation in Grouped Data, Rank correlation Coefficient, Merits and Limitations of Rank correlation Method, Regression Analysis for bivariate data.

UNIT III: ANALYSIS OF VARIANCE (ANOVA) AND MARKOV CHAINS THEORY

13 Hrs

Assumptions of Analysis of Variance, Computation of Test Statistic, Analysis of Variance Table, Classification of Analysis of Variance.

Markov Process, State and Transition Probabilities, Characteristic of a Markov Process, State Transition Matrix, Transition Diagram, Construction of a State Transition Matrix, n-step Transition Probabilities, Steady State Conditions , Markov Analysis Algorithm

UNIT IV: QUEUING THEORY **10 Hrs**

Queuing System, Elements of a Queuing System, Operating Characteristics of a Queuing System, Classification of Queuing Models, Model 1(M/M/1):(α/FIFO), Simulation : Process of simulation , Simulation Models, Generation of Random Numbers, Monte Carlo Simulation

SELF STUDY **5 Hrs**

TEXT BOOKS:

1. Fundamental of Mathematical Statistics S.C Gupta and V.K Kapoor
2. Operations Research, Kanti Swarup, P.K Gupta and Man Mohan

SUGGESTED BOOKS :

1. Business Statistics , J.K Sharma, Vikas Publishing House
2. Operations Research: Theory and Applications , J.K Sharma

Code number: BCADA 2121

Title of the paper: PROBABILITY DISTRIBUTIONS AND STATISTICAL ANALYSIS

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	15	31
Unit II	15	22
Unit III	15	22
Unit IV	10	35
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

Semester	II
Paper Code	**BCADA 2221**

Paper Title	MATHEMATICS II
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES

This course will enable students to acquire further skills in the techniques of linear algebra, as well as understanding of the principles underlying the subject. This course will prepare students for further courses in mathematics and/or related disciplines.

COURSE OUTCOMES

CO1: Use matrices techniques for solving systems of linear equations in the different areas of Linear Algebra.

CO2: Understand vector spaces and related topics arising in magnification and rotation of images.

CO3: Understand various graphs in different geometries related to edges and integral calculus

UNIT I: MATRICES **20 Hrs**

System of linear equation, Row reduction and echelon forms, vector equation, Matrix equation, Solution sets of linear systems, Linear Independence, Introduction to Linear Transformation, The matrix of a Linear Transformation.

Matrix Operations, The Inverse of a matrix, Characterization of Invertible Matrices, Subspaces of R^n and Dimension and rank.

UNIT II: VECTOR SPACES **20 Hrs**

Vector spaces, subspaces, Null spaces, Column Spaces and Linear Transformation, Linearly independent set and Bases, Coordinate system, The dimension of a vector space, Rank, Change of Basis, Eigenvectors and Eigenvalues, The characteristic equation, Diagonalization,

UNIT III: INTEGRAL CALCULUS **15 Hrs**

Area and Estimating with Finite Sums, Limits of Finite, The Definite Integral, The Fundamental Theorem of calculus, Area sums, Indefinite Integral and Substitution Method, Area between curves, Arc Length Area of Surface Revolution, Techniques of Integration, Geometric significance of integration, Real World Applications

SELF STUDY **5 Hrs**

TEXT BOOKS

1. "Linear Algebra and its Applications," 3rd edition, Pearson Education (Asia) Pte. Ltd,2005. David C. Lay
2. "Thomas's Calculus" Pearson, 14th Edition by Joel Hass, Christopher Heil, Maurice D Weir

SUGGESTED BOOKS

1. "Discrete Mathematics with Applications" By Thomas Koshy
2. "Discrete Mathematics with Applications" By Susanna S. Epp
3. "Linear Algebra with Applications, 8th Edition By Steve Leon
4. "Introduction to Linear Algebra with Applications By James DeFranza, Daniel Gagliardi
5. "Linear Algebra," 2nd edition, Pearson Education (Asia) Pte. Ltd/2004. Kenneth Hoffman and Ray Kunze

Code number: BCADA 2221

Title of the paper: MATHEMATICS II

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	20	45
Unit II	20	45
Unit III	15	20
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

Semester	II
Paper Code	**BCADA 2321**
Paper Title	PYTHON PROGRAMMING
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVE:

This Python Programming course leads students from the basics of writing and running Python scripts to more advanced features such as file operations, regular expressions, working with binary data, and using the extensive functionality of Python modules. Extra emphasis is placed on features unique to Python, such as tuples, array slices, and output formatting.

COURSE OUTCOMES:

CO1: Understand the basic concepts and principles of Python programming.

CO2: Understand the pros and cons of scripting languages vs. classical programming languages (at a high level) by implementing various control statements.

CO3: Able to gain insight knowledge towards Functions, I/O, File Handling and Packages.

CO4: Gain knowledge of object-oriented programming in Python.

UNIT 1: INTRODUCTION TO PYTHON INTERPRETER 10 Hrs

Python - Introduction, Advantages and Disadvantages, History, Features, Applications, Python Internals, Runtime Structure, Basic Syntax, Python Identifiers, Reserved Keywords, Data Types, List, Tuple, Dictionary, Set

UNIT 2: CONTROL STATEMENTS 15 Hrs

while loop, for loop, if statement, break statement, continue statement

UNIT 3: FUNCTIONS, I/O, FILE HANDLING, PACKAGES/LIBRARIES 15 Hrs

Functions - Define, call, pass by reference, Function Arguments, Anonymous Function or Lambda Function, return statement.

I/O - Handling Files, Types of Files, Open(), close(), Different modes, Read & Write, file positions, File Seek, OS File/Directory Methods - Types and Methods

Packages/Libraries - Modules, import statement, packages.

UNIT 4: EXCEPTION HANDLING, OO PROGRAMMING 15 Hrs

Exception Handling - Exception Types, Handling Exceptions, Raising Exceptions

OO Programming - Classes, Objects, creating object, self-parameter, init function, destructors, privacy in python, Inheritance and its types, Polymorphism - Method overloading, method overriding, constructor overriding, operator overloading.

SELF STUDY 5 Hrs

TEXT BOOKS

1. Python in easy steps - Mike McGrath, In Easy Steps Limited, Second Edition

2. “Hello World” - Computer Programming for Kids and other Beginners - Warren and Carter, Manning Publications, 2014

REFERENCE BOOKS

1.. Python3 Tutorial - Tutorialspoint

Code number: BCADA 2321

Title of the paper: PYTHON PROGRAMMING

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	10	31
Unit II	15	22
Unit III	15	22
Unit IV	15	35
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

Semester	II
Paper Code	**BCADA 2421**
Paper Title	DIGITAL PRINCIPLES AND FUNDAMENTALS OF COMPUTING
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES

This course prepares students to understand the digital fundamentals of computer, learn the concept and importance of the number systems, logic gates and flips flops; analyze the working of devices like encoders and decoders, multiplexers and de-multiplexers.

COURSE OUTCOMES

CO1: Understand the digital fundamentals of computer and number systems.
CO2: Understand different methods used for the simplification of Boolean functions.
CO3: Design and implement combinational circuits.
CO4: Design and implement sequential circuits.

UNIT 1: COMPUTER FUNDAMENTALS 12 Hrs.

Fundamentals of computers – Characteristics of computers – Computer Language – Operating Systems – Generation of Computers. Number systems: Decimal numbers, Binary numbers: Counting in binary, The weighted structure of binary numbers, Octal numbers, hexadecimal numbers and their mutual conversions, Binary arithmetic: Addition, subtraction, multiplication and division of binary numbers, 1‘s and 2‘s complement, signed numbers, arithmetic operations.

UNIT 2: BOOLEAN ALGEBRA AND LOGIC GATES 13 Hrs.

Review of binary number systems - Binary arithmetic – Binary codes – Boolean algebra and theorems - Boolean functions – Simplifications of Boolean functions using Karnaugh map and tabulation methods – Logic gates.

UNIT 3: COMBINATIONAL LOGIC 15 Hrs.

Basic Adders: Half adder, Full adder, 4-bit Parallel adders, Subtractor: Half subtractor, Full subtractor Implementation using logic gates, Decoders: 4-bit decoder, BCD to decimal decoder, Encoder: Decimal to BCD encoder, Multiplexer: 4 to 1 multiplexer, Demultiplexer: 1 to 4 demultiplexer.

UNIT 4: SEQUENTIAL LOGIC 15 Hrs.

Latches: SR latch, Clocked flip-flops: SR flip-flop, D flip-flop, JK flip-flop, Positive edge triggered flip flops, Timing diagrams, Master slave JK flip-flop.

SELF STUDY 5 Hrs.

TEXT BOOKS

1. Floyd, Thomas L: Digital Computer Fundamentals, 11th Edition, Pearson International, 2015.

REFERENCE BOOKS

1. Malvino, Paul Albert, Leach, Donald P, Gautam Saha: Digital Principles And Applications, TMH,8th Edition, 2015.
2. Bartee, Thomas C: Digital Computer Fundamentals, 6 Edition, TMH, 2010.

Code number: BCADA 2421

Title of the paper: DIGITAL PRINCIPLES AND FUNDAMENTALS OF COMPUTING

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	12	31
Unit II	13	22
Unit III	15	22
Unit IV	15	35
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

SEMESTER III

Semester	III
Paper Code	**BCADA 3121**
Paper Title	**MULTIVARIATE STATISTICS**
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES

After studying this course students can understand the nature and properties of multivariate data. Discuss the guidelines for application and interpretation of multivariate analyses. Determine which multivariate technique is appropriate for a specific business problem.

COURSE OUTCOME

CO1: The multivariate analysis of data deals with examining interrelationship between three or more equally important variables or explaining of variation in, usually one (or more than one) dependent variable(s) on the basis of two or more independent (explaining) variables.

CO2: Make students familiar with the differences between simple linear regression analysis and multiple linear regression analysis. Predicts model and interprets confidence intervals and makes hypothesis testing.

CO3: Understand the terminology of factor analysis, including the interpretation of factor loadings, specific variances, and communalities; understand factor rotation, and interpret rotated factor loadings.

CO4: Discriminant analysis help students analyze business problems, with the goal of differentiating or discriminating the response variable into its distinct classes. Students can also learn about the Binary Outcome model using Logit function.

CO5: They will be able to identify clusters in multivariate data. correctly interpret the output of different clustering procedures.

UNIT I: MULTIVARIATE DISTRIBUTION **15 hrs**

Distribution of two Random Variable, Review of Matrix and vector Algebra, Basic Properties of Random Vectors, Bivariate and Multivariate distributions, Multivariate Normal Distribution, Marginal and conditional distributions, G.F of Multivariate Normal Distribution, Multinomial Distribution , Multivariate Variance Covariance Matrix

UNIT II: MULTIPLE REGRESSION **10 hrs**

Regression Analysis, Test of Significance of Regression Parameters, Goodness of Fit of regression equation, Use of regression analysis in Prediction, Multiple Regression Model, Dummy variables in Regression Analysis

UNIT III: FACTOR ANALYSIS **10 hrs**

Uses of Factor Analysis, Conditions for a Factor Analysis, Steps in a Factor Analysis, Factor Score Coefficient Matrix, factor loadings, Communality, Application of Factor Analysis

UNIT IV: DISCRIMINANT AND LOGIT ANALYSIS **10 hrs**

Objectives and Use of Discriminant Analysis, Illustration of Discrimination Analysis, Correlation matrix, Unstandardized discriminant function, Classification of cases using discriminant function, assessing classification accuracy, Logistic Regression

UNIT V: CLUSTER ANALYSIS **10 hrs**

Cluster Analysis- A Classification Technique, Usage of Classification Technique, Statistics associated with Cluster Analysis, Process of clustering, hierarchical Clustering

SELF STUDY **5 hrs**

TEXT BOOK

1. Multivariate Statistical Analysis , Parimal Mukhopadhyay

SUGGESTED BOOKS

1. Applied Multivariate Statistical Analysis : Richard A. Johnson and Dean W. Wichern, Prentice Hall, 2002
2. Anderson, T.W. (1984) An Introduction to Multivariate Statistical Analysis, John Wiley.

Code number: BCADA 3121

Title of the paper: MULTIVARIATE STATISTICS

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	15	30
Unit II	10	20
Unit III	10	20
Unit IV	10	20
Unit V	10	20
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

Semester	III
Paper Code	**BCADA 3221**
Paper Title	**Mathematics III**
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES

To make the students learn the process of working with data using matrix, numerical methods, solutions for maxima minima problems Make the student understand the practical applications of the above-mentioned methods.

COURSE OUTCOME

CO1: Apply forward, backward difference formulae and central differences formulae in solving interpolation-extrapolation problems

CO2: Applications of partial derivatives

CO3: Identify and solve first order ordinary differential equations.

UNIT I : NUMERICAL METHODS **25 Hrs**

Errors in Numerical Calculations, **Solutions of Algebraic and Transcendental Equations:** Bisection Method, Method of False Position, Newton-Raphson Method, Secant Method. **Interpolation:** Error in Polynomial Interpolation, Finite differences: Forward and Backward differences, Gregory- Newton forward and backward interpolation formula, Newton's divided difference formula, Lagrange's interpolation formula and inverse interpolation formula. Central differences: Gauss difference formulae, Sterling's, and Bessel's formula. **Numerical Linear Algebra:** Gauss-elimination method, Gauss –Jordan method and Gauss-Seidel method, LU Decomposition. **Numerical Integration:** Trapezoidal Rule, Simpson's ⅓ formula, Simpson's ⅜ formula. **Numerical solution to ordinary differential equations:** Solution by Taylor Series, Picard's successive approximation, Euler's Method and Runge-Kutta Method. (All formulae without proof) – problems.

UNIT II : CALCULUS OF SEVERAL VARIABLE **15 Hrs**

Functions of Several variables, Limit and Continuity in Higher Dimensions, Geometric significance of derivatives, Partial differentiations, The Chain Rule, Directional Derivatives and Gradient Vectors, Extremal Values and Saddle Point, Lagrange's Multipliers, Taylor's formula for two variables

UNIT III: DIFFERENTIAL EQUATIONS **15 Hrs**

Introduction to differential equations, Formation of differential equations, **Equations of First Order and First Degree:** Existence Theorem, Exact Equations, Integrating Factors, Separation of Variables, Solving equations which are both homogeneous and exact, Equations reducible to the homogeneous form, Linear Equations, Rules for determining Integrating Factors. **Equations of First order but not First Degree:** Equations Solvable for p, Equations solvable for y, Equations solvable for x, Clairaut's Form.

SELF STUDY **5 Hrs**

TEXT BOOK

1. "An introduction to Differential Equation" , New Central Book Agency, 2011, R K Ghosh and K C Maity
2. "Introductory Method to Numerical Analysis", Prentice Hall India Learning Private Limited; Fifth edition (1 January 2012), S S Sastry
3. "Thomas's Calculus" Pearson, 14th Edition by Joel Hass, Christopher Heil, Maurice D Weir

SUGGESTED BOOKS

1. Higher Engineering Mathematics by B.S.Grewal

Code number: BCADA 3221

Title of the paper: MATHEMATICS III

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	25	40
Unit II	15	35
Unit III	15	35
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

Semester	III
Paper Code	**BCADA 3321**
Paper Title	**DATABASE MANAGEMENT SYSTEM**
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES

This course concentrates on introduction, principles, design and implementation of DBMS. It introduces the distributed system and brief about data mining and data warehouse. To provide strong foundation of database concepts and develop skills for the design and implementation of a database application with a brief exposure to advanced database concepts.

COURSE OUTCOMES

CO1: Understanding the fundamental concepts of Database Management systems
CO2: Understanding the concepts of Database models.
CO3: Able to gain knowledge towards the core terms, concepts, and tools of relational database management systems.
CO4: Understanding database design and logic development for database programming.

UNIT 1: DATABASE MANAGEMENT SYSTEM INTRODUCTION 12 Hrs.

Data- Database- Database management system- Characteristics of the database approach- Role of Database administrators- Role of Database Designers- End Users- Advantages of Using a DBMS-Data models, Schema and Instances –Database design - Database Engine – 1 tier architecture – 2 tier architecture- 3 tier architecture – History of Database Management systems- Types of Databases.

UNIT 2: DATABASE MODELS AND IMPLEMENTATION 13 Hrs.

Data Model and Types of Data Model- Relational Data Model- Hierarchical Model- Network Data Model- Object/Relational Model- Object-Oriented Model- Entity-Relationship Model- Modeling using E-R Diagrams- Notation used in E-R Model- Relationships and Relationship Types- Cardinalities. Subclasses, Super classes and Inheritance – Specialization and Generalization – Characteristics of Specialization and Generalization – Modeling of UNION types with categories- An example University EER Schema.

UNIT 3: RELATIONAL DATABASES 15 Hrs.

Structure of relational databases- Properties of relational databases and Tables –Structure of relational databases – Database Schema – Armstrong Axioms – Functional Dependency-Anomalies in a Database- Properties of Normalized Relations- First Normalization- Second Normal Form Relation- Third Normal Form- Boyce-Codd Normal Form (BCNF).

UNIT 4: SQL AND ADDITIONAL CONCEPTS 15 Hrs.

Categories of SQL Commands; Data Definition; Data Manipulation Statements, SELECT - The Basic Form, Subqueries, Functions, GROUP BY Feature, Updating the Database, Data Definition Facilities. Cursors and Triggers

SELF STUDY 5 Hrs.

TEXT BOOKS

1. Elmasri Ramez and Navathe Shamkant B, Fundamentals of Database Systems, Addison-Wesley, 6th Edition, 2010.

REFERENCE BOOKS

1. Silberschatz, Korth, Sudarshan, Database System Concepts, 5 Edition, McGraw Hill, 2006.
2. O`neil Patricand, O`neil Elizabeth, Database Principles, Programming and Performance, 2nd Edition, Margon Kaufmann Publishers Inc, 2008.

Code number: BCADA 3321

Title of the paper: DATABASE MANAGEMENT SYSTEM

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	12	25

Unit II	13	25
Unit III	15	30
Unit IV	15	30
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

Semester	III
Paper Code	**BCADA 3421**
Paper Title	**DATA WAREHOUSING AND MINING**
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVE

This course explores the concepts of Data Warehousing, in-depth understanding of data mining tasks like constructing Decision trees, finding Association Rules and Classification, provides basic understanding of data mining algorithms.

COURSE OUTCOMES

CO1: Basic knowledge of a Data Warehouse system
CO2: Understand data pre-processing techniques for data analysis.
CO3: Broad understanding of different association algorithms or classification techniques for data analysis.
CO4: Understand association rule mining.

UNIT 1: DATA WAREHOUSE **15 Hrs.**

The Need for an Operational Data Store, Operational Data Store, Data Warehouse, Data Marts, Data Warehouse versus OLTP, Data Warehouse Schema- Introduction to Data Warehouse Schema, Star Schema, Snow flake schema, Fact Constellation Schema.

UNIT 2: INTRODUCTION TO DATA MINING **10 Hrs.**

Data mining Introduction, Data Mining Tasks, Data Preprocessing- Types of data, Data Quality, Data Preprocessing, Similarity & Dissimilarity measures.

UNIT 3: CLASSIFICATION **15 Hrs.**

Introduction, Applications Decision Tree based Algorithms, Model Overfitting, Performance Evaluation of a classifier, Comparison Classifiers.

UNIT 4: ASSOCIATION RULE MINING **15 Hrs.**

Introduction, Applications, Market-Basket Analysis, Frequent Itemsets, Apriori Algorithm, Alternative Methods

SELF STUDY **5 Hrs.**

TEXT BOOKS

1. Tan P. N., Steinbach M & Kumar V. "Introduction to Data Mining" Pearson Education, 2006.
2. Prateek Bhatia, "Data Mining and Data warehousing", Cambridge University Press, 2019.

REFERENCE BOOKS

1. Dunhum M.H. & Sridhar S. "Data Mining-Introductory and Advanced Topics", Pearson Education, 2006.
2. Han J & Kamber M, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Second Edition, 2006

Code number: BCADA 3421

Title of the paper: DATA WAREHOUSING AND MINING

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	15	30
Unit II	10	20
Unit III	15	30
Unit IV	15	30
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

SEMESTER IV

Semester	IV
Paper Code	**BCADA 4121**
Paper Title	**STATISTICAL FORECASTING AND INFERENCE**
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVE:

This course concentrates on the knowledge of forecasting to students, make the students aware of the different techniques of forecasting, analyse the methodology of hypothesis testing.

COURSE OUTCOMES:

CO1: Understand the concept of estimation

CO2: Use concept of estimation for hypothesis testing

CO3: Learn the use of forecasting for different types of data

CO4: Use forecasting techniques for building ARMA and ARIMA model

UNIT I : STATISTICAL INFERENCE **12 Hrs.**

Point and interval estimation, properties of good estimators, unbiasedness, minimum variance unbiased estimation, uniformly minimum unbiased estimators, methods of estimation, maximum likelihood estimation

UNIT II : TESTS OF HYPOTHESIS **13 Hrs.**

Types of hypothesis , errors in hypothesis testing ,one tailed and two tailed test, power of test, various parametric and non parametric test like Z, t, Chi Square, F- test , ANOVA(one way)

UNIT III: FORECASTING **15 Hrs.**

Introduction, Distinction among prediction , projection and forecasting , types of forecast –judgemental, time series and associative, compare and contrast qualitative and quantitative approaches to forecasting , steps in forecasting , methods of forecasting , utility of forecast , reliability of forecast, forecasting for cross section and time series data

UNIT IV: TIME SERIES FORECASTING **15 Hrs.**

Introduction, notation and concepts, moving average process, autoregressive process, autocorrelation function , building ARMA model , Box Jenkins approach, exponential smoothing, forecasting using ARIMA model

SELF STUDY **5 Hrs.**

TEXT BOOKS:

1. Time Series Analysis" by James Douglas Hamilton
2. Introduction to Time Series Analysis and Forecasting" by Douglas C. Montgomery, Cheryl L. Jennings, and Murat Kulahci

Code number: BCADA 4121

Title of the paper: STATISTICAL FORECASTING AND INFERENCE

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	15	30
Unit II	10	20
Unit III	15	30
Unit IV	15	30
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

Semester	IV
Paper Code	**BCADA 4221**
Paper Title	**JAVA PROGRAMMING**
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVE

This course introduces computer programming using the JAVA programming language with object-oriented programming principles. Emphasis is placed on event-driven programming methods, including creating and manipulating objects, classes, and using object-oriented tools such as the class debugger.

COURSE OUTCOMES

CO1: Understand the basic Java programming concept using OOP principles.

CO2: Develop Java programs with the concepts of inheritance and interfaces.

CO3: Able to Build Java applications using exceptions and I/O streams

CO4: Gain in depth knowledge towards Java applications using threads, generic classes and Event Driven concepts.

UNIT 1: INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 10 Hrs.

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java – The Java Environment - Java Source File - Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays , Packages - Javadoc comments.

UNIT 2: INHERITANCE AND INTERFACES 15 Hrs.

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Object cloning -inner classes, Array Lists - Strings

UNIT 3: EXCEPTION HANDLING AND I/O 15 Hrs.

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files

UNIT 4: MULTITHREADING, GENERIC PROGRAMMING AND EVENT DRIVEN PROGRAMMING 15 Hrs.

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations. Graphics programming - Frame – Components - working with 2D shapes - Using colour, fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events.

SELF STUDY 5 Hrs.

TEXT BOOKS

1. Herbert Schildt, ―Java The complete reference‖, 8th Edition, McGraw Hill Education, 2011.

2. Cay S. Horstmann, Gary cornell, ―Core Java Volume –I Fundamentals‖, 9th Edition, Prentice Hall, 2013.

SUGGESTED BOOKS

1. Paul Deitel, Harvey Deitel, ―Java SE 8 for programmers‖, 3rd Edition, Pearson, 2015.

2. Steven Holzner, ―Java 2 Black book‖, Dreamtech press, 2011.

3. Timothy Budd, ―Understanding Object-oriented programming with Java‖, Updated Edition, Pearson Education, 2000.

Code number: BCADA4221

Title of the paper: JAVA PROGRAMMING

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	10	20
Unit II	15	30
Unit III	15	30
Unit IV	15	30
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question) = 70		

Semester	IV
Paper Code	BCADA 4321
Paper Title	ABSTRACT ALGEBRA AND ORDINARY DIFFERENTIAL OF HIGHER ORDER
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES:

To make the students learn the process of working with data using matrix, numerical methods, solutions for maxima minima problems Make the student understand the practical applications of the above-mentioned methods.

COURSE OUTCOMES:

CO1: Apply forward, backward difference formulae and central differences formulae in solving interpolation-extrapolation problems

CO2: Applications of matrix to solve the system of equations

CO3: Learn the maxima and minima for optimization

CO4: Identify and solve first order ordinary differential equations.

UNIT I: GROUP **20 Hrs.**

Introduction to Groups: Binary Operation, Definition of Groups, Examples of Group, Introduction to set of Integers modulo n, Uniqueness of identity element and Uniqueness of Inverse element, Subgroups: Order of an element, Subgroups, One-Step Subgroup Test , One-Step Subgroup Test (proof not required), Examples of Subgroups, Cyclic Groups: Generators of Cyclic Group, Fundamental Theorem of Cyclic Groups and its corollaries, Permutation groups: Writing a permutation as a product of disjoint cycles, Disjoint cycles commute, Order of a permutation, Even and Odd Permutation

UNIT II: RINGS AND FIELDS **20 Hrs.**

Definition and examples of Rings, Properties of rings, Subrings, Definition and example of Integral Domains, Definition and examples of Field, Ideals, Factor Rings, Prime Ideal and Maximal Ideal, Ring Homomorphism and its properties. Polynomial Ring, Division Algorithm and its corollaries.

Unit III: DIFFERENTIAL EQUATIONS II **15 Hrs.**

Second and Higher order Ordinary Differential Equations: Solving equations of second and higher order homogeneous equations with constant coefficients. Solving equations of second and higher order non-homogeneous equations with constant coefficients by finding the complementary function particular integral, Method of undetermined coefficients, Method of variation of parameters, Cauchy Euler Equation, Exact Equations, Criterion of an Differential Exact Equation, Equations that are not exact, Change of dependent variable, Change of independent variable, Factorization of operator.

SELF STUDY **5 Hrs.**

TEXT BOOKS

1. Contemporary Abstract Algebra, 4th Ed., Narosa, 1999 by Joseph A Gallian
2. “An introduction to Differential Equation” , New Central Book Agency, 2011, R K Ghosh and K C Maity

SUGGESTED BOOKS

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.

2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. 4. George E Andrews, Number Theory, Hindustan Publishing Corporation, 1984.x

Code number: BCADA4321

Title of the paper: ABSTRACT ALGEBRA AND ORDINARY DIFFERENTIAL OF HIGHER ORDER

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	20	40
Unit II	20	40
Unit III	15	30
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question) = 70		

SEMESTER V

Semester	V
Paper Code	BCADA 5121
Paper Title	MACHINE LEARNING
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE DESCRIPTION:

To provide strong foundation for Machine Learning.

COURSE OBJECTIVES:

1. To understand the basics of Machine Learning (ML)
2. To understand the methods of Machine Learning
3. To know about the implementation aspects of machine learning

4. To understand the concepts of Data Analytics and Machine Learning
5. To understand and implement use cases of ML

COURSE OUTCOMES:

CO1: Understand the basics of ML
CO2: Explain various Machine Learning methods
CO3: Demonstrate various ML techniques using standard packages.
CO4: Explore knowledge on Machine learning and Data Analytics
CO5: Apply ML to various real time examples

UNIT I: MACHINE LEARNING BASICS **10 Hrs.**

Introduction to Machine Learning (ML) **-** Essential concepts of ML – Types of learning – Machine learning methods based on Time – Dimensionality – Linearity and Non linearity – Early trends in Machine learning – Data Understanding Representation and visualization.

UNIT I: MACHINE LEARNING METHODS **14 Hrs.**

Linear methods – Regression **-**Classification –Perceptron and Neural networks – Decision trees – Support vector machines – Probabilistic models —Unsupervised learning – Featurization

UNIT III: MACHINE LEARNING IN PRACTICE **10 Hrs.**

Ranking – Recommendation System **-** Designing and Tuning model pipelines**-** Performance measurement – Azure Machine Learning – Open-source Machine Learning libraries – Amazon's Machine Learning Tool Kit: Sagemaker

UNIT IV: MACHINE LEARNING AND DATA ANALYTICS **11 Hrs.**

Machine Learning for Predictive Data Analytics – Data to Insights to Decisions – Data Exploration – Information based Learning – Similarity based learning – Probability based learning – Error based learning – Evaluation – The art of Machine learning to Predictive Data Analytics.

UNIT V: APPLICATIONS OF MACHINE LEARNING **10 Hrs.**

Image Recognition – Speech Recognition – Email spam and Malware Filtering – Online fraud detection – Medical Diagnosis.

SELF STUDY **5 Hrs.**

TEXT BOOKS:

1. Ameet V Joshi, Machine Learning and Artificial Intelligence, Springer Publications, 2020

2. John D. Kelleher, Brain Mac Namee, Aoife D' Arcy, Fundamentals of Machine learning for Predictive Data Analytics, Algorithms, Worked Examples and case studies, MIT press,2015

REFERENCES:

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer Publications, 2011

2. Stuart Jonathan Russell, Peter Norvig, John Canny, Artificial Intelligence: A Modern Approach, Prentice Hall, 2020

3. Machine Learning Dummies, John Paul Muller, Luca Massaron, Wiley Publications, 2021

BLUE PRINT

Code number: BCADA 5121

Title of the paper: Machine learning

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	10	20
Unit II	14	30
Unit III	10	20
Unit IV	11	20
Unit V	10	20
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question) = 70		

Semester	V
Paper Code	BCADA 5321
Paper Title	OPERATING SYSTEM
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60

Number of credits	4

COURSE OBJECTIVES:

1. To analyze the various evolutions of operating systems.
2. To learn the basic concepts and roles of an operating system.
3. To study the various design issues in developing an operating system.
4. To familiarize with the important mechanisms in operating systems.
5. To appreciate the emerging trends in operating systems.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

CO1: Understand the evolution of Operating systems
CO2 Understand the Key concept of Operating Systems
CO3: Analyze the issues in designing Operating Systems
CO4: Analyze the usage and strengths of various algorithms of Operating Systems
CO5: Appreciate the role of various concepts and algorithms towards the performance of the system

UNIT I: OPERATING SYSTEMS OVERVIEW 11 Hrs.

Introduction to operating systems – Computer system organization, architecture – Operating system structure, operations–Process, memory, storage management–Protection and security– Distributed systems – Computing Environments – Open-source operating systems – OS services – User operating-system interface – System calls – Types – System programs – OS structure – OS generation – System Boot – Process concept, scheduling – Operations on processes – Cooperating processes – Inter-process communication – Examples – Multithreading models – Thread Libraries – Threading issues – OS examples.

UNIT II: PROCESS MANAGEMENT 11 Hrs.

Basic concepts – Scheduling criteria – Scheduling algorithms – Thread scheduling – Multiple- processor scheduling – Operating system examples – Algorithm Evaluation – The critical-section problem – Peterson‘s solution – Synchronization hardware – Semaphores – Classic problems of synchronization – Critical regions – Monitors – Synchronization examples – Deadlocks – System model – Deadlock characterization – Methods for handling deadlocks – Deadlock Prevention – Deadlock Avoidance – Deadlock detection – Recovery from deadlock.

UNIT III: STORAGE MANAGEMENT 11 Hrs.

Memory Management – Swapping – Contiguous memory allocation – Paging –Segmentation – Example: The Intel Pentium - Virtual Memory: Background – Demand paging – Copy on write – Page replacement – Allocation of frames – Thrashing.

UNIT IV: I/OSYSTEMS **11 Hrs.**

File concept – Access methods – Directory structure – File-system mounting – Protection – Directory implementation – Allocation methods – Free-space management – Disk scheduling – Disk management – Swap-space management – Protection.

UNIT V: CASE STUDY **11 Hrs.**

The Linux System – History – Design Principles – Kernel Modules – Process Management – Scheduling – Memory management – File systems – Input and Output – Inter-process Communication – Network Structure – Security – Windows 7 – History – Design Principles – System Components – Terminal Services and Fast User – File system – Networking.

SELF STUDY **5 Hrs.**

TEXT BOOK:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts Essentials", John Wiley & Sons Inc., 2010.

REFERENCES:

1. Andrew S.Tanenbaum, "Modern Operating Systems", Second Edition, Addison Wesley,2001.

2. D M Dhamdhere, "Operating Systems: A Concept-based Approach", Second Edition, Tata McGraw-Hill Education,2007.

3. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education‖,1996.

4. William Stallings, "Operating Systems: Internals and Design Principles", Seventh Edition, Prentice Hall,2011.

BLUE PRINT

Code number: BCADA 5321

Title of the paper: Operating System

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	11	20

Unit II	11	30
Unit III	11	20
Unit IV	11	20
Unit V	11	20
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question) = 70		

Semester	V
Paper Code	BCADA 5221
Paper Title	OPERATIONS RESEARCH
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES:

1. To analyze the various evolutions of operations research.
2. To learn the basic concepts and roles of operations research.
3. To study the various design issues in developing an operations research problems.
4. To familiarize with the important mechanisms in operations research.
5. To appreciate the emerging trends in operating systems.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

CO1: Understand the evolution of LPP
CO2 Understand the Key concept of Duality of LPP
CO3: Understand the game theory problems and solving them
CO4: Understand the Queuing theory problems and solving them
CO5: Understand the simulation problems

UNIT I: LINEAR PROGRAMMING PROBLEMS **11 Hrs.**

Mathematical formulation, graphical method of solution, simplex method

UNIT II: DUALITY IN LINEAR PROGRAMMING PROBLEMS **11 Hrs.**

dual simplex method, sensitivity analysis, transportation and assignment problems, Traveling salesman Problem.

UNIT III: GAME THEORY **11 Hrs.**

Introduction, two-person zero-sum games, some basic terms, the maxminiminimax principle, games without saddle points-Mixed Strategies, graphic solution of 2 * n and m*2 games, dominance property. CPM & PERT-project scheduling, critical path calculations, Crashing.

UNIT IV: QUEUEING THEORY **11 Hrs.**

basic structure of queuing systems, roles of the Poisson and exponential distributions, classification of queues basic results of M/M/1: FIFO systems, extension to multi-server queues.

UNIT V: SIMULATION **11 Hrs.**

simulation concepts, simulation of a queuing system using event list,pseudo random numbers, multiplication congruential algorithm, inverse transformation method, basic ideas of Monte-Carlo simulation.

SELF STUDY **5 Hrs.**

REFERENCES:

1. Taha.H.A ,operation Research : An Introduction, McMilan publishing Co., 1982. 7 th ed.
2. Ravindran A, Philips D.T & Solbery.J.J, Operations Research: Principles and practice, John Wiley & Sons, New York, 1987.
3. Frank S. Budnick, Dennis Mcleavey and Richard Mojena, Principles of Operations Research for Management. All India Traveler Book seller, Delhi.
4. Gillet.B.E., Introduction to Operations Research - A Computer oriented algorithmic approach, McGraw Hill, 1987.
5. Joseph.G.Ecker & Michael Kupper Schimd, Introduction to operations Research, John Wiley & Sons, 1988.
   • Hillier.F.S & Liberman.G.J, operation Research, Second Edition, Holden Day Inc, 1974.
6. Kanti Swarup, Gupta.P.K. & Man Mohan, operations Research, S.Chand & Sons.

BLUE PRINT

Code number: BCADA 5221

Title of the paper: Operations Research

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	11	20
Unit II	11	30
Unit III	11	20
Unit IV	11	20
Unit V	11	20
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question) = 70		

Semester	V
Paper Code	BCADA 5421
Paper Title	ENABLING DATA ANALYTICS
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES:

This course explains the key issues in big data management and trains the students to have skills that will help them to solve complex real-world problems for prediction and decision making using different tools. We give them some idea about the cloud environment.

COURSE OUTCOMES:

CO1: Understand the key issues in big data management and its associated applications using Hadoop

CO2: Acquire fundamental enabling techniques and scalable algorithms like Map Reduce

CO3: Acquire fundamental enabling techniques of HIVE,SQOOP, PIG

UNIT 1: BIG DATA AND HADOOP **20 Hrs.**

Hadoop architecture, Hadoop Versioning and configuration, Single node & Multi-node Hadoop, Hadoop commands, Models in Hadoop, Hadoop daemon, Task instance, Illustrations.

UNIT 2: MAP-REDUCE **20 Hrs.**

Framework, Developing Map-Reduce program, Life cycle method, Serialization, Running Map-Reduce in local and pseudo-distributed mode, Illustrations

UNIT 3: Hive, SQOOP, PIG **15 Hrs.**

SELF STUDY **5 Hrs.**

SUGGESTED BOOKS:

1. Hadoop in Action : Chuck Lam, 2010, ISBN : 9781935182191

2. Data-intensive Text Processing with Map Reduce : Jimmy Lin and Chris Dyer, Morgan& Claypool Publishers, 2010

BLUE PRINT

Code number: BDA 2421

Title of the paper: Enabling Technologies for Data Science I

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	20	40
Unit II	20	40
Unit III	15	30
Self-Study	5	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question)= 70		

Semester	V
Paper Code	BCADA 5521
Paper Title	ETHICS IN BUSINESS ENVIRONMENT
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES:

The course aims to equip the students to analyse the overall business environment and evaluate its various components in business.

COURSE OUTCOMES:

CO1: To familiarize the students with business environment and social responsibility

CO2: To get an insight in to the culture, society on business decision and corporate governance

CO3: Implement the moral and social values pertaining to the personal and social life

CO4: Understand how to tackle the rights in their professional life.

UNIT I: BUSINESS ENVIRONMENT **11 Hrs**

characteristics of business environment – types of environments – environmental analysis - Social responsibility – socio culture environment - Political and government environment – constitution and its role in business.

UNIT II : MANAGING ETHICS **11 Hrs**

meaning and types – modern decision making and ethics - ethics across culture - factors influencing business ethics - ethical decision making - ethical values and stakeholders - ethics and profit. Corporate Governance - structure of Boards- reforms in Boards - compensation issues - ethical leadership.

UNIT III: SAFETY, RESPONSIBILITIES AND RIGHTS **11 Hrs**

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the Three Mile Island and Chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality -

conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT IV: GLOBAL ISSUES **11 Hrs**

Multinational corporations - Environmental ethics - computer ethics – weapons development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - moral leadership – Ethics and research – analysing ethical problems in research

SELF STUDY **5 Hrs**

TEXT BOOK

1. Mittal Vivek (2007) Business Environment, Excel Books.
2. Spiro George W. (1993) The Legal Environment of Business, Englewood Cliffs, NJ Prentice Hall.
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

SUGGESTED BOOK

1. Mishra, Puri (2006) Economic Environment of Business, Himalaya Publications House
2. Spiro George W. (1993) The Legal Environment of Business, Englewood Cliffs, NJ Prentice Hall
3. Starling, Grower (1996) The Changing Environment of Business, Cincinnati, OH, South Western College Publishing
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001

BLUE PRINT

Code Number: BCADA 5421

Title of the Paper: Ethics in Business Environment

Term Paper on "Ethics in Business Environment" – 100 marks

Semester	V
Paper Code	BCADA 5621
Paper Title	COMPUTER NETWORKS

Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES:

1. To understand the protocol layering and physical level communication
2. To analyze the performance of a network
3. To understand the various components required to build different networks
4. To learn the functions of network layer and the various routing protocols
5. To familiarize the functions and protocols of the Transport, Network and application layer

COURSE OUTCOMES:

On successful completion of this course, the student will able to

CO1: Comprehend the basic layers and its functions in computer networks.
CO2: Understand the basics of how data flows from one node to another.
CO3: Analyze and design routing algorithms.
CO4: Design protocols for various functions in the network.
CO5: Understand the working of various application layer protocols.

UNIT I: INTRODUCTION AND PHYSICAL LAYER **11 Hrs.**

Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.

UNIT II: DATA-LINK LAYER & MEDIA ACCESS **11 Hrs.**

Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Wired LANs: Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.

UNIT III: NETWORK LAYER **11 Hrs.**

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets – Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.

UNIT IV: TRANSPORT LAYER **11 Hrs.**

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

UNIT V: APPLICATION LAYER **11 Hrs.**

WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP.

SELF STUDY **5 Hrs.**

TEXT BOOKS

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013**.**

2. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.

REFERENCE BOOKS

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", Seventh Edition, Pearson Education, 2017.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011.

BLUE PRINT

Code number: BCADA 5621

Title of the paper: Computer networks

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	11	20
Unit II	11	30
Unit III	11	20
Unit IV	11	20

Unit V	11	20
Self-Study	05	
TOTAL	**60**	**110**
Maximum marks for the paper (Excluding bonus question) = 70		

SEMESTER VI

Semester	VI
Paper Code	BCADA 6121
Paper Title	PROJECT
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

BLUE PRINT

Code Number: BCADA 6121

Title of the Paper: Project

Report on project – 100 marks

Semester	VI
Paper Code	BCADA 6221
Paper Title	CLOUD COMPUTING
Number of teaching hrs per week	4 Hrs

Total number of teaching hrs per semester	60
Number of credits	4

COURSE OBJECTIVES:

1. To understand the concept of cloud computing.
2. To appreciate the evolution of cloud from the existing technologies.
3. To have knowledge on the various issues in cloud computing.
4. To be familiar with the lead players in cloud.
5. To appreciate the emergence of cloud as the next generation computing paradigm.

COURSE OUTCOMES:

On Completion of the course, the students should be able to:

CO1: Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
CO2: Learn the key and enabling technologies that help in the development of cloud.
CO3: Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
CO4: Explain the core issues of cloud computing such as resource management and security and able to install and use current cloud technologies.
CO5: Evaluate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

UNIT I: INTRODUCTION **11 Hrs.**

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning

UNIT II: CLOUD ENABLING TECHNOLOGIES **11 Hrs.**

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.

UNIT III: CLOUD ARCHITECTURE, SERVICES AND STORAGE **11 Hrs.**

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

UNIT IV: RESOURCE MANAGEMENT AND SECURITY IN CLOUD 11 Hrs.

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

UNIT V: CLOUD TECHNOLOGIES AND ADVANCEMENTS 11 Hrs.

Virtual Box -- Google App Engine – Programming Environment for Google App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.

SELF STUDY 5 Hrs.

TEXT BOOKS:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012. 2. Rittinghouse, John W., and James F. Ransome, “Cloud Computing: Implementation, Management and Security”, CRC Press, 2017.

REFERENCES:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata Mcgraw Hill, 2013.

2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach”, Tata Mcgraw Hill, 2009.

3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)”, O'Reilly, 2009.

BLUE PRINT

Code number: BCADA 6221

Title of the paper: Cloud computing

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	11	20
Unit II	11	30
Unit III	11	20
Unit IV	11	20
Unit V	11	20
Self-Study	05	
TOTAL	**60**	**110**

Semester	VI
Paper Code	BCADA 6321
Paper Title	AI and DEEP LEARNING
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE DESCRIPTION:

To provide strong foundation for Artificial Intelligence and Deep Learning.

COURSE OBJECTIVES:

- To Understand the basic concepts of intelligent agents
- To develop general-purpose problem solving agents and logical reasoning.
- To understand the concepts of Artificial Neural Networks
- To understand CNN of architectures of deep neural networks.
- To learn about applications of deep learning in AI and Data Science

COURSE OUTCOMES:

1. Explain autonomous agents that make effective decisions in fully informed, partially observable, and adversarial settings
2. Choose appropriate algorithms for solving given AI problems Understand Smart Objects and IoT Architectures
3. Basics of Artificial Intelligence using deep learning.
4. Apply Convolution Neural Network for image processing.
5. Apply deep learning algorithms for variety applications.

UNIT I: INTELLIGENT AGENTS **11 Hrs.**

Introduction to AI – Agents and Environments – Concept of rationality – Nature of environments – Structure of agents Problem solving agents – search algorithms – uninformed search strategies

UNIT II: PROBLEM SOLVING **11 Hrs.**

Heuristic search strategies – heuristic functions Local search and optimization problems – local search in continuous space – search with nondeterministic actions – search in partially observable environments – online search agents and unknown environments.

UNIT III: DEEP LEARNING ALGORITHMS FOR AI **11 Hrs.**

Artificail Neural Netowrks – Linear Associative Networks – Perceptrons -The Backpropagation Algorithm - Hopfield Nets - Boltzmann Machines - Deep RBMs - Variational Autoencoders - Deep Backprop Networks- Autoencoders.

UNIT IV: CONVOLUTIONAL NEURAL NETWORKS **11 Hrs.**

Convolution Operation -- Sparse Interactions -- Parameter Sharing -- Equivariance -- Pooling -- Convolution Variants: Strided -- Tiled -- Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions -- Loss Functions -- Regularization -- Optimizers -- Gradient Computation.

UNIT V: APPLICATIONS OF DEEP LEARNING **11 Hrs.**

Detection in chest X-ray images -object detection and classification -RGB and depth image fusion -NLP tasks - dimensionality estimation - time series forecasting -building electric power grid for controllable energy resources - guiding charities in maximizing donations and robotic control in industrial environments.

SELF STUDY **5 Hrs**

TEXT BOOKS

1. Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Fourth Edition, Pearson Education, 2020
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning", MIT Press, 2016

REFERENCE BOOKS

1. Stone, James. (2019). Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning, Sebtel Press, United States, 2019.
2. Vance, William , Data Science: A Comprehensive Beginners Guide to Learn the Realms of Data Science (Hardcover - 2020), Joiningthedotstv Limited.
3. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007.
4. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008

BLUE PRINT

Code number: BCADA 6321

Title of the paper:

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	11	20
Unit II	11	30
Unit III	11	20
Unit IV	11	20
Unit V	11	20
Self-Study	05	
TOTAL	**60**	**110**

Semester	VI
Paper Code	BCADA 6421
Paper Title	AI and IoT
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	4

COURSE DESCRIPTION:

To provide strong foundation for Artificial Intelligence and Internet of Things.

COURSE OBJECTIVES:

1. To Understand the basic concepts of intelligent agents
2. To develop general-purpose problem solving agents and logical reasoning.
3. To understand Smart Objects and IoT Architectures
4. To learn about various IOT-related protocols.
5. To design and use of AI enabled IoT system

COURSE OUTCOMES:

CO1: Understand the basic concepts of intelligent agents
CO2: Develop general-purpose problem solving agents and logical reasoning.
CO3: Understand Smart Objects and IoT Architectures
CO4: Learn about various IOT-related protocols.
CO5: Design and use of AI enabled IoT system

UNIT I: INTELLIGENT AGENTS **11 Hrs.**

Introduction to AI – Agents and Environments – Concept of rationality – Nature of environments – Structure of agents Problem solving agents – search algorithms – uninformed search strategies

UNIT II: PROBLEM SOLVING **11 Hrs.**

Heuristic search strategies – heuristic functions Local search and optimization problems – local search in continuous space – search with nondeterministic actions – search in partially observable environments – online search agents and unknown environments.

UNIT III: FUNDAMENTALS OF IoT **11 Hrs.**

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT IV: IoT PROTOCOLS **11 Hrs.**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT.

Unit V: DESIGN AND DEVELOPMENT **11 Hrs.**

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi.

SELF STUDY **5 Hrs**

TEXT BOOKS

3. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020
4. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017

REFERENCE BOOKS

5. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
6. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012 (for Unit 2).
7. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007.
8. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008

BLUE PRINT

Code number: BCADA 6421

Title of the paper: AI and IoT

Chapter	Number of Hours	Total marks for which the questions are to be asked (including bonus questions
Unit I	11	20
Unit II	11	30
Unit III	11	20
Unit IV	11	20
Unit V	11	20
Self-Study	05	
TOTAL	**60**	**110**