

**School of Computer Applications  
Bachelor of Computer Applications (Data Science & Artificial Intelligence)  
In Collaboration with IBM**

**Eligibility:** Minimum Aggregate of 50% or equivalent in 10+2, relaxation in qualification and reservation will be as per UGC and Government Norms

**Minimum Duration of the Course: 3 Years**

**Maximum Duration of the Course: 5 Years**

**School of Computer Applications**  
**Bachelor of Computer Applications (Data Science & Artificial Intelligence)**  
**In Collaboration with IBM**  
**Evaluation Scheme (w. e. f. Academic Session 2021-22)**

<b>SEMESTER I</b>										
<b>Course Category</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Contact Hours</b>			<b>Evaluation Scheme</b>			<b>Credits</b>	<b>Mode</b>
			<b>L</b>	<b>T</b>	<b>P</b>	<b>CIA</b>	<b>ESE</b>	<b>Course Total</b>		
<b>Theory</b>										
C	BCADS1101	Python with Data Science	3	1	0	40	60	100	4	IBM
F	BCACS1102	Fundamentals of Information Technology	3	1	0	40	60	100	4	School
F	BCACS1103	Discrete Mathematics	3	1	0	40	60	100	4	
C	BCADS1104	Data Structures using Python	3	1	0	40	60	100	4	
AECC	BSAE2101	Environmental Studies	3	1	0	40	60	100	4	
	BCACS1105	Basic Mathematics	Qualifying						0	
<b>Practical</b>										
F	BCACS1151	Fundamental of Information Technology Lab	0	0	4	40	60	100	2	School
C	BCADS1152	Data Structures using Python Lab	0	0	4	40	60	100	2	
	GP1101	General Proficiency	-	-	-	100	-	100	1	
<b>Total</b>			15	5	8	-		800	25	

**Note:** BCACS1105: Basic Mathematics will be non-credit qualifying for the course

<b>SEMESTER II</b>										
<b>Course Category</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Contact Hours</b>			<b>Evaluation Scheme</b>			<b>Credits</b>	<b>Mode</b>
			<b>L</b>	<b>T</b>	<b>P</b>	<b>CIA</b>	<b>ESE</b>	<b>Course Total</b>		
<b>Theory</b>										
C	BCADS1201	Data Visualization	3	1	0	40	60	100	2	IBM
	BCADS1202	Cloud Application Development	3	1	0	40	60	100	4	
AECC	HSAE2201	Communicative English	3	1	0	40	60	100	4	School
C	BCADS1203	Programming with JAVA	3	1	0	40	60	100	4	
C	BCACS1204	Relational Database Management System using SQL	3	1	0	40	60	100	4	
C	BCADS1205	Statistical Mathematics	3	1	0	40	60	100	4	
	BCACS1206	Human Values and Professional Ethics	Qualifying						0	
<b>Practical</b>										
C	BCADS1251	Programming with JAVA Lab	0	0	4	40	60	100	2	School
C	BCACS1252	Relational Database Management System using SQL Lab	0	0	4	40	60	100	2	
	GP1201	General Proficiency	-	-	-	100	-	100	1	
<b>Total</b>			18	6	8	-		900	27	

**Note:** BCACS1206: Human Values & Professional Ethics will be non-credit qualifying for the course

<b>SEMESTER III</b>										
<b>Course Category</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Contact Hours</b>			<b>Evaluation Scheme</b>			<b>Credits</b>	<b>Mode</b>
			<b>L</b>	<b>T</b>	<b>P</b>	<b>CIA</b>	<b>ESE</b>	<b>Course Total</b>		
<b>Theory</b>										
C	BCADS1301	Descriptive Analytics	3	1	0	40	60	100	4	IBM
	BCADS1302	NO SQL and DbaaS 101	3	1	0	40	60	100	2	
C	BCA4301	Basics of Design & Analysis of Algorithms	3	1	0	40	60	100	4	School
C	BCACS1302	Basics of Operating System	3	1	0	40	60	100	4	
C	BCADS1303	Software Engineering	3	1	0	40	60	100	4	
C	BCACS1304	Basics of Computer Organization & Architecture	3	1	0	40	60	100	4	
<b>Practical</b>										
C	BCACS1351	Basics of Design & Analysis of Algorithm Lab	0	0	4	40	60	100	2	School
C	BCACS1352	Basics of Computer Organization Lab	0	0	4	40	60	100	2	
	GP1301	General Proficiency	-	-	-	100	-	100	1	
<b>Total</b>			18	6	8	-		900	27	

**SEMESTER IV**

Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Course Total		
<b>Theory</b>										
C	BCADS1401	Big Data Fundamentals	3	1	0	40	60	100	4	IBM
	BCADS1402	Data Science	3	1	0	40	60	100	4	
C	BCADS1403	Web Development	3	1	0	40	60	100	4	School
C	BCA4403	Basics of .NET Framework & C#	3	1	0	40	60	100	4	
C	BCA4404	Data Warehousing & Data Mining	3	1	0	40	60	100	4	
C	BCADS1404	Artificial Intelligence	3	1	0	40	60	100	4	
<b>Practical</b>										
C	BCADS1451	Web Development Lab	0	0	4	40	60	100	2	School
C	BCA4452	Basics of .NET Framework & C# Lab	0	0	4	40	60	100	2	
	GP1401	General Proficiency	-	-	-	100	-	100	1	
<b>Total</b>			18	6	8	-	-	900	29	

<b>SEMESTER V</b>										
<b>Course Category</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Contact Hours</b>			<b>Evaluation Scheme</b>			<b>Credits</b>	<b>Mode</b>
			<b>L</b>	<b>T</b>	<b>P</b>	<b>CIA</b>	<b>ESE</b>	<b>Course Total</b>		
<b>Theory</b>										
C	BCADS1501	Predictive Analytics	3	1	0	40	60	100	4	IBM
C	BCA4502	Mobile Application Development	3	1	0	40	60	100	4	School
C	BCADS1503	Management Information System	3	1	0	40	60	100	4	
GE	-	Generic Elective	3	1	0	40	60	100	4	
OE	-	Open Elective	3	1	0	40	60	100	4	
<b>Practical</b>										
C	BCADS1551	Management Information System Lab	0	0	4	40	60	100	2	School
C	BCA4552	Mobile Application Development Lab	0	0	4	40	60	100	2	
	GP1501	General Proficiency	-	-	-	100	-	100	1	
<b>Total</b>			15	5	8	-		800	25	

<b>SEMESTER VI</b>										
<b>Course Category</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Contact Hours</b>			<b>Evaluation Scheme</b>			<b>Credits</b>	<b>Mode</b>
			<b>L</b>	<b>T</b>	<b>P</b>	<b>CIA</b>	<b>ESE</b>	<b>Course Total</b>		
<b>Practical</b>										
C	BCADS1651	Industrial Training	-	-	-	280	420	700	24	School
	GP1601	General Proficiency	-	-	-	100	-	100	1	
<b>Total</b>								800	25	

**Legends:**

- L Number of Lecture Hours per week
- T Number of Tutorial Hours per week
- P Number of Practical Hours per week
- CIA Continuous Internal Assessment
- ESE End Semester Examination

## Credit Summary Chart

Course Category	Semester						Total Credits	%age
	I	II	III	IV	V	VI		
Basic Sciences		4					4	2.5
Humanities								
Ability Enhancement Compulsory Course	4	4					8	5.1
Professional Subject - Core	20	18	26	28	16	-	108	68.4
Professional Subject – Generic Elective					4		4	2.5
Professional Subject – Open Elective					4		4	2.5
GP	1	1	1	1	1	1	6	3.8
Project Work, Seminar and/or Internship in Industry or elsewhere						24	24	15.2
Total	25	27	27	29	25	25	158	100



## Discipline wise Credit Summary Chart

Course Category	Semester						Total Credits	%age
	I	II	III	IV	V	VI		
F	10						10	6.3
C	10	22	26	28	16	24	126	79.7
GE					4		4	2.5
OE					4		4	2.5
AECC	4	4					8	5.2
GP	1	1	1	1	1	1	6	3.8
<b>Total</b>	<b>25</b>	<b>27</b>	<b>27</b>	<b>29</b>	<b>25</b>	<b>25</b>	<b>158</b>	<b>100</b>

### Category of Courses:

F Foundation Course

C Core Course

GE Generic Elective

OE Open Elective

AECC Ability Enhancement Compulsory Course

## **Generic Elective Subjects List**

1. BCADS1511: IOT & Technology
2. BCADS1512: Distributed System
3. BCADS1513: Cloud Computing
4. BCADS1514: Data Privacy and Laws

**BCACS1105: Basic Mathematics****Course Objective:**

1. To introduce the fundamental concepts of Mathematics this will help and guide students to understand and make comprehensive rest of the course.
2. Understand the foundations of mathematics

**Learning Outcome:** Upon successful completion of the course the student will be able to:

1. Understand the concept of Sequence, Matrices and Determinant.
2. Understand the concept of Differentiation and Integration.
3. Develop and maintain problem-solving skills
4. Be able to perform basic computations in higher mathematics

**Course Contents:**

Module	Course Topics	Hours	Credits
I	<b>Finite and Infinite Sequences:</b> Definition, $n^{\text{th}}$ term, Sum of $n$ terms of sequence, Arithmetic Progression, Geometric Progression and Harmonic Progression. <b>Matrices and Determinant:</b> Definition, Types of matrices, multiplication of matrix by scalar, Sum of matrices, difference of matrices, Product of matrices, Transpose of matrix. Determinant: definition and basic properties.	4 Hours	0
II	<b>Differentiation and Integration:</b> Meaning and geometrical interpretation of derivative, derivatives of simple algebraic and trigonometric function, derivatives of sum/difference, product and quotient of function, <b>Integration:</b> Integration as the inverse of differentiation, Integration of algebraic and trigonometric function, Definite Integral.	4 Hours	0

**Suggested Readings:**

1. O.P. Malhotra, S. K. Gupta, "Mathematics", S. Chand, 2000 Edition
2. Shanti Narain, "Textbook of Matrices", S. Chand

## Semester I

### **BCADS1101: Python with Data Science**

Note: The Course **BCADS1101: Python with Data Science** will be conducted by IBM

## BCADS1101: Python with Data Science

### Course Objective:

1. Using the frameworks necessary to analyze and interpret data
2. To acquire technical expertise using popular open source analytics frameworks for Data Science
3. To define the Demonstrate knowledge of statistical data analysis techniques utilized in business decision making
4. To learn how to Use data mining software to solve real-world problems.

### Learning Outcome: Upon successful completion of the course the student will be able to:

1. Understand programming basics including functions, variables, and data type
2. Data Science lifecycle revolve around using some techniques and other Analytical methods to produce insights and predictions from data to achieve a business objective.
3. Applying and analyzing, is the process of determining which features might be useful in training a model, and then creating those features by transforming raw data found in log files and other sources.
4. Understand Data engineering and data modeling practices using machine learning and Building and create role-playing challenge-based scenarios to propose real-world solutions

### Course Contents:

**Note: Number of Modules will depend on the credits. One module is of 1 credit**

Module	Course Topics	Hours	Credits
I	<b>INTRODUCTION OF PYTHON</b> What is Python, Its advantages and disadvantages, How to run python scripts, How to use variables, String operator and functions, Inputting the data, Working with Boolean and other statements, Use of pandas library for data analysis, Different types of errors that one can encounter while working with Python.	15 Hours	1
II	<b>INTRODUCTION TO DATA SCIENCE</b> What is Data Science, what does a data scientist do, various examples of Data Science in the industries, How Python is deployed for Data Science applications, Various steps in Data Science process like data wrangling, data exploration and selecting the Model	15 Hours	1
III	<b>DATA MANIPULATION AND VISUALIZATION</b> Introduction to NumPy, Pandas and Matplotlib, How to Import NumPy module, what is a data Manipulation using Panda's library? Series object in pandas, Data Frame in Pandas, Loading an handling data with Pandas, Introduction to Matplotlib, Using Matplotlib for plotting Graphs and charts like Scatter, Bar, Pie, Line, Histogram and more	15 Hours	1
IV	<b>SUPERVISED AND UNSUPERVISED LEARNING</b> What is linear regression? Logistic Regression, what is classification? Decision Tree, Confusion Matrix, Random Forest, Naïve Bayes classifier, support vector machine, use cases of unsupervised learning, what is clustering and Types	15 Hours	1

	of clustering. What is K-means clustering and Hierarchical Clustering? Step by step calculation of k-means algorithm		
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**Suggested Readings:**

1. Analytics: Data Science, Data Analysis and Predictive Analytics for Business” by Daniel Covington.
2. Machine Learning for Big Data: Hands-On for Developers and Technical Professionals” by Jason Bell

## BCACS1102: Fundamentals of Information Technology

### Course Objective:

1. The subject focuses on the fundamental of Computer and its peripherals.
2. Subject introduces basics to computer system along with methodology of programming with concepts of C Programming.

**Learning Outcome:** Upon successful completion of the course the student will be able to:

1. Demonstrate the knowledge of the basic structure of computer, History of Computer, Hardware, Software, Input / Output devices.
2. Describe the concept of computer languages, language translators and construct algorithms to solve problems using programming concepts.
3. Learn various constructs of C Language along with proper syntax.
4. Understand the concept of decision control statements and array.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Introduction to Computers:</b> Introduction to computer, Basics of computers and its operation, History of computer, Capabilities and limitations of computers, Types of computers; <b>Hardware:</b> CPU(Architecture & Related Technology) and Microprocessors; <b>Storage Devices:</b> Primary & Secondary; Auxiliary Storage Devices; Cache Memory; Memory Hierarchy; Buffering and Spooling; <b>Software:</b> Types of software; <b>System Software:</b> Control, Development, Management; <b>Input devices:</b> Keyboard, Mouse, Joystick, Stylus, Tablet, Touchpad, Touch Screen, Data Gloves, Camera Scanner, Microphones, Barcode reader, OCR, OMR, MICR; <b>Output Devices:</b> Display; CRT Plasma, LCD, LED, Printers and Plotters, projectors, Speaker, VR Head; Booting and POST; <b>Operating System:</b> Functions, Types; <b>DOS:</b> Internal and External Commands; Basics of MS Office	15 Hours	1
II	<b>Introduction to Programming Concept:</b> Introduction; History of programming languages; <b>Programming Approach:</b> Top-down Approach, Bottom-up Approach; <b>Concept of Translator:</b> Compiler, Interpreter & Assembler; <b>Types of Languages:</b> Machine Language, Assembly Languages, High level Languages; Loader, Linker, Relationship between Compiler, Loader and Linker; Flowchart; <b>Algorithms:</b> Introduction, Definition, Characteristics, Limitations	15 Hours	1

<b>III</b>	<b>Introduction to C:</b> Introduction; Structure of C Program; Writing the first C Program; File used in C Program; Compiling and Executing C Programs Using Comment; <b>Data Type:</b> Primitive, Derived, User-Defined; <b>Token:</b> Keywords, Literals, Identifiers, Variables, Constants; I/O Statements ; <b>Operators:</b> Types of operators, Precedence and Associativity of operators; Programming Examples; Type Conversion and Type Casting	15 Hours	1
<b>IV</b>	<b>Decision Control and Looping Statements:</b> Introduction to <b>Decision Control Statements:</b> IF, IF-ELSE, Nested IF, IF-ELSE ladder, Switch-case; <b>Iterative Statements:</b> FOR loop, WHILE loop, DO-WHILE loop; <b>Jump Statement:</b> Break and Continue	15 Hours	1

**Suggested Readings:**

1. E. Balagurusamy, "Fundamentals of Computers", McGraw Hill Education.
2. Peter Norton's., "Introduction to Computers", McGraw Hill Education.
3. Raja Raman .V, "Fundamentals of Computers", PHI Publications, 3rd Edition, 2004.
4. Thareja R., "Fundamentals of Computers", Oxford University Press.
5. Yashavant P. Kanetkar, "Let us C", BPB
6. E.Balagurusamy, "Programming in ANSI C", TMH Publications.
7. Reema Thareja, "Programming in C", OXFORD University Press



## BCACS1103: Discrete Mathematics

### Course Objective:

1. Students should be able to distinguish between the notion of discrete and continuous mathematical structures.
2. Students should be able to understand the basic concepts of set theory.
3. Students should be able to apply fundamental counting algorithms to solve applied problems in the area of computer science.
4. Students should be able to prove mathematical statements by means of inductive reasoning.
5. Students should be able to understand the principle of recursion and apply it to the study of sequences and sets.

### Learning Outcomes: On completion of this course students will be able to:

1. Verify the correctness of an argument using propositional and predicate logic and truth tables.
2. Demonstrate the ability to solve problems using counting techniques and combinatorics.
3. Solve problems of recurrence relations and generating functions.
4. Use graphs and trees as tools to visualize and simplify network related problems.
5. Perform operations on discrete structures such as sets, functions, relations, and sequences.
6. Construct proofs using direct proof, proof by contraposition, proof by contradiction, proof by cases and mathematical induction.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Discrete Numeric Function and Recurrence Relation:</b> Numeric Function; Generating Function; Recurrence Relation: Linear Recurrence Relation with Constant Coefficients, Homogeneous and Particular Solution, Total Solution, Solution by Method of Generating Function.	15 Hours	1
II	<b>Counting Techniques &amp; Probability:</b> Basics of Counting; Sum and Product rules; Pigeonholes Principle; <b>Combinations and Permutations:</b> Generalized Permutations and Combinations; <b>Probability:</b> Some Basic Concepts, Types of Events, Probability of an Event, Conditional Probability.	15 Hours	1
III	<b>Fundamentals of Logics:</b> Introduction, Proposition, First order Logic, Logical Operation, Truth Values, Compound Proposition, Tautologies, Contradiction, Logical Equivalences, De- Morgan's laws, Duality, Predicates, Universal and Existential Quantifiers.	15 Hours	1
IV	<b>Graph:</b> Simple Graph, Multi Graph, Graph Terminology, Bipartite, Regular and Planar Graph, Directed Graph, Euler Graphs, Hamiltonian Path and Circuits, Graph Coloring, Chromatic Number, Weighted Graphs, Shortest Path in Weighted Graphs.	15 Hours	1

	<b>Tree:</b> Trivial and Non-Trivial Tree, Rooted Tree, Distance and Centers in a Tree, Path Length in Rooted Tree, Spanning Tree, Minimal Spanning Tree, Kruskal's and Prim's Algorithms.		
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**Suggested Readings:**

1. J. P. Tremblay and R. Manohar, "Discrete Mathematical Structure with Application to Computer Science", TMH, New Delhi, 2000.
2. Kolman, Busby and Ross "Discrete Mathematical Structures" PHI/Pearson., 6<sup>th</sup> Ed., 2009.
3. Kenneth H. Rosen, "Discrete Mathematics & Applications", TMH, 6th Ed., 2007.
4. C. L. Liu, "Elements of Discrete Mathematics", McGraw Hill Book Company, 2nd Ed., 1985.
5. Narsingh Deo, "Graph Theory", PHI, 24th Indian Print, 2003.

## BCADS1104: Data Structures using Python

### Course Objective:

1. The objective of this course is to learn fundamental data structures algorithms.
2. The course describes and implements algorithms such as stacks, queues, linked lists, trees, searching techniques, sorting techniques, hashing techniques and graphs.
3. Comprehend alternative implementations using the differing logical relationships and appreciate the significance of choosing a particular logical relationship for implementation within real-world setting.
4. Demonstrate the ability to plan, design, execute and document sophisticated technical programs to handle various sorts of data structures.
5. Be familiar with the use of data structures as the foundational base for computer solutions to problems.
6. Become introduced to and investigate the differing logical relationships among various data items.

**Learning Outcome:** Having successfully completed this course, the student will be able to:

1. Apply advance Python programming techniques to develop solutions for particular problems.
2. Design and implement abstract data types such as linked list, stack, queue and tree by using Python as the programming language using static or dynamic implementations.
3. Analyse, evaluate and choose appropriate abstract data types and algorithms to solve particular problems.
4. Design and implement Python programs that apply abstract data types.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Introduction to Data Structures:</b> Introduction to Data Structure, Classification of Data Structure: Linear, Non-Linear, Python Specific Data Structure; Operations on Data Structure, Algorithms Analysis, Approach to solve algorithm design problems, Types of Case Analysis, Big-O Notation, Abstract Data Type. <b>Array:</b> Creation, array(data_type, value), Basic operations on Array: Adding elements, Accessing elements, Removing elements, Slicing, Searching element, Updating Array; <b>List:</b> Creation, list(), Accessing Elements in List, Negative List Indices ,List Slicing[start:end], Updating List, Deleting List Elements, Built-in list class Methods, List operators, List Comprehension, Difference between list & array; <b>Tuple:</b> Creation, tuple(),Accessing Elements in Tuple, Updating Tuple, Deleting Tuple Elements Built-in tuple class methods, Indexing & slicing, Operations on tuple, List & Tuple	15 Hours	1
II	<b>Set:</b> Creation, set(), Accessing values in set, Adding items in set, Removing items in set, set operator, Built-in set class methods, Set operations: union(), intersection(), difference(), symmetric_difference(); <b>Dictionary:</b> Creation, dict(), Adding values, Replacing values, Retrieving Values, Formatting, Deleting items, Comparing, Built-in dict class methods, Traversing, Nested Dictionary, Traversing Nested Dictionary; 2D Array, Matrix, Map(); <b>Functions:</b> Syntax, use of function, return statement, parameters & arguments;	15 Hours	1

	<p><b>Recursion:</b> Recursive Definition and Processes, Principles of Recursion, Tower of Hanoi Problem, Recursion Vs. Iteration</p> <p><b>Stack:</b> Introduction, Implementation of stack in python, Operations on Stacks: Empty, Full, Push &amp; Pop, Applications of stack, Conversion in Infix, Prefix and Postfix Expressions, Evaluation of postfix expression using stack.</p> <p><b>Queue:</b> Introduction, Implementation of Queues in Python, Operations on Queue: Create, Add, Delete, Full and Empty Queue, Circular Queue, Dequeue and Priority Queue.</p>		
III	<p><b>Classes:</b> Defining Classes: Adding Attributes, Assigning values to an attribute; Self parameters and adding methods to a class, Displaying class attributes and methods, special class attributes, Accessibility, <code>_init_()</code> (Constructor), <code>_del_()</code> (Destructor)</p> <p><b>Link Lists:</b> Linear List concept, Linked List Terminology, Representation of Linked List in Memory, Types of Linked List, Single Linked List, Doubly Linked List, Single Circular Linked list, Circular Doubly Linked List, Operations on Link List: Creation, Traversing, Insert a node(empty list, beginning, middle, end), Delete a node (first, Last, at any position), Traversing node, Searching node, Print list, Count Nodes, Sort Lists, Implementation using Linked List: Stack Queue, Circular Queue, Dequeue, Priority Queue.</p>	15 Hours	1
IV	<p><b>Trees:</b> Introduction to Tree &amp; its Terminology, Binary trees, Types of Binary trees, Representation of Binary Tree, Traversals (Inorder, Preorder, Postorder), Expression Tree, Binary Search Tree, Insertion and Deletion in BST, Heap: Min Heap, Max Heap.</p> <p><b>Graph:</b> Terminology, Representation of Graph: Adjacency Matrix, Incidence Matrix.</p> <p><b>Sorting &amp; Searching Techniques:</b> Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort Sequential/Linear Search, Binary Search.</p>	15 Hours	1

### Suggested Readings:

1. Ashok N. Kamthane & Amit A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Educations
2. Rance D. Necaie, Data Structures and Algorithms Using Python, JOHN WILEY & SONS, INC
3. Hemant Jain, Problem Solving in Data Structures & Algorithms Using Python, Createspace Independent Pub, First edition
4. Narasimha Karumanchi, Data Structure and Algorithmic Thinking with Python, Career Monk (1 January 2015)
5. Brad N. Miller and David L. Ranum, Problem Solving with Algorithms and Data Structures using Python, Franklin, Beedle & Associates
6. Data Structure and Algorithmic Thinking with Python
7. Ellis Horowitz, S. Sahni, D. Mehta, "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi.
8. S. Lipschutz, "Data structures", Mc-Graw-Hill International Editions, 1986.

9. Jean-Paul Tremblay, Paul. G. Soresan, "An Introduction to Data Structures with Applications", Tata Mc-Graw-Hill International Editions, 2nd edition 1984.
10. A. Michael Berman, "Data Structures via C++", Oxford University Press, 2002.
11. M. Weiss, "Data ` in C++", Pearson Education, 2nd Edition, 2002.

## **BSAE2101: Environmental Studies**

Note: The Syllabus **BSAE2101: Environmental Studies** will be approved by the Board of Studies of School of Humanities and Social Sciences

**BCACS1151: Fundamental of Information Technology Lab**

<b>Module</b>	<b>Course Topics</b>	<b>Credits</b>
<b>I</b>	<ol style="list-style-type: none"><li>1. Implementation of internal and external commands of DOS.</li><li>2. Introduction to MSWord, Menus, Shortcuts, Document types</li><li>3. Working with documents and formatting documents.</li><li>4. Creating Tables, inserting files and pictures, working with various tools.</li><li>5. Opening new Presentation, Different presentation templates, setting backgrounds, selecting presentation layouts.</li><li>6. Creating and Formatting of presentation.</li><li>7. Adding Graphics and effects to presentation.</li><li>8. Implementation and working of spreadsheet.</li><li>9. Entering and Editing and Computing data in spreadsheet.</li><li>10. Working with database using MS Access.</li></ol>	1
<b>II</b>	<ol style="list-style-type: none"><li>1. Implementation of Fundamental Data Types.</li><li>2. Implementation of Fundamental Operators.</li><li>3. Implementation of Conditional Program such as if, switch etc.</li><li>4. Implementation of Basic Control Constructs such as for loop, while loop, do while loop.</li><li>5. Implementation of Various Pattern Printing Program.</li><li>6. Implementation of program to print various series.</li></ol>	1

**BCADS1152: Data Structures using Python Lab**

<b>Module</b>	<b>Course Topics</b>	<b>Credits</b>
<b>I</b>	<ol style="list-style-type: none"><li>1. Implementation of Arrays</li><li>2. Implementation of List.</li><li>3. Implementation of tuple.</li><li>4. Implementation of set.</li><li>5. Implementation of dictionary.</li><li>6. Implementation of matrix.</li><li>7. Implementation of 2D Array.</li><li>8. Implementation of Recursive Procedures.</li><li>9. Implementation of Tower of Hanoi.</li><li>10. Implementation of Various Recursive Functions</li><li>11. Implementation of Stack.</li><li>12. Implementation of Queue.</li><li>13. Implementation of Circular Queue.</li><li>14. Implementation of Dequeue.</li><li>15. Implementation of Priority Queue.</li></ol>	1
<b>II</b>	<ol style="list-style-type: none"><li>1. Implementation of various operations on Linked List.</li><li>2. Implementation of various operations on Double Linked List.</li><li>3. Implementation of Stack using Linked List.</li><li>4. Implementation of Queue using Linked List.</li><li>5. Implementation of Circular Queue using Linked List.</li><li>6. Implementation of Dequeue using Linked List.</li><li>7. Implementation of Priority Queue using Linked List.</li><li>8. Implementation of Binary tree.</li><li>9. Implementation of Linear Search.</li><li>10. Implementation of Binary Search.</li><li>11. Implementation of Bubble sort.</li><li>12. Implementation of Merge sort.</li><li>13. Implementation of Insertion sort</li><li>14. Implementation of Selection sort.</li><li>15. Implementation of Quick sort.</li></ol>	1



## Semester II

**BCADS1201: Data Visualization**

**BCADS1202: Cloud Application Development**

Note: The Course **BCADS1201: Data Visualization** and **BCADS1202: Cloud Application Development** will be conducted by IBM

## BCADS1201: Data Visualization

### Course Objective:

1. To learn different statistical methods for Data visualization
2. To learn basics of Watson Studio R and Python.
3. To learn about packages Numpy, pandas and matplotlib
4. To learn functionalities and usages of Seaborn.

**Learning Outcome:** Upon successful completion of the course the student will be able to:

1. Understand and apply statistical methods for Data visualization.
2. Gain knowledge of Watson Studio, R and Python.
3. Identify appropriate data visualization techniques given particular requirements imposed by the data.
4. Acquire and Apply data visualization tools on various data sets.

### Course Contents:

**Note: Number of Modules will depend on the credits. One module is of 1 credit**

Module	Course Topics	Hours	Credits
I	<b>Introduction of Statistics:</b> Introduction to Statistics, Difference between inferential statistics and descriptive statistics, Inferential Statistics-Drawing Inferences from Data, Random Variables, Normal Probability Distribution, Sampling, Sample Statistics and Sampling Distributions. R overview and Installation-Overview and About R, R and R studio Installation, Descriptive Data analysis using R, Description of basic functions used to describe data in R..	15 Hours	1
II	<b>Data Visualization with Watson Studio and Python:</b> Introduction to data visualization, Adding data to data refinery, Visualization of Data on Watson Studio, Data manipulation packages, Data visualization with R. Introduction to Python, installation, Introduction to Jupyter Notebook, Python scripting basics, Numpy and Pandas, Matplotlib overview, Basic plots using matplotlib, Specialized Visualization Tools using Matplotlib, Advanced Visualization Tools using Matplotlib-Waffle Charts, Word Clouds.	15 Hours	1

### Suggested Readings:

1. IBM Courseware
2. R Graphics Essentials for Great Data Visualization by Alboukadel Kassambara
3. Core Python Programming -Second Edition, R. Nageswara Rao, Dreamtech Press.
4. The Visual Display of Quantitative Information (2nd Edition). E. Tufte. Graphics Press, 2001.
5. Envisioning Information, E. Tufte. Graphics Press, 1990.



## BCADS1202: Cloud Application Development

### Course Objective:

1. Understand how deep our industries rely on the cloud computing global infrastructure, Explore the existing ecosystems developed around the concept of API integration.
2. Develop the ability to use the concepts of DevOps, Toolchain and Cloud Foundry.
3. Develop the ability to use services in the IBM Cloud catalog that you can enrich the cloud apps needed to solve a variety of business problems

**Learning Outcome:** Upon successful completion of the course the student will be able to:

1. Able to deploy applications on IBM Cloud.
2. Able to understand how to work on containerization concept using Docker as a Tool and will work on Kubernetes
3. To learn basic concepts of Web-Application security.

### Course Contents:

**Note: Number of Modules will depend on the credits. One module is of 1 credit**

Module	Course Topics	Hours	Credits
I	<b>Introduction to cloud computing</b> , characteristics of Cloud., benefits of Cloud and the factors contributing to its growth., cloud services models (IaaS, PaaS and SaaS), cloud deployment options (Private, Public, Hybrid), cloud-native applications and development methods  <b>Deep Down into IBM Cloud-</b> What is IBM Cloud?, Evolution of IBM Cloud, Distinguish among the various compute options in IBM Cloud, Identify the runtimes and services that IBM Cloud offers, IBM Cloud regions, zones, and multi-availability zones, IBM Cloud dashboard, catalog, and documentation features, starter kits and Cloud Foundry boilerplates., bind services to an application in IBM Cloud, describe the environmental variables that are used with IBM Cloud services, explain function as a service	15 Hours	1
II	Introduction to DevOps- Illustration of DevOps, describe the capabilities of IBM Cloud Continuous Delivery, identify the web-based integrated development environment features in IBM Cloud Continuous Delivery. how to use source code management and Issue tracking, learn how to build and deploy applications using DevOps tools on IBM Cloud.	15 Hours	1

<b>III</b>	REST architecture and Watson APIs- Architecture of Representational State Transfer (REST),representation format of data in REST, advantages of the JavaScript Object Notation (JSON) data format, list the IBM Watson services on IBM Cloud.	15 Hours	1
<b>IV</b>	Introduction to data services on IBM Cloud- Describe different services and databases types and capabilities, types of data services in IBM Cloud, benefits of IBM Cloudant, access Cloudant databases and documents on IBM Cloud, use HTTP APIs to interact with Cloudant database. Enriching your applications with IBM Cloud services- Discuss business problem and goals, identify functional and non-functional requirements, selection of technical components that best fit your solution, design a simple architecture for a cloud application.	15 Hours	1

**Suggested Readings:**

- 1) Cloud Computing Concepts And Technologies- Sunil Kumar Manvi, Gopal Shyam
- 2) The Enterprise Cloud: Best Practices For Transforming Legacy It- James Bond

## **HSAE2201: Communicative English**

**Note:** The Syllabus of **HSAE2201: Communicative English** will be approved by the Board of Studies of School of Applied Sciences

## BCADS1203: Programming with JAVA

### Course Objective:

1. To introduce the fundamental concepts of object oriented Programming.
2. Show competence in the use of the Java programming language in the development of small to medium-sized application programs that demonstrate professionally acceptable coding and performance standard.
3. To familiarize the concepts of packages and interfaces, handling exceptions, and demonstrate the concept of event handling used in GUI
4. To impart foundation for understand java based technologies like HADOOP etc.

### Learning Outcome: On completion of this course students will be able to:

1. Understand the concept of object oriented programming and implement it in Java.
2. Comprehend building blocks of OOPs language, class, objects and method etc.
3. Understand inheritance, package and interfaces.
4. Implement multithreading in object oriented programs; design GUI using AWT Control and understanding about events.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Introduction to Java:</b> Evolution of Java, Features of Java, Byte Code and Java virtual machine, JDK, Structure of Simple Java Program, Compiling and Interpreting Applications, Java Tokens: Java Character set, Keyword and Identifiers. Data Types, Operators and Expression, Control Statements, Looping. <b>Array and String:</b> Single and Multidimensional Arrays, String Class, StringBuffer Class, Operations on String, Command Line Argument, and Use of Wrapper Class.	15 Hours	1
II	<b>Classes, Objects &amp; Methods:</b> Class, Object, Object Reference, Methods in Java, Method Overloading, Constructor, Constructor Overloading, Passing and Returning Object from method, new Operator, this & Static Keyword, finalize() method, Visibility modifiers, Nested Class, Inner Class.	15 Hours	1
III	<b>Inheritance and Polymorphism:</b> Inheritance in Java, Types of Inheritance, Member Access Rule, Use of this and Super Keyword, Abstract class, Dynamic Method Dispatch, Use of final Keyword <b>Package &amp; Interface:</b> Defining and Importing Packages, Defining and Implementing Interfaces, Extending Interfaces. <b>I/O STREAM:</b> Concept of Streams, Streams Classes: Byte and Character Stream, Reading Console input & Writing Console output.	15 Hours	1
IV	<b>Exception Handling:</b> Exception Type, Usage of try, catch, throw, throws and finally Keywords, Creating Own Exception Classes. <b>Multi-Threading:</b> Concept of Thread, Thread Life Cycle, Creating Thread Using Thread Class and Runnable Interface, Thread Priority,	15 Hours	1

	<b>AWT Control:</b> The AWT Class Hierarchy, User Interface Components: Labels, Button, Text Components, Check Box, Check Box group, Choice, List Box, Panels, Working with Frame Class, Fonts and Layout Manager, <b>Event Handling:</b> Events, Event Sources, Event Listeners, EDM, Handling Mouse and Keyboard Events.		
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**Suggested Readings:**

1. Herbert Schild, "The Complete Reference, Java 2 (Fourth Edition)," TMH
2. E.Balaguruswamy, Programming with Java A Primer, Mc Grawhill
3. Head First Java, O'rielly publications
4. Udit Agrawal, "Internet and Java Programming," Dhanpat Rai & Co.



## BCACS1204: Relational Database Management System using SQL

### Course Objective:

1. To present the fundamental concepts of Database Management. To understand conceptual and physical design of a database.
2. To understand RDBMS and to design Relational database and perform various SQL commands.
3. To develop skill of Database Design, Database Languages and Database-System Implementation with respect to Relational Database Management System.
4. To develop the concepts of Transaction Processing System, Concurrency control and Recovery procedures in database.

**Learning Outcome:** Students who have successfully completed this course will have understanding of the following concepts:

1. Students will be able to understand the basic concepts of the database and data models.
2. Design a database using ER diagrams and map ER diagrams into Relations.
3. Develop a simple database applications using normalization.
4. Understand Concurrency, Recovery and Security mechanism in DBMS.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Introduction:</b> Meaning of data and information, need for data, data processing and information. Meaning of persistent data, Meaning of file and file management system. File Structure and Organization, Introduction, Logical and Physical Files, Basic File Operations, File Organization, Types of file organization. <b>Database Management System:</b> Introduction, Definition of DBMS, Evolution of DB & DBMS, Characteristics of the Database Approach, Components of Database System, database management system vs. file management system, Advantages and Disadvantages of DBMS, Users of DBMS, DBMS Architecture, Capabilities of good DBMS, Database Schemas and Instances, Classification of Database Management Systems, database languages; <b>Data Models:</b> Introduction Data Models: Object Based Logical Model; Record Based Logical Model: Relational Model, Network Model, Hierarchical Model; Entity Relationship Model.	15 Hours	1
II	<b>Relational Database Management System &amp; Data Modeling:</b> Introduction to relational database, Structure of Relational Database, Data Modeling Using the Entity-Relationship Model: Entity Types, Entity Sets, Attributes, and Keys, Relationships, Relationship Types, Rules, and Structural, Constraints, Weak Entity Types, ER Diagrams, Naming Conventions, and Design Issues. Relational Data Model, Relational Constraints, Relational model terminology; domains, Attributes, Tuples, Relations, <b>Relational Algebra:</b> Basic operations selection and projection, Set Theoretic operations Union, Intersection, set difference and division, Codd's Rules for relational algebra, Relational Database Schemas, Examples of Queries in Relational Algebra	15 Hours	1

<b>III</b>	<p><b>SQL and Database Design Theory:</b> The Relational Database Standard: Data Definition, Constraints, and Schema Changes in SQL, Types of SQL Commands(DDL, DML, DCL), SQL Operators and their Precedence, Insert, Delete, and Update Operations and Dealing with Constraint Violations, Queries and Sub Queries, Aggregate Functions, Joins, Unions, Intersection, Minus, Views (Virtual Tables) in SQL.</p> <p><b>Functional Dependencies and Normalization:</b> Informal Design Guidelines for Relation Schemas, Functional Dependencies, Anomalies in a Database ,Armstrong Rules, Closure of Attributes, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Forms.</p>	15 Hours	1
<b>IV</b>	<p><b>Transaction Processing &amp; Concurrency Control:</b> Transaction Processing Concepts; Introduction to Transaction Processing, Consistency and Isolation, Atomicity and Durability, Transaction and System Concepts, Desirable Properties of Transactions. Transaction logs, Importance of backups. Database recovery. Data storage. Causes, of failures. Recovery concepts and terminology.</p> <p><b>Concurrency Control:</b> Definition of concurrency, lost update, dirty read and incorrect summary problems due to concurrency.</p>	15 Hours	1

### Suggested Readings:

1. Korth, Silbertz, Sudarshan —Data Base Concepts, McGraw-Hill.
2. Elmasri, Navathe —Fundamentals Of Data Base Systems, Addison Wesley.
3. Date C. J.—An Introduction to Data Base System, Addison Wesley.
4. Bipin C. Desai —An introduction to Data Base Systems, Galgotia Publication.
5. Ramakrishnan, Gehrke —Data Base Management System, McGraw-Hill.
6. Connolly & Begg —Database Systems: A Practical Approach to Design, Implementation and Management, Pearson Education.
7. R. S. Deshpande --SQL/PL SQL forOracle.
8. Ivan Bayross -- SQL, PL/SQL: The Programming Language of Oracle, BPP Publication.

## BCADS1205: Statistical Mathematics

### Course Objective:

5. Analyze statistical data graphically using frequency and cumulative frequency distribution.
6. Analyze statistical data using central tendency and dispersion.
7. Use the basic probability concept and rules including additive and multiplicative laws.
8. Derive the probability density function of transformation of random variables.

**Learning Outcome:** Upon successful completion of the course the student will be able to:

1. To apply statistical distributions for real life problems.
2. To draw valid inferences based on the analysis of statistical data.
3. Learn the mathematical and statistical foundations of statistical inference.
4. Implement the concept probability and probability distribution.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Population, Sample and Data Condensation:</b> Definition and scope of Statistics, Concept of population simple with illustration, Raw data, attributes and variables, Classification, Frequency distribution, Cumulative frequency distribution. Different Frequency Chart: Histogram, Frequency Curve, Pi-Chart etc. <b>Measurement of Central Tendency:</b> Concept of Central Tendency, requirements of a good measures of central tendency, Types of Central Tendency: Arithmetic Mean, Geometric Mean, Harmonic Mean, Median and Mode for grouped and ungrouped data.	15 Hours	1
II	<b>Measures of dispersion:</b> Concept of dispersion, Absolute and Relative Measures of Dispersion: Range, Inter Quartile Range, Mean Deviation, Standard Deviation <b>Correlation and Regression:</b> Concept and types of correlation: Karl Pearson's, Spearman's Rank correlation, Linear Regression: Concept and line of best fit(Y on X and X on Y).	15 Hours	1
III	<b>Probability and Expected Value:</b> Experiment, Sample Space, Event, Types of Event, Probability: Classical Approach, Subjective Approach, Axiomatic Approach & Modern Definition; Probability Theorems (Additive, Multiplicative), Conditional Probability, Bayes's Theorem, Mathematical Expectation, Random Variable & Probability Distribution of Random Variable.	15 Hours	1
IV	<b>Theoretical Distributions:</b> Meaning of Theoretical Distributions, Difference between Theoretical & Observed Frequency Distributions, Binomial Distribution, Properties and Constants of Binomial Distribution; Poisson Distribution, Characteristics, Properties and Constants of Poisson Distribution, Poisson Distribution as an Approximation of Binomial Distribution; Normal Distribution, Properties and Constants of Normal	15 Hours	1

	Distribution, Relation between Binomial, Poisson & Normal Distribution.		
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**Suggested Readings:**

3. S.C. Gupta, "Fundamental of Statistics ", Second Edition
4. Roy D. Yates and David J. Goodman, "Probability and Stochastic Processes-A friendly introduction for Electrical & Computer Engineers, Second Edition
5. Rohatgi V, "An Introduction to probability and Mathematical Statistics" Wiley Eastern Ltd. New Delhi
6. Johnson, S. and Kotz, "Distributions in Statistics", Vol. I, II and III, Houghton and Mifflin

## BCACS1206: Human values and Professional Ethics

### Course Objectives:

1. The subject distinguishes between values and skills, and understand the need, basic guidelines, content and process of value education.
2. The subject focuses on understanding the harmony at all the levels of human living, and live accordingly.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

### Learning Outcome: Upon successful completion of the course the student will be able to:

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society
4. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Introduction:</b> need, basic guidelines, content and process for Value Education; Self-Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self-exploration; Continuous Happiness and Prosperity- A look at basic Human Aspirations; Right understanding; Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority; Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario; Method to fulfill the above human aspirations: understanding and living in harmony at various levels	15 Hours	0
II	<b>Understanding Harmony in the Human Being and family:</b> Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’, Understanding the needs of Self (‘I’) and ‘Body’ , Understanding the Body as an instrument of ‘I’, Understanding the characteristics and activities of ‘I’ and harmony in ‘I’, Understanding the harmony of I with the Body; correct appraisal of Physical	15 Hours	0

	needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya; Understanding harmony in the Family: the basic unit of human interaction , Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family), Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society; Undivided Society (Akhand Samaj); Universal Order - from family to world family		
III	<b>Understanding Harmony in the Nature and Existence:</b> Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.	15 Hours	0
IV	<b>Implications of the above Holistic Understanding of Harmony on Professional Ethics:</b> Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.	15 Hours	0

#### Suggested Readings:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics
2. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
3. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991

**BCADS1251: Programming with JAVA Lab**

<b>Module</b>	<b>Course Topics</b>	<b>Credits</b>
<b>I</b>	<ol style="list-style-type: none"><li>1. <a href="http://www.horstmann.com/bigcpp/labs/BigC_ch1.htm">http://www.horstmann.com/bigcpp/labs/BigC_ch1.htm</a>Implementation of a simple Java Program, Interpreting &amp; Compiling.</li><li>2. Implementation of Fundamental Data Type.</li><li>3. Implementation of control, such as Loop etc.</li><li>4. Implementation of Single and Multidimensional Array.</li><li>5. Implementation of String class and String Operations.</li><li>6. Implementation of Classes and Objects.</li><li>7. Implementation of Method in Java.</li><li>8. Implementation of Constructors and Constructor Overloading.</li><li>9. Implementation of Access Modifier.</li><li>10. Implementation of static and this keyword.</li></ol>	1
<b>II</b>	<ol style="list-style-type: none"><li>1. Implementation of Inheritance in Java</li><li>2. Implementation of Super Keyword.</li><li>3. Implementation of Abstract class and final Keyword.</li><li>4. Defining and Importing Packages.</li><li>5. Defining and Implementing Interface.</li><li>6. Implementation of I/O Stream.</li><li>7. Implementation of Exception Handling</li><li>8. Handling of Multiple Threads.</li><li>9. Implementation of AWT Control.</li><li>10. Implementation of Event Handling.</li></ol>	1

**BCACS1252: Relational Database Management System using SQL Lab**

<b>Module</b>	<b>Course Topics</b>	<b>Credits</b>
<b>I</b>	<ol style="list-style-type: none"><li>1. Use of DDL for creating objects (Table, Database).</li><li>2. Use of DML for performing retrieval operations.</li><li>3. Use of DCL for specifying constraints on tables.</li><li>4. Use of commands for aS Changes in SQL.</li><li>5. Use of Aggregate Functions.</li><li>6. Use of Different Operators in SQL.</li><li>7. Use of String Functions.</li></ol>	1
<b>II</b>	<ol style="list-style-type: none"><li>1. Grouping of Records.</li><li>2. Ordering of Records.</li><li>3. Creating and Performing various operations on Views.</li><li>4. Performing Subqueries.</li><li>5. Performing queries for Union &amp; intersection, difference, Cartesian product and division.</li><li>6. Performing queries for various Joins.</li></ol>	1



## BCADS1301: Descriptive Analytics

**Note: Syllabus Provided by IBM**

### Course Objective:

1. Understand how analytics provided a solution to industries using real case studies
2. To learn the importance of analytics and how its transforming the world today
3. Describe a reporting application, its interface, and the different report types and prompts.
4. Learn the implementation of conditional formatting and different layout to work on.

**Learning Outcome:** Upon successful completion of the course the student will be able to:

1. To understand and implement the concept of configuring and using IBM Cognitive Analytics Tool.
2. Understand how a business analysis software works, and its architecture
3. Create different types of advanced reports.
4. Learn to create gauge, pie charts and RAVE visualizations

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Changing business with data insight Overview:</b> Understand how analytics is transforming the world, Understand the profound impact of analytics in business decisions, Understand what is analytics and how it works, Understand why business analytics has become important in various industries, Understand the history of analytics and how it has changed today, Understand how to analyze unstructured data, Understand how analytics is making the world smarter, Understand where the future of analytics lies, Explain why successful enterprises need business analytics, Understand how business analytics can help turn data into insight, Understand how predictive analytics is transforming all types of organizations, Explain how analytics supports retail companies, Understand how analytics can reduce crime rates and accidents, Explain the use of analytics in law enforcement and insurance companies, Understand how analytics can affect the future of education, Predictive Analytics Modeler, Big Data Developer, Data Warehouse Developer	15 Hours	1
II	<b>IBM Cognos Analytics for Consumers:</b> Introduction to IBM Cognos Analytics – Reporting What is IBM Cognos Analytics – Reporting, Explore the environment, Examine the side panel, Explore authoring templates, Generate the report, Create list reports Examine list reports, Group data, Format list columns, Include list headers and footers Focus reports using filters Create filters, Filter your data with advanced detail filters, Create crosstab reports Create a	15 Hours	1

	crosstab report, Add measures to crosstab reports, Data sources for crosstabs.		
<b>III</b>	<b>Accessing the data warehouse and present data graphically:</b> Extend reports using calculations Derive additional information from the data source, Add run-time information to your report, Add Date/Time functions to your report, Add string functions to your report. Information integration Components, Functions, Information integration, The challenges, Data workflow, Present data graphically Create a chart report, Different chart options, Create charts containing peer and nested items, Create and reuse custom chart palettes, Add data-driven baselines and markers to charts, Focus reports using prompts Examine parameters and prompts, Create a parameter item on the report, Build a prompt page, Add a prompt item to a report, Use additional report building techniques Enhance report design, Add objects, Organize objects using tables, Break a report into sections, Convert a list to a crosstab, Reuse objects within the same report.	15 Hours	1
<b>IV</b>	<b>Wrap up and planning considerations and customize reports:</b> Wrap up and Planning considerations Summary and Planning Considerations, Data insight, The big picture, Bringing all together, Suggestions for success. Customize reports with conditional formatting Change displays based on conditions, 3 steps for conditional formatting, Step 1. Create a variable, Step 2. Assign the variable to a report object, Step 3. Apply formatting to object based on condition value. Drill-through definitions Let users navigate to related data in IBM Cognos Analytics, Set up drill-through access from a report, Package-based drill through, Specify the values passed to target parameters, Steps to set up a package-based drill-through definition, Limit the items that users can drill through from, Drill Through Assistant. Enhance report layout View the structure of the report, Force page breaks in reports, Horizontal pagination, Modify structures	15 Hours	1

#### **Suggested Readings:**

1. IBM Courseware
2. Analytics: Business Intelligence, Algorithms and Statistical Analysis (Predictive Analytics, Data Visualization, Data Analytics, Business Analytics, Decision Analysis, Big Data, Statistical Analysis)” by Todd J Blatt
3. Learning Spark: Lightning-Fast Big Data Analysis by Holden Karau
4. Python for Everybody: Exploring Data in Python 3 by Dr. Charles Russell SeveranceManaging Your Business
5. The Wall Street Journal Guide To Information Graphics: The Dos And Don’ts of Presenting Data, Facts, And Figures

## BCADS1302: NO SQL and DbaaS 101

**Note: Syllabus Provided by IBM**

### Course Objective:

1. Students will understand fundamental concepts of a number of different NOSQL products.
2. Students will also learn various CRUD operations and the querying mechanisms in NOSQL.
3. Students will also comprehend with advanced topics.
4. Use the MongoDB tools to develop and deploy your applications.
5. Implement Java/ Python / PHP web application for a real world problem with MongoDB.

**Learning Outcome:** Upon successful completion of the course the student will be able to:

1. Define, compare and use the four types of NoSQL Databases (Document-oriented, Key Value Pairs, Column-oriented and Graph).
2. Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.
3. Explain the detailed architecture, define objects, load data, query data and performance tune Document-oriented NoSQL databases.
4. Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Key-Value Pair NoSQL databases.

### Course Contents:

Module	Course Topics	Hours	Credits
I	Definition of NOSQL, History of NOSQL and different NOSQL Products Interfacing Exploring Mongo DB java, Exploring Mongo DB Ruby/Python, Interfacing and Interacting with NOSQL Interacting with NOSQL	15 Hours	1
II	Data Model Design (Embedded Data Models and Normalized Data Models), Querying NOSQL stores, Modifying Data Stores and Managing Evolution MongoDB Use Cases, Understanding the NOSQL architecture, Understanding the, NOSQL architecture, Understanding the, NOSQL architecture, Performing CRUD	15 Hours	1
III	NOSQL in cloud, Parallel Processing with Map Reduce, Big Data with Hive Surveying Database, Migrating from RDBMS to NOSQL, Query for All Documents in a Collection Query by a Top Level Field	15 Hours	1
IV	Batch Processing, Data Aggregation, Indexing, Replication via Replica Sets, Query by a Field in an Embedded Document, Query by a Field in an Array, Specify Conditions with Operators, Combine Condition, Auto-Sharding, Shard Keys, Horizontal Scalability, MongoDB-Java/Python	15 Hours	1

**Suggested Readings:**

1. David Hows, “The definitive guide to MongoDB”, 2nd edition, Apress Publication, 2009, 8132230485.
2. Shakuntala Gupta Edward, “Practical Mongo DB ”, Second edition, Apress Publications, 2016, ISBN 1484206487

## BCA4301: Basics of Design & Analysis of Algorithms

### Course Objective:

1. To know the importance of studying the complexity of a given algorithm.
2. To study various algorithmic design techniques.
3. To utilize data structures and/or algorithmic design techniques in solving new problems.
4. To know and understand basic computability concepts and the complexity classes P, NP, and NP-Complete.
5. To study some techniques for solving hard problems.

**Learning Outcome:** Upon successful completion of the course the student will be able to:

1. Prove the correctness and analyze the running time of the basic algorithms for those classic problems in various domains.
2. Apply the algorithms and design techniques to solve problems.
3. Analyze the complexities of various problems in different domains.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Basic Concepts of Algorithms:</b> Definition of algorithm; Characteristic of algorithm; Pseudo Codes & Time Complexity of Basic Control Structures; Time and Space Complexity of Insertion Sort; Selection Sort; Heap Sort; Bubble Sort; Asymptotic Notations (Growth of Functions).	15 Hours	1
II	<b>Divide and conquer:</b> Binary Search, Maximum & Minimum, Merge Sort, Quick Sort, Strassen's matrix multiplication; <b>Greedy Method:</b> General method, Knapsack Problem, Travelling Salesman problem, Job Sequencing with deadline, Optimal Storage on tapes, Huffman Codes, An Activity Selection Problem.	15 Hours	1
III	<b>Dynamic Programming:</b> Assembly Line Scheduling, Matrix Chain Multiplications, Longest Common Subsequence; <b>Backtracking:</b> General method, N Queens Problem, Sum of subsets, Hamiltonian Circuit Problem.	15 Hours	1
IV	<b>Branch &amp; Bound:</b> Introduction, Live Node, Dead Node and Bounding Functions, Travelling Salesman Problem, Knapsack Problem, Assignment Problem; <b>Analysis of Graph Algorithms:</b> Elementary Graph Algorithms, Multistage Graphs, <b>Minimum Spanning Trees:</b> Kruskal's & Prim's Algorithm, Single Source Shortest Path: Dijkstra's & Bellman Ford, All Pairs Shortest Path: Warshal Algorithm, Maximum Flow: Ford Fulkerson Algorithm	15 Hours	1

### Suggested Readings:

1. Thomas H. Cormen, "Introduction to Algorithms", PHI.
2. Horowitz & Sahani, "Fundamental of Algorithms", Galgotia.
3. Aho, "Design & Analysis of Computer Algorithms", Pearson.
4. Johnsonbaugh, "Algorithms", Pearson.
5. Bressard "Fundamental of Algorithm", PHI.

6. Jon Kleinberg and Eva Tardos “Algorithm Design”, Pearson Education, 2006.

## BCACS1302: Basics of Operating System

### Course Objective:

1. Able to Understand Operating systems and Different types of Operating systems.
2. Develop an understanding of Processes, and CPU scheduling and able to solve process synchronization problems.
3. Understand issues resource allocation and manage deadlock handling and memory management.
4. Explain paging and segmentation methods suitable for virtual memory.
5. Able to manage disk spaces management of file systems.

### Learning Outcomes: Upon successful completion of the course the student will:

1. Understand the main principles and techniques used to implement processes and threads as well As the different algorithms for process scheduling.
2. Understand the main mechanisms used for inter-process communication.
3. Be able to give the rationale for virtual memory abstractions in operating systems.
4. Have the ability to evaluate security risks in operating systems and understand the role operating systems can and should play in establishing security.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Introduction and Process Management:</b> Operating System: System Components, System Calls and its types, System Programs; Types of Operating System; Operating System Structure: Simple Structure, Layered Approach, Microkernels, Exokernels; Virtual machine; Introduction to Process: Process States, Process Control Block; Process Scheduling: Scheduling Queues, Schedulers, Context Switch, Scheduling Objectives, Scheduling Criteria; Scheduling Algorithms: First Come First Serve, Shortest Job First, Round Robin, Priority; Multiple- Processor Scheduling; Real-Time Scheduling; Multilevel Feedback Queue Scheduling; Threads.	15 Hours	1
II	<b>Process Synchronization and Deadlocks:</b> Critical Section Problem; Peterson's Solution; Semaphore: Usage of Semaphore; Classical Problems of Synchronization: Producer-Consumer, Readers-Writer, Dining Philosophers; Deadlock System Model; Deadlock Characterization: Necessary Condition, Resource Allocation graph; Deadlock Handling Methods: Deadlock Prevention, Deadlock Avoidance Mechanisms: Resource Allocation graph Algorithm, Banker's Algorithm, Deadlock Detection and Recovery.	15 Hours	1
III	<b>Memory Management:</b> Memory Management Strategies: Address Binding, Logical and Physical Address Space, Dynamic Linking; Swapping; Contiguous and Non-Contiguous Memory Allocation; Paging; Segmentation; Virtual Memory Management Concept; Demand Paging;	15 Hours	1

	Page Replacement Policies: Basic Page Replacement, FIFO Page Replacement, LRU Page Replacement, Optimal Page Replacement, Counting Based Page Replacement; Allocation of Frames: Minimum Number of Frames, Allocation Algorithm, Global Versus Local Allocation; Thrashing: Cause of Thrashing, Working Set Model.		
IV	<b>Storage Management:</b> File Concept: File Attribute, File Operations, File Types, File Structure; File Access Method: Sequential Method, Direct Access Method; Directory Structure; File System Implementation: File System Structure, Allocation Methods, Free space Management; <b>Secondary Storage Structure:</b> Disk Structure, Disk Scheduling Algorithms, Disk Management.	15 Hours	1

**Suggested Readings:**

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", Wiley India, 2009, 8th edition.
2. Andrew S. Tanenbaum, "Modern Operating Systems", PHI, 3rd Edition
3. Elmasri, Carrick, Levine," Operating Systems: A Spiral Approach ", TMH



## BCADS1303: Software Engineering

### Course Objectives:

1. Software engineering is a subject that emerged recently as a result of the need to manage software projects that are rising in demand day by day.
2. Software is developed in diverse areas and the fact that a systematic approach is required to manage their development spawns this interesting subject of study.
3. After successfully completing this module the student will be able to explain the software engineering principles and techniques that are used in developing quality software products.

**Learning Outcomes:** After successful completion of this course, the students would be able to:

1. Develop the understanding of Development Life Cycle.
2. Preparation of SRS, High Level, Low Level Design and Test Cases.
3. Aware about the various types of project management activities.
4. Know how to ensure quality during software development life cycle.

### Course Contents:

Module	Course Topics	Total Hours	Credits
I	<b>Overview of System:</b> Introduction, Characteristics, Elements, Types of System. <b>Introduction Software Engineering and Models:</b> Introduction to Software Engineering, Software Components, Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Development Life Cycle (SDLC), <b>Models:</b> Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.	15 hours	1
II	<b>Software Requirement Analysis and Project Planning:</b> Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS; Project Planning; Software Cost Estimation: COCOMO model.	15 hours	1
III	<b>Software Analysis &amp; Design:</b> Basic Concept of Software Design, Architectural Design. <b>Low Level Design:</b> Modularization, Design Structure Charts, Coupling and Cohesion Measures. <b>Design Strategies:</b> Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics.	15 hours	1
IV	<b>Coding, Testing and Maintenance:</b> Introduction to Software Coding: Coding Standards and Guidelines, Testing Objectives, Types of Testing, Walk Through, Code Inspection, Compliance with Design and	15 hours	1

	Coding Standards, Software Quality Assurance, Levels of Software Quality Assurance, Quality Attributes. <b>Software Maintenance:</b> Need for Maintenance, Categories of Maintenance, Software Re-Engineering, Reverse Engineering.		
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**Suggested Readings:**

1. R. S. Pressman, "Software Engineering: A Practitioners Approach", McGraw Hill.
2. Rajib Mall, "Fundamentals of Software Engineering", PHI Publication.
3. Pankaj Jalote, "Software Engineering", Wiley.
4. Carlo Ghezzi, M. Jarayeri, D. Manodrioli, "Fundamentals of Software Engineering", PHI Publication.
5. Ian Sommerville, "Software Engineering", Addison Wesley.
6. Kassem Saleh, "Software Engineering", Cengage Learning.

## BCACS1304: Basics of Computer Organization & Architecture

**Course Objective:** Provide a better understanding of Computer Organization, its designing & implementation.

1. Explain Computer performance measurement methods.
2. Student should learn how to quantitatively evaluate different designs and organizations.
3. Student should be able to articulate design issues in the development of processor or other components that satisfy design requirements.

**Learning Outcome:** Upon successful completion of the course the student will:

1. Describe software and hardware interaction layers in computer architecture.
2. Describe various machine language instructions.
3. Be familiar with the terminology and basic principles of Digital electronics and Computer organization systems.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Introduction to Digital Electronics:</b> Number System, Boolean Algebra, Minimization of Boolean Expressions using K-Map; Logic Gates: Implementations of Logic Functions using Gates; <b>Combinational Circuits:</b> Introduction to combinational circuits, Adders & Subtractors; Multiplexer & De-Multiplexer; Decoder; <b>Sequential Circuit:</b> Introduction to Flip Flops, Types of Flip flop, Introduction of Registers; Classification of Registers, Introduction of Counter; Synchronous and Asynchronous counter.	15 Hours	1
II	<b>Register Transfer and Micro-operation:</b> Register Transfer Language: Register Transfer, Bus and Memory Transfer; Micro operations: Arithmetic, Logical, Shift micro- operations; Arithmetic logic shift unit; Timing and control; <b>Basic Computer Organizations and Design:</b> Instruction Cycle; Memory Reference Instructions; Register Reference Instructions; Input-Output Instructions; Instructions Format. <b>Central Processing Unit:</b> Accumulator based organization; General register organization; Stack organization; Addressing modes; RISC vs. CISC, Hard wired & micro programmed control Unit	15 Hours	1
III	<b>I/O Organizations:</b> Introduction to system buses; Input/ output interface; Interrupt; Serial Vs Parallel communications; Synchronous Data Transfer; Asynchronous Data Transfer methods: Strobe Control, handshaking; Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O. DMA; DMA: DMA Controller, DMA Transfer.	15 Hours	1
IV	<b>Memory organizations:</b> Memory hierarchy; Main Memory: RAM Chips, ROM Chips; Address Mapping; Auxiliary Memory; Cache memory: Mapping Techniques: Direct mapping, Associative mapping, Set associative mapping; Associative memory; <b>Microprocessor:</b> Introduction to 8085 microprocessor with instruction set and programming concepts	15 Hours	1

**Suggested Readings:**

1. M. Morris Mano “Digital Logic and Computer Design”, 2<sup>nd</sup> Edition, PHI.
2. P. Raja, “Switching Theory”, Fourth Edition, Umesh Publication.
3. M. Morris Mano, “Computer System Architecture”, PHI
4. William Stalling, “Computer Organization & Architecture”, Pearson Education Asia
5. R. S. Goankar, “Microprocessor architecture, Programming and application with 8085”, Pen Ram International

**BCACS1351: Basics of Design & Analysis of Algorithm Lab**

<b>Module</b>	<b>Course Topics</b>	<b>Credits</b>
<b>I</b>	<ol style="list-style-type: none"><li>1. Implementation of 1D and 2D Arrays</li><li>2. Implementation of Bubble sort.</li><li>3. Implementation of Insertion sort</li><li>4. Implementation of Selection sort</li><li>5. Implementation of Merge sort.</li></ol>	<b>I</b>
<b>II</b>	<ol style="list-style-type: none"><li>1. Implementation of Quick sort.</li><li>2. Implementation of Heap sort</li><li>3. Implementation of Binary Search.</li><li>4. Implementation of Linear Search</li><li>5. Program to Implement Strassen's Algorithm.</li></ol>	<b>I</b>

**BCACS1352: Basics of Computer Organization Lab**

<b>Module</b>	<b>Course Topics</b>	<b>Credits</b>
<b>I</b>	<ol style="list-style-type: none"><li>1. Implementation of Gates.</li><li>2. Verification of various gates (NOT, OR, AND, Ex-OR, Ex-NOR) using universal gates. (NAND &amp; NOR).</li><li>3. Implementation of Adders</li><li>4. Implementation of Subtractors</li><li>5. Proving of Characteristic table of different Flip Flops</li></ol>	1
<b>II</b>	<ol style="list-style-type: none"><li>1. Write a program using 8085 &amp; verify for :<ol style="list-style-type: none"><li>A. Addition of two 8-bit numbers.</li><li>B. Addition of two 16-bit numbers (with carry).</li></ol></li><li>2. Write a program using 8085 &amp; verify for :<ol style="list-style-type: none"><li>A. Subtraction of two 8-bit numbers. (display of barrow)</li><li>B. Subtraction of two 16-bit numbers. (display of barrow)</li></ol></li><li>3. Write a program using 8086 for arranging an array of numbers in descending order &amp; verify.</li><li>4. Write a program using 8085 for finding First and second</li><li>5. Compliment of an 8-bit number.</li><li>6. Write a program using 8085 for finding first and second Compliment of 16-bit number.</li><li>7. Write a program using 8085 for left shift 8-bit number by 2.</li><li>8. Write a program using 8085 for left shift 16-bit number by 2.</li></ol>	1

## BCADS1401: Big Data Fundamentals

**Note: Syllabus Provided by IBM**

### Course Objective:

1. To provide an overview of an exciting growing field of big data analytics.
2. To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce.
3. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
4. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

**Learning Outcome:** Upon successful completion of the course the student will be able to:

1. Develop an understanding of the complete open-source Hadoop ecosystem and its near term future direction
2. Understand the functions and features of HDP
3. Understand the MapReduce model v1 and review java code
4. Develop an understanding of the complete open-source Hadoop ecosystem and its near-term future directions

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Introduction to Big Data:</b> Explain what Big Data is, Describe the complete open-source Hadoop ecosystem and its near-term future directions, Describe the major challenges of data, Explain how the growth of interconnected devices contributes big data, List real-life examples of Big Data, List the types of Big Data, Identify Big Data use cases, Describe the evolution from traditional data processing to big data processing Introduction to RDBMS With DDL, DML, DCL Commands, HDFS commands. Explain the basic need for a big data strategy in terms of parallel reading of large data files and internode network speed in a cluster, Describe the nature of the Hadoop Distributed File System (HDFS), Explain the function of NameNode and DataNode in a Hadoop cluster, Explain how files are stored and blocks (splits) are replicated.	15 Hours	1
II	<b>Introduction to Hortonworks Data Platform (HDP)</b> Describe the functions and features of HDP, List the IBM added value components, Describe the purpose and benefits of each added value component. Explain the purpose of Apache Ambari in the HDP stack, Describe the overall architecture of Ambari and its relation to other services and components of a Hadoop cluster.	15 Hours	1

<p style="text-align: center;"><b>III</b></p>	<p><b>Storing and querying data</b>          Explain the purpose of Apache Ambari in the HDP stack, Describe the overall architecture of Ambari and its relation to other services and components of a Hadoop cluster, List the functions of the main components of Ambari, Explain how to start and stop services with the Ambari Web UI. Hive introduction, bucketing, partitioning of data using hive, pig introduction.</p>	<p style="text-align: center;">15 Hours</p>	<p style="text-align: center;">1</p>
<p style="text-align: center;"><b>IV</b></p>	<p><b>Data processing with different Hadoop Tools</b>           Describe the MapReduce programming model, Describe Hadoop v1 and MapReduce v1 and list their limitations, Describe Apache Hadoop v2 and YARN, Compare Hadoop v2 and YARN with Hadoop v1, Explain the nature and purpose of Apache Spark in the Hadoop ecosystem, Describe the architecture and list the components of the Apache Spark unified stack, Describe the role of a Resilient Distributed Dataset (RDD), Explain the principles of Apache Spark programming, List and describe the Apache Spark libraries, Start and use Apache Spark Scala and Python shells. Introduction of map reduce with java/python code.</p>	<p style="text-align: center;">15 Hours</p>	<p style="text-align: center;">1</p>

**Suggested Readings:**

1. Bigdata Analytics by Shankarmani wiley
2. IBM material
3. Hadoop in Practice. by Alex Holmes. .



## BCADS1402: Data Science

**Note: Syllabus Provided by IBM**

### Course Objective:

1. To acquire technical expertise using popular open source analytics frameworks for Data Science
2. To understand the scientific method for Data Science, use cases, and the Data science team Key roles
3. To define the Demonstrate knowledge of statistical data analysis techniques utilized in business decision making
4. To learn how to Use data mining software to solve real-world problems.

**Learning Outcome:** Upon successful completion of the course the student will be able to:

1. Understand the scientific method for analytics projects, and the data science team key roles
2. Data Science lifecycle revolve around using some techniques and other Analytical methods to produce insights and predictions from data to achieve a business objective.
3. Applying and analyzing, is the process of determining which features might be useful in training a model, and then creating those features by transforming raw data found in log files and other sources.
4. Understand Data engineering and data modeling practices using machine learning and Building and create role-playing challenge-based scenarios to propose real-world solutions

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>INTRODUCTION TO DATA SCIENCE</b> Data Science overview, Data Science domains with roles, Data Analytics in Practice with Methodologies, Data Science Method, Accessing IBM Cloud and Watson Studio.	15 Hours	1
II	<b>IMPLEMENT DATA TECHNIQUES ON THE CLOUD</b> Integrated Environments for Data Science Projects, Cloud based Data science lifecycle with capabilities, Understand Business needs, explore and prepare the data.	15 Hours	1
III	<b>REPRESENT AND TRANSFORM DATA AND Data Modeling</b> Statistics and Representation Techniques, Understand Data Transformation, Represent and Transform unstructured data, Data Transformation Tools, Decision-centered visualization, Fundamentals of Visualization, Common graphs, Common tools, understand the popular open source data science frameworks. Understand modeling and Machine Learning techniques, Accuracy Precision & recall, Model Deployment and Techniques, Building and Deploying models using AutoAI	15 Hours	1

<b>IV</b>	<b>Various approaches to Machine Learning</b> About Machine learning techniques like Regression to neural nets, Decision tree classifier, Machine learning Framework, Auto insurance Fraud Analyzed in Jupyter Notebooks.	15 Hours	1
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**Suggested Readings:**

1. Introduction to Probability – By Joseph K. Blitzstein and Jessica Hwang
2. Introduction to Machine Learning with Python: A Guide for Data Scientists – By Andreas C. Muller and Sarah Guido
3. Python for Data Analysis – By Wes McKinney
4. R for Data Science – By Hadley Wickham and Garret Golemund

## BCADS1403: Web Development

### Course Objective:

1. To focus on the process of Web Designing.
2. Provide a fundamental understanding of web site creation
3. Provide understanding of client-side technologies (HTML, CSS, forms, JavaScript).
4. To create a static and dynamic, interactive web pages quickly, confidently and successfully.

**Learning Outcome:** Students who have successfully completed this course will have understanding of the following concepts:

1. Visualize and recognize the basic concept of HTML and application in web designing.
2. Gradually build a static and dynamic website using HTML and CSS.
3. Understanding the basic concept of Java Script and its application
4. Introduce basics concept of Web Hosting and apply the concept of SEO

### Course Contents:

Module	Course Topics	Total Hours	Credits
I	<b>Introduction:</b> Basic principles involved in developing a web site, Planning process, Domains and Hosting, Responsive Web Designing, Types of Websites (Static and Dynamic Websites), Introduction to Web (www), Uniform Resource Locator (URL), Hypertext Transfer Protocol (HTTP), Hypertext Transfer Protocol Secure (HTTPS), Web Browsers, Web Clients, Web Servers, Web Standards and W3C recommendations. <b>Introduction to HTML:</b> What is HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks	15 Hours	1
II	<b>Elements of HTML:</b> HTML Tags., Working with Text, working with Marquee, Working with Lists, Tables, Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls, Linking Documents: Inter-page and Intra-page linking. <b>Cascading Style Sheets:</b> Introduction, Inline, Internal, External CSS, Linking CSS to Web Page.	15 Hours	1
III	<b>Client-Side Programming:</b> Introduction to JavaScript: Basic Programming Techniques: Data Types, Creating Variables and JavaScript Array; Operators and Expressions in JavaScript: Arithmetic, Logical, Comparison, String and Conditional Operators; JavaScript Programming Constructs: Conditional checking, Loops; Functions in JavaScript: Built in Functions and User Defined Functions; Dialog Boxes: Alert , Confirm and Prompt Dialog Box; Event Handling; Form Object: Form Object's Methods and Properties, Text Element, Button Element; Other Built in Objects in JavaScript, String, Math and Date Object; Writing Client Side Validations from HTML Form Elements.	15 Hours	1

<b>IV</b>	<p><b>Web Hosting:</b> Web Hosting Basics, Types of Hosting Packages, Registering domains, Defining Name Servers, Using Control Panel, Creating Emails in Cpanel, Using FTP Client, Maintaining a Website.</p> <p><b>Concepts of SEO:</b> Basics of SEO, Importance of SEO, Onpage Optimization Basics.</p>	15 Hours	1
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**Suggested Readings:**

1. Xavier, C, "Web Technology and Design", New Age International Publications.
2. Bayross Ivan,"HTML, DHTML. JavaScript, and PHP", BPB Publications.
3. Achyut S Godbole and Atul Kahate, "Web Technologies", Tata McGraw Hill.
4. Ramesh Bangia, "Internet and Web Design", New Age International.
5. Steven M. Schafer, "HTML, XHTML, and CSS Bible, 5ed", Wiley India
6. Ian Pouncey, Richard York, "Beginning CSS: Cascading Style Sheets for Web Design", Wiley India

## BCA 4403: Basics of .Net Framework & C#

### Course Objective:

1. To present the fundamental concepts of Windows Desktop and Website development through Microsoft Technologies.
2. To impart solid foundation and develop the skill of Web Development through C# Programming.
3. To develop the concepts of static and dynamic Web Pages and make the students familiar with Client Server
4. Technology, Distributed Applications and Web Services.

**Learning Outcome:** Students who have successfully completed this course will have full understanding of the following concepts:

1. Develop the understanding of .Net technology.
2. Develop the skills in ASP.NET with C# Programming.
3. Understand the Microsoft Database Connectivity.
4. Will be able to understand the Static and Dynamic web pages.
5. Will be able to understand about Distributed applications.
6. Will be able to develop a light to medium weight website

### Course Contents:

Module	Course Topics	Total Hours	Credits
I	<b>.Net Framework:</b> Introduction and Origin of .Net technology, Framework Components, Common Language Runtime(CLR) and FCL, Managed and Unmanaged Code, Common Type System (CTS) & Common Language Specification (CLS), Microsoft Intermediate Language (MSIL) and Metadata, Just-In-Time Compilation (JIT), Garbage Collection, Base Classes and Ms.Net Namespaces.	15 Hours	1
II	<b>C# Basics:</b> Introduction and Evolution of C#, Types, Identifiers, Variables, Constants, Literals, Type Conversion and Casting, Operators, Data Structures in C#: Enum, Arrays, ArrayList, Strings; Control Statements and Looping: If Statement, Switch Statement, For Loop, While Loop, Do While Loop, For each Loop; Object and Classes: Properties(Read, Write), Indexers, Inheritance (Multilevel and Hierarchical), Polymorphism (Operational and Inclusion), Operator Overloading, Interfaces, Delegates and Events, Boxing and Unboxing.	15 Hours	1
III	<b>C# Libraries and .Net Advance Features:</b> Input output (Streams Classes), Multithreading, Managing Consol I/O Operations, .NET Assemblies: Type of Assemblies, GAC (Global Assembly Cache), Global ASAX Files, State management: Session Object, Hidden Fields, View State, Cookies, Cross page posting; Web Configuration and Machine Configuration Files.	15 Hours	1

IV	<b>Windows and Website Development:</b> Windows Forms (A Skeletal Form Based Windows Program, Handling Messages, Adding a Menu and introduction and usage of various Windows Form Controls), Debugging, Exceptions and Error Handling, ASP.NET Web Form Controls (User controls and Server Controls) Web Services (UDDI, DISCO, WSDL), ADO.NET(Architecture, Difference between Dataset and Data Reader, Connection and Command Object, Distributed applications, Globalization and Localization, Authentication and Authorizations, XML in .NET.	15 Hours	1
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**Suggested Readings:**

1. Balagurusamy —Programming with c# —, Tata McGraw Hill Publication.
2. ASP.NET 3.0 Black Book II, Dreamtech Press.
3. Beginning ASP.NET3.0 II, WROX Publication.
4. Stephen C. Perry, Atul Kahae, Stephen Walther, Joseph Mayo, —Essential of .NET and Related Technologies with a focus on C#, XML, ASP.net and ADO.net, Pearson, 2nd Edition.

## BCA4404: Data Warehousing & Data Mining

### Course Objective:

1. Understand the architecture of Data warehouse and its organization.
2. Introduce DM as a cutting edge business intelligence method and acquaint the students with the DM techniques for building competitive advantage through proactive analysis, predictive modeling, and identifying new trends and behaviors.
3. Describing and demonstrating basic data mining algorithms, methods, and tools.
4. Identifying business applications of data mining.
5. Overview of the developing areas - web mining, text mining, and ethical aspects of data mining.

**Learning Outcome:** After successful completion of this course, the students would be able to:

1. Define what knowledge discovery and data mining are; define the concept, structure and major issues of data warehousing.
2. Discover interesting patterns from large amounts of data to analyze and extract patterns to solve problems, make predictions of outcomes.
3. Select and apply proper data mining algorithms to build analytical applications.
4. Comprehend the roles that data mining plays in various fields and manipulate different data mining techniques.

### Course Content:

Module	Course Topics	Hours	Credits
I	<b>Introduction:</b> Data Mining Definition, Steps In Data Mining, Architecture Of Data Mining System, Types Of Data For Data Mining: Relational Databases, Data Warehouses, Transactional Databases, Adverse Data Information System And Advance Applications, Classification Of Data Mining Systems, Data Mining Task Primitives, Integration Of A Data Mining System With A Data Base Or Data Warehouse System, Major Issues In Data Mining, Approaches to Build A Data Warehouse, Building A Data Warehouse, Metadata & Its Types.	15 Hours	1
II	<b>Data Preprocessing:</b> Need of data preprocessing, descriptive <b>Data Summarization:</b> Measuring the crystal Tendency, Measuring the Dispersion of data, Graphic Display of Basic Descriptive Data Summaries, Data cleaning, Data Integration and transformation, Data Reduction. <b>Data Warehouse and OLAP Technology:</b> Data warehouse, differences between operational Database systems and Data warehouses, Multidimensional data model. A three- tier data warehouse architecture.	15 Hours	1

<b>III</b>	<b>Mining Frequent Patterns:</b> Basic concepts Frequent Item set mining method: the Apriori Algorithm, Generating Association Rules from frequent item sets. FP-Growth Algorithm: FP Tree Representation. Frequent item set Generation in FP- Growth Algorithm.	15 Hours	1
<b>IV</b>	<b>Classification:</b> General Approach to solving classification problems, Classification by decision Tree Induction: Attribute selection measure, Tree pruning, Bayesian Classification: Bayes' Theorem Rule based classification, Nearest neighbor classifier. Evaluating the performance of a classifier: Holdout Method, Random sub sampling, cross-validation.	15 Hours	1

**Suggested Readings:**

1. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques" Elsevier.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", PHI
3. Max Bramer, "Principles of Data Mining", Springer



## BCADS1404: Artificial Intelligence

### Course Objective:

1. To introduce the fundamental concepts of artificial intelligence.
2. To equip students with the knowledge and skills in logic.
3. To explore the different paradigms in knowledge representation and reasoning.
4. To evaluate the effectiveness of hybridization of different artificial intelligence techniques.

**Learning Outcome:** Upon successful completion of the course the student will be able to:

1. Understand the history, development and various applications of artificial intelligence.
2. Understand the concept of searching and different searching technique
3. Learn the knowledge representation and reasoning techniques familiarize with propositional and predicate logic and their roles in logic and handling inconsistency.
4. Understand different learning concepts.

### Course Contents:

Module	Course Topics	Total Hours	Credits
I	<b>Introduction to AI:</b> Scope of AI; General Issues and Overview of AI; AI Techniques; AI Problems; <b>Intelligent Agents:</b> Definitions of a Rational Agent, Reflex, Model-Based, Goal-Based and Utility-Based Agents, Agent and its Environment; <b>Problem Solving:</b> Defining the problem as a State Space Search, Issues in defining problems solving rules, <b>Production System:</b> Components of Production System, Search Space Control Strategies;	15 Hours	1
II	<b>Searching:</b> Uninformed Search: Depth-First, Breadth-first search. Informed /Heuristic Search: Hill Climbing, Best-First Search, A*, AO* Search, Branch and Bound; Problem Reduction; Constraint Satisfaction;	15 Hours	1
III	<b>Knowledge Representation:</b> Predicate Logic, Unification, Modus Ponens, Declarative and Procedural Representation, Rule Based Systems, <b>Structured Knowledge Representation:</b> Semantic Nets, Slots, Exceptions and Default Frames, Conceptual Dependency, <b>Handling Inconsistent and Incomplete Knowledge:</b> Truth Maintenance Systems, Reasoning Techniques, Concept of Uncertainty, Bayes' Theorem.	15 Hours	1

<b>IV</b>	<b>Learning:</b> Learning from observations, forms of learning, Inductive learning, Learning decision trees, Ensemble learning, Knowledge in learning – Logical formulation of learning – Explanation based learning – Learning using relevant information – Inductive logic programming, Statistical learning methods, Learning with complete data, Learning with hidden variable, Instance based learning, Neural networks	15 Hours	1
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**Suggested Readings:**

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach” (2nd ed.), Pearson Education, 2005.
2. Elaine Rich and Kelvin Knight, “Artificial Intelligence”, Tata McGraw Hill, 2002.
3. Eugene Charniak and Drew McDermott, “Introduction to Artificial Intelligence”, Pearson Education, 2009.
4. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Prentice Hall of India, 2006.
5. George F. Luger, “Artificial Intelligence, Structures and Strategies For Complex Problem Solving”, Pearson Education, 5th Edition, 2010.

**BCADS1451: Web Development Lab**

<b>Module</b>	<b>Course Topics</b>	<b>Credits</b>
I	<ol style="list-style-type: none"><li>1. Implementation of Basic Tags (Formatting Tags) in HTML.</li><li>2. Implementation of Marquee Tag in HTML.</li><li>3. Implementation of list Tags in HTML.</li><li>4. Implementation of Table Tags in HTML.</li><li>5. Implementation of Anchor Tag in HTML.</li><li>6. Implementation of Frame Tag in HTML.</li><li>7. Implementation of Form Tag in HTML.</li><li>8. Implementation of CSS (Cascading Style Sheet) in HTML.</li></ol>	1
II	<ol style="list-style-type: none"><li>1. Implementation of Basic variables in Java Script.</li><li>2. Implementation of Conditional Statements in Java Script.</li><li>3. Implementation of Loops in Java Script.</li><li>4. Implementation of String in Java Script.</li><li>5. Implementation of Inbuilt functions in Java Script.</li><li>6. Implementation of user defined functions in Java Script.</li><li>7. Implementation of Dialogue Boxes in Java Script.</li><li>8. Implementation of Form Validation in Java Script.</li><li>9. Implementation of various events and methods of request and response object in Java Script.</li></ol>	1

**BCA4452: Basics of .NET Framework & C# Lab**

<b>Module</b>	<b>Course Topics</b>	<b>Credits</b>
I	<ol style="list-style-type: none"><li>1. Implementation of Decision Making and Branching Statements on Console Applications.</li><li>2. Implementation Iterative Statements on Console Applications.</li><li>3. Implementation of Arrays and Array List on Console Applications.</li><li>4. Implementation of Boxing and Unboxing on Console Applications.</li><li>5. Implementation of Strings on Console Applications.</li><li>6. Implementation of Inheritance and Polymorphism on Console Applications.</li><li>7. Implementation of Interfaces on Console Applications.</li><li>8. Implementation of Properties and Indexers on Console Applications</li><li>9. Construct the C# console application to implement the Operator Overloading.</li><li>10. Implementation of Delegates and Events on Console Applications.</li></ol>	1
II	<ol style="list-style-type: none"><li>1. Implementation of Multithreading in C#</li><li>2. Implementation of private assemblies in .NET Applications.</li><li>3. Implementation of shared assemblies in .NET Applications.</li><li>4. Implementation of Server Side Controls in asp.net.</li><li>5. Implementation of Database Connectivity in asp.Net</li><li>6. Implementation of various Data Rendering Controls in asp.Net.</li><li>7. Implementation of Web Services in asp.Net Applications.</li></ol>	1

## BCADS1501: Predictive Analytics

**Note: Syllabus Provided by IBM**

### Course Objective:

1. To provide an overview of an exciting field of Predictive Analytics.
2. To introduce the tools required For the Predictive Analytics.
3. Review and explore data to look at data distributions and to identify data problems, including missing values.
4. To enable students to have skills that will help them to solve complex real-world problems for decision support.

**Learning Outcome:** Upon successful completion of the course the student will be able to:

1. Understand and critically apply the concepts and methods of Business analytics
2. To understand and apply IBM SPSS Modeler in Data Mining, what kinds of data can be mined, what kinds of patterns can be mined.
3. Applying and analyzing how to use functions, deal with missing values, use advanced field operations, handle sequence data and improve efficiency.
4. To evaluate the Model on the basis of different Predictive Methods.
5. Building and create advanced analytical model that leverage historical data to uncover real-time insights to predict future events.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>ANALYTICS OVERVIEW</b> Definition of business Analytics with real time examples, How Predictive analytics: Transforming data into future insights, Analytics trends: Past, Present & Future, Towards a Predictive enterprise.	15 Hours	1
II	<b>IBM SPSS MODELER &amp; DATA MINING</b> What is a Data Mining applications, Strategy for data mining: CRISP-DM, Identify nodes and streams, The framework of a Data – mining project, Brief the unit of analysis, Explain the type of dialog box.	15 Hours	1
III	<b>UNIT OF ANALYSIS</b> Concepts of Unit of analysis (Distinct, Aggregate, SetToFlag), Integrate data, CLEM Expression, Role of Relationship between two fields, Identifying the modeling objective.	15 Hours	1
IV	<b>ADVANCED DATA PREPARATION WITH IBM SPSS MODELER</b> Functions to enrich data, Method to transform data, Cross-record functions, Sampling, Partitioning and sampling data, Improving Efficiency. <b>PROJECT</b> Predicting using IBM SPSS Modeler & IBM Watson with real Case studies.	15 Hours	1

### Suggested Readings:

1. IBM Courseware
2. Predictive Analytics Mesmerizing & fascinating by ERIC SIEGEL

## BCA4502: Mobile Application Development

### Course Objectives

1. The capabilities and limitations of mobile platforms that affect application development and deployment
2. The technology and business trends impacting mobile application development
3. The characterization and architecture of mobile applications
4. The techniques for deploying and testing mobile applications, and for enhancing their performance and scalability

### Learning Outcome

1. Model and manage mobile application development using a range of methods.
2. Advantages and limitations of development frameworks.
3. Designing and develop mobile applications using a chosen application development framework
4. Develop enterprise-level mobile solutions.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Android Development:</b> Overview: Overview of the Android Operating System Development tools, Deploying application packages, Step-by-step application development Android version: Platform version: Android 10.0, 5.0 Lollipop, 4.4 Kit-Kat, Framework API level: SDK compatibility, each platform version has an API level; NDK API level: API level for native headers	15 Hours	1
II	<b>Tools for application development:</b> Android SDK: Provides the Java framework classes, Compiles to java byte code, Class framework is updated with every OS release Android NDK: C/C++ tool chain for compiling to machine code, Android platform tools, adb (android debug bridge): runs and debugs apps from your dev machine. <b>Android developer tools:</b> Eclipse plug-in for Android, Android studio (doesn't yet fully support all NDK features) Application packages: .apk files: compressed files, class byte code, resources (icons, sounds, etc.), Binary native files; All .apks are signed: Default development key is created by SDK, When updating an application, signature are checked.	15 Hours	1

<p style="text-align: center;"><b>III</b></p>	<p><b>Installing an application, Android Menu, Adaptor, Layout Manager, View:</b> From your local computer using adb; AndroidManifest.xml: Package Name / version, Required SDK and target, SDK Application/Activities, Permissions; Android Activity: Provides user interaction: <a href="http://developer.android.com/reference/android/app/Activity.html">http://developer.android.com/reference/android/app/Activity.html</a>, Callbacks for life-cycle management: onCreate(), onResume(), onPause(); An application can have multiple activities: Needs one launcher activity, Use onCreate() to create UI; Android Menu: Option Menu, Context Menu, Popup Menu; Adaptor: Array, Array list, Base adaptor; Layout Manager: Relative layout, Linear layout, Table layout, Grid layout, Frame layout, Constraint layout; Views: Grid view, Web view, Scroll view, Search view, Table view, Dynamic view.</p>	<p style="text-align: center;">15 Hours</p>	<p style="text-align: center;">1</p>
<p style="text-align: center;"><b>IV</b></p>	<p><b>Android service, Data Storage, Content Provider, Android Notification, Multimedia, Speech API, Telephone API, Location API:</b> Android service: API, Android started service, Android bound service, Android service life cycle, Android service example; Data Storage: Shared preferences, Internal storage, External storage; Content Provider: Content provider fundamental, Contact content provider, Other built-in content Provider, Creating custom content provider, Understanding content URI, Content Resolver, Sharing Information from custom content provider; Android Notification: Notification API, Creating notification builder, Setting notification properties, Attaching actions, Issuing notification, Notification compat.Builder class, Android Notification class; Multimedia: Wallpaper, Live wallpaper, Multimedia API, Playing audio, Creating audio, Playing video, Alarm manager, Gallery; Speech API: Text to speech API, Text to Speech example, Managing speed and pitch; Telephone API: Telephone manager, Get call state, Call state Broadcast receiver, Simple caller Talker, Making phone call, Sending mails, sms; Location API: Location API fundamental, Example of android: Location API, Working with Google API.</p>	<p style="text-align: center;">15 Hours</p>	<p style="text-align: center;">1</p>

**Suggested Readings:**

1. Pradeep Kothari, “Android Application Development (With KitKat support)” Black Book, Dreamtech Press
2. Barry Burd, “Android Application Development (All-In-One for Dummies)”, Second Edition, John Wiley & Sons

## BCADS1503: Management Information System

### Course Objectives:

1. To describe the role of information technology and decision support systems in business.
2. To introduce the fundamental principles of computer-based information systems analysis and design and develop an understanding of the principles and techniques used.
3. To enable students understand the various knowledge representation methods and different expert system structures as strategic weapons to counter the threats to business and make business more competitive.
4. To enable the students to use information to assess the impact of the Internet and Internet technology on electronic commerce and electronic business

**Course Outcomes:** After successful completion of this course, the students would be able to:

1. Relate the basic concepts and technologies used in the field of Management information systems;
2. Compare the processes of developing and implementing information systems.
3. Outline the role of the ethical, social, and security issues of information systems.
4. Translate the role of information systems in organizations, the strategic Management processes, with the implications for the management.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Overview of Information System:</b> Information System Concepts: Introduction, Data vs. Information, Characteristics of Valuable Information, Types of Information; Elements. Types of Information System, Manual Vs Computerized Information System, Information System Classification: Operations Support Systems, Management Support Systems.	15 Hours	1
II	<b>Concepts of Management &amp; Organization Theory and IS Technology:</b> Levels, Hierarchy, Types of decisions; Information requirements, Types of Computer-Based Information System, Information System Technology & Implementation, Evolution of Information System Technology; Computer Hardware (Input, Processing, Storage & Output H/W); Computer Software (System Software, Application Software); Horizontal Market Application Software; Vertical Market Application Software; Custom- Developed Application Software.	15 Hours	1
III	<b>Management and Decision Support System:</b> MIS concept, Definition, Role, MIS Inputs & Output, Characteristics, Applications. <b>Functional Aspects of the MIS:</b> Financial Management Information Systems, Manufacturing Management Information Systems, Marketing Management	15 Hours	1



	Information Systems, Human Resource Management Information Systems, <b>Overview of Decision Support Systems:</b> Characteristics, Components, Capabilities, Types, Comparison of DSS and MIS.		
<b>IV</b>	<b>Business Applications of Information System:</b> Introduction to Electronic Commerce: Business-to-Business (B2B) E-Commerce, Business-to-Consumer (B2C) E-Commerce, Consumer-to-Consumer (C2C), E-Commerce; E-Commerce Challenges; Electronic Commerce Applications. <b>Business Application Tools:</b> Enterprise Resource Planning, Production and Supply Chain Management, Procurement Management, Customer Relationship Management and Sales Ordering.	15 Hours	1

**Suggested Readings:**

1. Ralph M. Stair & George W. Reynolds, "Principles of Information System: A Managerial Approach", Course Technology"
2. Laudon and Laudon, "Management Information Systems", Pearson Education.
3. Jawadekar, "Management Information Systems", Tata McGraw-Hill.
4. Davis and Olson, "Management Information Systems", Tata McGraw-Hill.
5. O'Brien, "Management Information Systems", Tata McGraw-Hill.
6. D. P. Goel, "Management Information System", Macmillan

## BCADS1511: IOT & Technology

### Course Objective:

1. To study fundamental concepts of IoT
2. To understand roles of sensors in IoT
3. To Learn different protocols used for IoT design
4. To be familiar with data handling and analytics tools in IoT
5. Understand the role of IoT in various domains of Industry.

### Learning Outcomes: On completion of the course, student will be able to

1. Understand the various concepts, terminologies and architecture of IoT systems.
2. Use sensors and actuators for design of IoT.
3. Understand and apply various protocols for design of IoT systems.
4. Understand various applications of IoT.

Module	Course Topics	Hours	Credits
I	<b>Fundamentals of IoT:</b> Introduction, Definitions & Characteristics, Architectures, Physical & Logical Design, Enabling Technologies in IoT, History, Frameworks, IoT and M2M. Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects.	15 Hours	1
II	<b>Sensors Networks:</b> Definition, Types of Sensors, Types of Actuators, Examples and Working. <b>IoT Development Boards:</b> Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components, <b>Wireless Sensor Networks:</b> History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.	15 Hours	1
III	<b>Wireless Technologies for IoT:</b> WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols	15 Hours	1
IV	<b>Overview of IoT Security:</b> Introduction, Securing the Internet of Things, Architecture, Requirements. <b>Case Studies/Industrial Applications:</b> Home Automation, Smart Cities, Energy, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.	15 Hours	1

### Suggested Readings:

1. Vijay Madiseti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
2. sPublished: January 11, 2017, Elsevier

3. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web", ISBN: 978-1- 84821-140-7, Wiley Publications
4. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Wiley Publications
5. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.
6. Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.

## BCADS1512: Distributed System

### Course Objective:

1. Able to explain the distributed systems architecture.
2. Outline the inter-process communication in distributed systems.
3. Explain the file accessing model and various services in the distributed system.
4. Demonstrate concurrency control and properties of transaction in Distributed systems.
5. Discuss resource and process management in distributed system

**Learning Outcomes:** Students after successfully completing this course shall be able to

1. Understand various design and operational issues of Distributed Systems and System Services like Security, Distributed File System, Naming Services & Directory Services etc.
2. Understand the working of various Algorithms required in modelling various functional aspects and designing the distributed systems.
3. Understand, design and develop distributed system application at the level of concept.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Characterization of Distributed Systems:</b> Introduction, Examples of Distributed Systems, Resource Sharing and the Web, Challenges. <b>System Models:</b> Introduction, Architectural Models, Fundamental Models. <b>Time and Global States:</b> Introduction, Clocks Events and Process States, Synchronizing Physical Clocks, Logical Time and Logical Clocks, Global States, Distributed Debugging.	15 Hours	1
II	<b>Message ordering and group communication:</b> Message ordering paradigms, Asynchronous execution with synchronous communication, Synchronous program order on an asynchronous system, Group communication Causal order (CO), Total order. Global state and snapshot recording algorithms: Introduction System model and definitions, Snapshot algorithms for FIFO channels	15 Hours	1
III	<b>Distributed mutual exclusion algorithms:</b> Introduction, Preliminaries, Lamport's algorithm, Ricart Agrawala algorithm, Maekawa's algorithm, Suzuki-Kasami's broadcast algorithm. Deadlock detection in distributed systems: Introduction, System model, Preliminaries, Models of deadlocks, Knapp's classification, Algorithms for the single resource model, the AND model and the OR model.	15 Hours	1
IV	<b>Transactions and Concurrency Control:</b> Introduction, Transactions, Nested Transactions, Locks, Optimistic Concurrency Control, Timestamp Ordering, Comparison of Methods for Concurrency Control. <b>Distributed Transactions:</b> Introduction, Flat and Nested Distributed Transactions, Atomic Commit Protocols,	15 Hours	1

	Concurrency Control in Distributed Transactions, Distributed Deadlocks, Transaction Recovery		
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**Suggested Readings:**

1. Distributed Systems, Concepts and Design, George Coulouris, J Dollimore and Tim Kindberg, Pearson Education, Edition. 2009.
2. Distributed Systems, Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, 2<sup>nd</sup> Edition, PHI.
3. Distributed Systems, An Algorithm Approach, Sukumar Ghosh, Chapman & Hall/CRC, Taylor & Fransis Group, 2007.

## BCADS1513: Cloud Computing

### Course Objectives:

1. Cover the principles and essentials of cloud computing.
2. Explain cloud computing's architecture and underlying ideas.
3. Describe cloud storage services and their suppliers, as well as inter-cloud resource management. Examine cloud computing security services and standards.
4. Analyze advanced cloud technologies.

### Learning Outcome

1. Understand the evolution, principles, and benefits of Cloud Computing in order to assess existing cloud infrastructures to choose an appropriate architecture that meets business needs.
2. Recognize virtualization foundations in order to meet cloud service providers' elasticity, portability, and resilience requirements.
3. Create a cloud framework with resource management policies and mechanisms that are appropriate.
4. Identify cloud computing security and privacy risks and develop appropriate security solutions to secure cloud resources.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Cloud Computing Foundations:</b> Recent Computing Trends: Grid Computing, Cluster Computing, Distributed Computing, Parallel Computing, Utility Computing, cloud computing; Cloud Computing Characteristics; Cloud History; Cloud Deployment Models: Private Cloud, Public Cloud, Hybrid Cloud, Community Cloud; Cloud Advantages; Challenges in cloud application; Cloud impact on enterprises.	15 Hours	1
II	<b>Cloud Architecture and Virtualization:</b> Virtualization: Definition, Types, Levels; Virtualization Structures: Tools, Mechanisms; Virtualization of CPU, Memory, and I/O Devices; Scaling a Cloud Infrastructure: Capacity Planning, Cloud Scale; Disaster Recovery Planning: Cloud Disasters, Disaster Management; Hypervisor Concepts and Types. Traditional Computing Architecture Vs Cloud Computing Stack; Cloud Computing Working; Services Provided at Various Levels; Networks in Cloud Computing; Protocols Employed; Role of Web Services; Cloud Service Models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Data as a Service (DaaS), Container as a Service (CaaS); Developing and Deploying Applications: Amazon EC2, Google App Engine.	15 Hours	1
III	<b>Cloud Resource Management and Scheduling:</b> Inter Cloud Resource Management: Resource Provisioning and Methods, Global Cloud Exchange; Cloud Security applied: SaaS, Governance, Virtual Machine, IAM; Security Standards; Service Level Agreements(SLAs); Billing & Accounting; Scaling Hardware Policies and Mechanisms: Two-Level Resource Allocation, Dynamic Thresholds; Autonomous Specialized Performance Managers; Utility-Based Cloud Model; Cloud Resource Bundling: Combinatorial Auctions, Cloud Scheduling Algorithms, Resource Management, Dynamic Application Scaling.	15 Hours	1

<b>IV</b>	<p><b>Cloud Security and Cloud Technologies:</b> Cloud Security Categories; Cloud Data Security: Encryption, Integrity, Auditing, Authentication, Reputation; Cloud Data Storage; Cloud Security and Privacy; Security Service Boundary; Identity Management and Access Control; Trusted Computing; Risk; Cloud Client access; Cloud contracting Model; Data Location Issues; Jurisdictional Issues; Business and commercial considerations.</p> <p>Cloud Computing Platforms: Microsoft Azure, SQL Azure, Windows Azure Platform, Appliance Cloudfoundry, OpenStack; Cloud Federation; Hadoop; Map Reduce; Virtual Box.</p>	15 Hours	1
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### Suggested Readings:

1. Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah, "Cloud Computing", Black Book, Dreamtech, 2015
2. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", 1<sup>st</sup> Edition, O'Reilly Media, 2009.
3. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management and Security", CRC Press, 2017.
4. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
5. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2013.
6. Tim Malhar, S. Kumaraswamy, "Cloud Security & Privacy ", S.Latif (SPD,O'REILLY)
7. Gautam Shroff, "Enterprise Cloud Computing: Technology, Architecture, Applications", Cambridge University Press, 2010.

## BCADS1514: Data Privacy and Laws

### Course Objective:

1. To understand the basics of Data Privacy.
2. Students are able to understand the privacy of individuals and the confidentiality of organizations and the protection of sensitive information.
3. To understand Security Policies and Laws.

**Learning Outcome:** Students who have successfully completed this course will have an understanding of the following concepts:

1. To learn about how to maintain the System's Security i.e., Confidentiality, Integrity and Availability.
2. Understand the concepts of privacy in today's environment.
3. Obtain the understanding of how automation is changing the concepts and expectations concerning privacy and the increasingly interconnected issue of security.
4. The student will be able to understand the basics of data privacy, policies, laws, and its issues along with its countermeasures.

### Course Contents:

Module	Course Topics	Hours	Credits
I	<b>Data Privacy:</b> Introduction to Data Privacy, Software Privacy, Ethical Issues, Strategic Attacks, Trends in Mobility Wireless Era, Security Challenges faced by Mobile Devices, Physical Security, Biometrics, Cryptography, Digital Signatures, Firewall.	15 Hours	1
II	<b>Cyber Crime:</b> Introduction to Cyber Crime, Classification of Cyber Crime, Who Commits a Cyber Crime? Prevention of Cyber Crime, Cyber Law, Need for Cyber Law, Elementary Problems of Cyber Law.	15 Hours	1
III	<b>Intellectual Property Rights (IPR):</b> The Concept and Categories, Patent Law, Copyright Law, Legal Issues in Data Mining Security, Building Security in Software Development Lifecycle.	15 Hours	1
IV	<b>Information Technology Act:</b> Introduction to IT Act 2000, Objectives of Indian IT Act 2000, Salient Features of IT Act 2000, Scheme of IT Act. Penalties, Adjudication, Appeals and Offences under IT ACT 2000. IT Act 2008 and its Amendments.	15 Hours	1

### Suggested Readings:



1. Nilakshi Jain and Ramesh Menon, Cyber Security and Cyber Laws, First Edition, Wiley, 2021
2. Virender Kumar and Ankur Aggarwal, "Information Security and Cyber Laws" First Edition, Dhanpat Rai Publications, 2011.
3. Berouz Forouzan, Cryptography and Network Security, TMH, 2 edition, ISBN -978-00-707-0208-0.

**Open elective**

**BCADS1551: Management Information System Lab**

<b>Module</b>	<b>Course Topics</b>	<b>Credits</b>
<b>I</b>	<ol style="list-style-type: none"><li>1. Creation of Table, View and Reports. Basics of SQL and running queries in database.</li><li>2. Identify a Real time Business Domain Problem.</li><li>3. Documentations of the Problem (Preparation of Problem statement) by using process Analyst tools for making DFD/ER Diagrams.</li><li>4. Perform Feasibility study of the solution.</li></ol>	1
<b>II</b>	<ol style="list-style-type: none"><li>1. Create a MIS Report in Excel</li><li>2. Designing and implementing fully functional Information System by using any language.</li><li>3. Development of an IT based Application for the Business.</li><li>4. Report Generation for Managerial Solutions.</li></ol>	1

## BCA4552: Mobile Application Development Lab

Module	Course Topics	Credits
I	<ol style="list-style-type: none"><li>1. Develop an application that uses GUI components, Font and Colours</li><li>2. Develop an application that uses Layout Managers and event listeners.</li><li>3. Develop a native calculator application.</li><li>4. Write a mobile application that creates alarm clock.</li><li>5. Write an application that draws basic graphical primitives on the screen.</li><li>6. Develop an application that makes use of databases.</li><li>7. Develop an application that makes use of Notification Manager</li></ol>	1
II	<ol style="list-style-type: none"><li>1. Implement an application that uses Multi-threading</li><li>2. Develop a native application that uses GPS location information</li><li>3. Implement an application that writes data to the SD card.</li><li>4. Implement an application that creates an alert upon receiving a message</li><li>5. Write a mobile application that makes use of RSS feed</li><li>6. Develop a mobile application to send an email.</li><li>7. Develop a Mobile application for simple needs (Mini Project)</li></ol>	1