Credit Framework for the Bachelor of Computer Applications (DS & AI) -NEP-2020
School of Computer Applications, BBD University, Lucknow

SEMESTER	Discipline Specific Core (DSC) (Major)	Discipline Specific Elective (DSE) (Major)	Generic Elective (GE) (Minor)	Co-Curricular (CC)	Vocational Course(VOC)	Survey/ Seminar/MOOC/Community Outreach (SSMC)	GP	Total Credit
1	4 Subjects 18 Credits (6+6+4+2 Credits)		1 Subject 4 Credits	1 Subject 3 Credits			1 Credit	26
2	3 Subjects 16 Credits (4+2+4+6 Credits)		1 Subject 4 Credits	1 Subject 3 Credits	1 Subject 2 Credits		1 Credit	26
Early Exit Option-1: Award of CERTIFICATE (After 1 Year: 52 Credits)								
3	5 Subjects 19 Credits (4+2+6+4+3 Credits)		1 Subject 4 Credits		1 Subject 2 Credits		1 Credit	26
4	4 Subjects 15 Credits (3+2+6+4 Credits)	1 Subjects 4 Credits	1 Subject 4 Credits		1 Subject 2 Credits		1 Credit	26
Early Exit Option-2: Award of DIPLOMA (After 2 Year: 104 Credits)								
5	3 Subjects 16 Credits (4+6+6 Credits)	2 Subjects 8 Credits (4+4 Credits)					1 Credit	25
6	1 Subject 4 Credit (Online Mode) Industrial Training Cum-Project 20 Credits						1 Credit	25
Early Exit Option-3: Award of Bachelor of Computer Applications (After 3 Year: 154 Credits)								
7	2 Subjects 12 Credits (6+6 Credits) Desertation-I 8 Credits	1 Subject 4 Credits					1 Credit	25
8	2 Subjects 10 Credits (6+4 Credits) Desertation-II 14 Credits						1 Credit	25
Award of Bachelor of Computer Applications With Research (After 4 Years: 204 Credits)								

Babu Banarasi Das University, Lucknow
School of Computer Applications
Bachelor of Computer Applications(DS & AI)
Evaluation Scheme (w. e. f. Academic Session 2023-24)

SEMESTER I

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCADSN11101	Python with Data Science	3	1	0	40	60	100	4	IBM
DSC	BCADSN11102	Fundamentals of Computer & Programming in 'C'	3	1	0	40	60	100	4	SCHOOL
DSC	BCADSN11103	Database Management System	3	1	0	40	60	100	4	
DSC	BCADSN11104	Basic Mathematics	2	0	0	40	60	100	2	
GE		Generic Elective-I	3	1	0	40	60	100	4	
CC		Co-Curricular-I	2	1	0	40	60	100	3	
DSC	BCADSN11151	Programming in 'C' Lab	0	0	4	40	60	100	2	
DSC	BCADSN11152	Database Management System Lab	0	0	4	40	60	100	2	
	GPN1101	General Proficiency	0	0	0	100	0	100	1	
Total			**16**	**5**	**8**	**420**	**480**	**900**	**26**	

SEMESTER II

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCADSN12101	Cloud Application Development	3	1	0	40	60	100	4	IBM
DSC	BCADSN12102	Data Visualization	2	0	0	40	60	100	2	
DSC	BCADSN12103	Operating System	3	1	0	40	60	100	4	SCHOOL
DSC	BCADSN12104	Data Structure Using C	3	1	0	40	60	100	4	
GE		Generic Elective-II	3	1	0	40	60	100	4	
CC		Co-Curricular-II	3	0	0	40	60	100	3	
DSC	BCADSN12151	Data Structure Using C Lab	0	0	4	40	60	100	2	
VC		Vocational Course-II	2	0	0	40	60	100	2	
	GPN1201	General Proficiency	0	0	0	100	0	100	1	
Total			**19**	**4**	**4**	**420**	**480**	**900**	**26**	

Early Exit Option-1: Award of CERTIFICATE (After 1 Year: 52 Credits)

SEMESTER III

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCADSN13201	Descriptive Analytics	3	1	0	40	60	100	4	IBM
DSC	BCADSN13202	NO SQL and Dbaas 101	2	0	0	40	60	100	2	
DSC	BCADSN13203	Linux & Shell Programming	3	1	0	40	60	100	4	SCHOOL
DSC	BCADSN13204	Computer Network	3	1	0	40	60	100	4	
DSC	BCADSN13205	Object Oriented Programming Using Java	3	0	0	40	60	100	3	
GE		Generic Elective-III	3	1	0	40	60	100	4	
DSC	BCADSN13251	Linux Lab	0	0	4	40	60	100	2	
DSC	BCADSN13252	Programming with Java Lab	0	0	4	40	60	100	2	
VC		Vocational Course-III / SSMC	2	0	0	40	60	100	2	
	GPN1301	General Proficiency	0	0	0	100	0	100	1	
Total			**19**	**4**	**8**	**460**	**540**	**1000**	**28**	

SEMESTER IV

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCADSN14201	Big Data Fundamentals	3	1	0	40	60	100	4	IBM
DSC	BCADSN14202	Data Science	2	0	0	40	60	100	2	
DSC	BCADSN14203	Data Warehousing & Data Mining	3	1	0	40	60	100	4	SCHOOL
DSC	BCADSN14204	Basics of Design & Analysis of Algorithms	3	0	0	40	60	100	3	
GE		Generic Elective-IV	3	1	0	40	60	100	4	
DSE		Discipline Specific Elective-I	3	1	0	40	60	100	4	
DSC	BCADSN14251	Data Warehousing & Data Mining Lab	0	0	4	40	60	100	2	
VC		Vocational Course-IV / SSMC	2	0	0	40	60	100	2	
	GPN1401	General Proficiency	0	0	0	100	0	100	1	
Total			**19**	**4**	**4**	**420**	**480**	**900**	**26**	

Early Exit Option-2: Award of DIPLOMA (After 2 Year: 104 Credits)

SEMESTER V

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCADSN15301	Predictive Analytics	3	1	0	40	60	100	4	IBM
DSC	BCADSN15302	Mobile Application Development	3	1	0	40	60	100	4	SCHOOL
DSC	BCADSN15303	Server Side Scripting	3	1	0	40	60	100	4	
DSE		Discipline Specific Elective-II	3	1	0	40	60	100	4	
DSE		Discipline Specific Elective-III	3	1	0	40	60	100	4	
DSC	BCADSN15351	Server Side Scripting Lab	0	0	4	40	60	100	2	
DSC	BCADSN15352	Mobile Application Development Lab	0	0	4	40	60	100	2	
	GPN1501	General Proficiency	0	0	0	100	0	100	1	
Total			**15**	**5**	**8**	**380**	**420**	**800**	**25**	

SEMESTER VI

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCADSN16301	Advance Computer Technologies (Online)	3	1	0	40	60	100	4	SCHOOL
DSC	BCADSN16351	Industrial Training Cum-Project	0	0	0	200	400	600	20	
	GPN1601	General Proficiency	0	0	0	100	0	100	1	
Total			**3**	**1**	**0**	**340**	**460**	**800**	**25**	

Early Exit Option-3: Award of Bachelor of Computer Applications (After 3 Year: 154 Credits)

SEMESTER VII

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCADSN17401	Statistical & Optimization Techniques	3	1	0	40	60	100	4	SCHOOL
DSC	BCADSN17402	Research Methodology	3	1	0	40	60	100	4	
DSE		Discipline Specific Elective-IV	3	1	0	40	60	100	4	
DSE		Discipline Specific Elective-V	3	1	0	40	60	100	4	
DSC	BCADSN17451	Statistical Package for Social Sciences(SPSS) La	0	0	4	40	60	100	2	
DSC	BCADSN17452	Dissertation-I	0	0	12	100	200	300	6	
	GPN1701	General Proficiency	0	0	0	100	0	100	1	
Total			**12**	**4**	**16**	**400**	**500**	**900**	**25**	

SEMESTER VIII										
Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCADSN18401	R Programming	3	1	0	40	60	100	4	SCHOOL
DSC	BCADSN18402	Intellectual Property Right	3	1	0	40	60	100	4	
DSC	BCADSN18451	R Programming Lab	0	0	4	40	60	100	2	
DSC	BCADSN18452	Dissertation-II	0	0	28	200	300	500	14	
	GPN1801	General Proficiency	0	0	0	100	0	100	1	
Total			**6**	**2**	**32**	**420**	**480**	**900**	**25**	

Award of Bachelor of Computer Applications With Research (After 4 Years: 204 Credits)

DSC	Discipline Specific Core
DSE	Discipline Specific Elective
GE	Generic Elective
CC	Co-Curricular
VC	Vocational Course
GP	General Proficiency
L	Lecture
T	Tutorial
P	Practical

Generic Elective-I		
1	BCADSN11111	Artificial Intelligence
2	BCADSN11112	Introduction to Statistical Method
Generic Elective-II		
1	BCADSN12111	Foundation of Machine Learning
2	BCADSN12112	Fundamentals of Data Science
Generic Elective-III		
1	BCADSN13211	Information & Data Security
2	BCADSN13212	Essential of Data Collection Ethics
Generic Elective-IV		
1	BCADSN14211	Foundation of Deep Learning
2	BCADSN14212	Big Data Analytics

Discipline Specific Elective-I		
1	BCADSN14221	Cloud Computing
2	BCADSN14222	IOT & Technology
3	BCADSN14223	Soft Computing
Discipline Specific Elective-II		
1	BCADSN15321	Machine Learning
2	BCADSN15322	Pattern Recognition
3	BCADSN15323	Neural Network
Discipline Specific Elective-III		
1	BCADSN15324	Deep Learning
2	BCADSN15325	Introduction to Hadoop
3	BCADSN15326	Blockchain Technology
Discipline Specific Elective-IV		
1	BCADSN17421	Distributed System
2	BCADSN17422	Ethics For Data Science
3	BCADSN17423	Data Privacy and Laws
Discipline Specific Elective-V		
1	BCADSN17424	Computer Vision
2	BCADSN17425	Natural Language Processing
3	BCADSN17426	Human Computer Interaction

Note: 1. Student may select any subject from Co-Curricular list offered by the University

2. Student may selct any subject from Vocational Course list offered by the University

Bachelor of Computer Applications

(Data Science & Artificial Intelligence)

In Collaboration with IBM

FIRST SEMESTER

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**	I		
Course Name	Python with Data Science				
Code	BCADSN11101				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Main objective of this course is using the frameworks to analyze and interpret data, demonstrate knowledge of statistical data analysis techniques utilized in business decision making and to learn how to Use data mining software to solve real-world problems.				
Course Outcomes					
CO1	Understand programming basics including functions, variables, and data type.				
CO2	Data Science lifecycle revolves around using some techniques and other Analytical methods to produce insights and predictions from data to achieve a business objective.				
CO3	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.				
CO4	Understand Data engineering and data modelling practices using machine learning and building and create role-playing challenge-based scenarios to propose real-world solutions				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction of Python:** 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 Hrs.	CO1
2	**Introduction to Data Science**: 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 Hrs.	CO2
3	**Data Manipulation and Visualization**: Introduction to NumPy, Pandas and Matplotlib, How to Import NumPy module, what is data Manipulation using Panda's library? Series object in pandas, Data Frame in Pandas, loading a handling data with Pandas, Introduction to Matplotlib, Using Matplotlib for plotting Graphs and charts like Scatter, Bar, Pie, Line, Histogram and more.	15 Hrs.	CO3
4	**Supervised and Unsupervised Learning**: 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 of clustering. What is K-means clustering and Hierarchical Clustering? Step by step calculation of k-means algorithm	15 Hrs.	CO4

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.

Online Resources

1. https://cognitiveclass.ai/courses/course-v1:CognitiveClass+DA0101EN+v2
2. https://www.youtube.com/watch?v=-ETQ97mXXF0

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	1	2	1	2	1		1		1	2	1	2
CO2	1	3		2	2	1		1		2		3	2	3
CO3	1	3		3	3	3			1	1		2	2	3
CO4	2	3		1	2	2	1		1	3	1	3	2	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**	I		
Course Name	Fundamentals of Computer & Programming in 'C'				
Code	BCADSN11102				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The subject focuses on the fundamentals of Computer and its peripherals with modern technology along with methodology of programming with concepts of C Programming.				
Course Outcomes					
CO1	Demonstrate the knowledge of the basic structure of computers, History of Computer, Hardware, Software, Input / Output devices, Computer languages, Language Translators.				
CO2	Describe the concept of data communication and networks along with the few concepts of modern technology.				
CO3	Learn various constructs of C Language along with programming constructs.				
CO4	Understand the concept of array, structure, functions, and pointers.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Computers:** Introduction to computer, Basics of computers and its operation, History of computer, Capabilities and limitations of computers, Types of computers; **Hardware:** CPU(Architecture & Related Technology); **Storage Devices:** Primary & Secondary; Auxiliary Storage Devices; Cache Memory; Memory Hierarchy; Buffering and Spooling; **Software:** Types of software : Application Software and System Software; Input devices; Output Devices; **Operating System:** Functions, Types, Need of Operating System; DOS; Translator: Compiler, Interpreter & Assembler; **Types of Languages:** Machine Language, Assembly Languages, High level Languages; Loader, Linker, Flowchart; **Algorithms:** Introduction, Definition, Characteristics, Limitations.	15 Hrs.	CO1
2	**Computer Networks & Internet:** Data communication: Signaling & Transmission; Network Devices: HUB, Switches, Router, Gateways; Types of Networks; Topology; Transmission Mode & Media; Switching Techniques, Internet and protocol, Internet services, OSI reference model; TCP/IP Reference Model.	15 Hrs.	CO2
3	**Introduction to C:** Introduction; Structure of C Program; Writing the first C Program; File used in C Program; Compiling and Executing C Programs; Comments; Data Types, **Tokens:** Keywords, Literals, Identifiers, Variables, Constants; I/O Statements; **Operators:** Types of operators, Precedence and Associativity of operators; Programming Examples; Type Conversion and Type Casting. **Decision Control Statements:** If, If-Else, Nested If, If-Else Ladder, Switch-Case; **Iterative Statements:** For Loop, While Loop, Do-While Loop; **Jump Statement:** Break, Goto and Continue.	15 Hrs.	CO3
4	**Introduction to Array, Structures, Union: Array :** Types of Array: Single Dimension Array, Two-Dimensional Array; Address Calculation of an Element in Array; Insertion and Deletion in an Array; **Functions:** User-Defined Functions;	15 Hrs.	CO4

	Function Declaration; Types of Arguments: Actual Arguments, Formal Arguments; Function Definition; Methods to Call a Function: Call by Value, Call by Reference; Passing Arrays as Parameters; Storage Classes; **Pointers:** Declaration of Pointer Variables; Pointer Arithmetic; Pointers and Arrays, Pointer and Character Strings, Array of Pointers, Pointers as Function Arguments; Structure, Union & Enumeration.		

Suggested Readings

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

Online Resources

1. https://nptel.ac.in/courses/106104128
2. https://archive.nptel.ac.in/courses/106/104/106104128/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2			1	2	2		2	1		1	2	1
CO2	1	3	1		2	3	2		2	1		1	3	1
CO3	3	2	2	3	2	3	2		2	2		3	2	3
CO4	2	3	3	3	3	3	2		2	3		3	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**	I		
Course Name	Database Management System				
Code	BCADSN11103				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The objective of this course is to introduce the fundamental concepts of DBMS, terminologies of database management system, E-R Modelling, PL/SQL concept, database transactions and concurrency control techniques.				
Course Outcomes					
CO1	Understand the basic concepts of the database and data models.				
CO2	Understand the fundamental concepts ER diagrams and map ER diagrams into Relations.				
CO3	Evaluate the alternative database designs to determine which one is better according to selected criteria.				
CO4	Understand the basic concepts/features of database transactions and concurrency control techniques.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Data and information, Concepts of persistent data, File and File management system., Basic File Operations, File Structure and Organization, Types of File Organization. **Database Management System:** Introduction 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, DBMS Users, DBMS Architecture, Capabilities of good DBMS, Database Schemas and Instances, Classification of Database Management Systems, Database Languages. **Data Models:** Introduction of Data Models: Relational Data Model, Entity Relationship Data Model, Object Based Data Model, Semi-Structure Data Model, Network Data Model, Hierarchical Data Model.	15 Hrs.	CO1
2	**Relational Database Management System & Data Modelling:** Introduction to Relational database, Structure of Relational Database, Relational Data Model, Relational model terminology: Relations , Domains, Attributes, Tuples, Relational Constraints, Codd Rule, Entity- Relationship Model: Entity Sets, Entity Types, Attributes , Attributes Types, Relationships, Relationship Types ,Keys, Constraints, Entity-Relationship Model: E-R Model Concepts, Notation for E-R Diagram, Mapping Constraints, Extended E-R Features, Reduction of E-R Diagram to Relation. **Relational Algebra:** Concepts of Relational Algebra, Fundamentals Operations: Select, Project, Rename, Union, Set difference, division, Cartesian Product, Additional Relational-Algebra Operations: Set Intersection, Natural Join And Outer join	15 Hrs.	CO1 & CO2
3	**SQL and Database Design Theory:** Introduction on SQL: Characteristics of SQL, Advantage of SQL, SQL Data Type and Literals, Types of SQL Commands, SQL Operators and their	15 Hrs.	CO3

	Procedure, Queries and Sub Queries, Aggregate Functions, Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, View, Cursors and Triggers. **Functional Dependencies and Normalization:** Informal Design Guidelines for Relation Schemas, Database Anomalies, Functional Dependencies, Armstrong's axioms, Closure of Attribute sets, Normal Forms, First Normal Form, Second Normal Form, Third Normal Forms and Boyce-Codd Normal Forms.		
4	**Transaction Processing & Concurrency Control:** Introduction to Transaction ACID Properties, Transaction State. Transaction logs, Importance of Backups. Database recovery. Causes of failures. Recovery concepts and terminology. **Concurrency Control:** Definition of concurrency, lost update, dirty read, and incorrect summary problems due to concurrency.	15 Hrs.	CO3 & CO4

Suggested Readings

1. Korth, Silbertz, Sudarshan, Database Concepts, McGraw Hill.
2. Elmasri, Navathe, Fundamentals of Database Systems, Addison Wesley.
3. Date C J, An Introduction to Database Systems, Addison Wesley
4. Bipin C. Desai, An Introduction to Database Systems, Galgotia Publications
5. Ramakrishnan, Gehrke, Database Management System, McGraw Hill
6. Ivan Bayross -- SQL, PL/SQL: The Programming Language of Oracle, BPP Publication.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105175/
2. https://nptel.ac.in/courses/106104135

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2					1			1		1	2	2	1
CO2	1	2	3	1	3	2	1		3	2	2	2	2	2
CO3	1	1	2	3	2	2	2		3	2	2	2	2	3
CO4	2	2	1	2		2	1		1	1		2	1	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**	I		
Course Name	Basic Mathematics				
Code	BCADSN11101				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		2	0	0	2
Course Objectives	To introduce the fundamental concepts of mathematics this will help and guide students to understand and make comprehensive rest of the course.				

Course Outcomes	
CO1	Understand the concept of Sequence, Matrices and Determinant.
CO2	Understand the concept of Differentiation and Integration.

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Finite and Infinite Sequences:** Definition, nth term, Sum of n terms of sequence, Arithmetic Progression, Geometric Progression and Harmonic Progression. **Matrices and Determinant:** 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.	15	CO1
2	**Differentiation and Integration:** Meaning and geometrical interpretation of derivative, derivatives of simple algebraic and trigonometric function, derivatives of sum/difference, product and quotient of function, **Integration:** Integration as the inverse of differentiation, Integration of algebraic and trigonometric function, Definite Integral.	15	CO2

Suggested Readings

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

Online Resources

1. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ma04/
2. https://archive.nptel.ac.in/courses/111/106/111106146/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1		1	1							1	1	1
CO2	1	1	1	2	2	1	1					2	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**	I		
Course Name	Artificial Intelligence				
Code	BCADSN11111				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The course aims to provide a comprehensive introduction to Artificial Intelligence, covering intelligent agents, search algorithms, planning, knowledge representation, and learning in Artificial Intelligence.				
Course Outcomes					
CO1	Understand the concept, scope, foundation, and various applications of Artificial Intelligence.				
CO2	Learn and familiarize with different Searching Techniques in Artificial Intelligence.				
CO3	Learn and familiarize with the basic concepts of Planning in AI, Reasoning techniques such as propositional and Predicate logic and their roles in designing Logical Agents.				
CO4	Develop conceptual skills in knowledge representation and reasoning systems, handling uncertainties, learning in the AI System.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to AI:** Overview, Scope, Foundations, Applications, Techniques, and Issues of Artificial Intelligence. **Intelligent Agents:** Agent and its Environment; Concept of a Rationality: Omniscience, Learning and autonomy; Structure of Agents: Simple Reflex, Model-Based, Goal Based, Utility Based Agents.	15	CO1
2	**Introduction to Search:** Introduction to search algorithm and search space in artificial intelligence, Searching for solutions; **Uninformed search strategies:** Introduction to Depth-First, Introduction to Breadth-first search, **Informed search strategies:** Hill Climbing; Adversarial Search: Minimax Algorithm.	15	CO2
3	**Logical Agents:** Knowledge based Agent, Logic, Propositional Logic, Agents Based on Propositional Logic, Introduction to First Order Logic and Inference. **Planning:** Classical Planning, Algorithms for Planning as State Space Search, Time Schedule and Resources, Hierarchical Planning, Planning in Nondeterministic Domains, Multi-agent Planning.	15	CO3
4	**Knowledge Representation:** Ontological Engineering, Categories and Objects, Events, Reasoning Systems, Reasoning with default information; Acting under Uncertainty, Basic Probability Notation, Probabilistic Reasoning, Bayes Rule. **Learning:** Learning from Observations, Inductive Learning, Knowledge in Learning, Explanation-based Learning. **Case Studies:** MYCIN: Overview, Domain, and features.	15	CO4

Suggested Readings

1. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach” (3rd ed.), Pearson Education, 2011.
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 Solving”, Pearson Education, 5th Edition, 2010.

Online Resources

1. https://www.youtube.com/watch?v=pKeVMlkFpRc
2. https://www.simplilearn.com/tutorials/artificial-intelligence-tutorial/what-is-artificial-intelligence

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	1	2	1	3	1	1	1	1	1	2	2	2
CO2	2	2	2	2	1	3		1	1	2	1	2	2	2
CO3	3	2	1	2	1	3		1	2	2	1	2	2	2
CO4	3	3	1	3	1	3		1	2	2	1	3	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**	I		
Course Name	Introduction to Statistical Method				
Code	BCADSN11112				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Subjects analyze statistical data graphically using frequency, cumulative frequency distribution, statistical data using central tendency, dispersion, basic probability concept & rules including additive and multiplicative laws.				
Course Outcomes					
CO1	To apply statistical distributions methods for real life problems.				
CO2	To draw & demonstrate valid inferences based on the analysis of statistical data.				
CO3	To Implement the concept of probability.				
CO4	To Implement the concept of conditional probability & Theoretical distribution.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Population, Sample and Data Condensation:** 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. **Measurement of Central Tendency**: 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	CO1
2	**Measures of dispersion:** Concept of dispersion, Absolute and Relative Measures of Dispersion: Range, Quartile, Interquartile Range, Mean Deviation, Standard Deviation **Correlation and Regression**: 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	CO2
3	**Probability and Expected Value:** Experiment, Sample Space, Event, Types of Events, Probability: Classical Approach, Subjective Approach, Axiomatic Approach & Modern Definition; Probability Theorems (Additive, Multiplicative).	15	CO3
4	**Conditional Probability & Theoretical Distribution:** Definition of conditional probability, Bayes's Theorem, Mathematical Expectation, Random Variable & Probability Distribution of Random Variable; Meaning of Theoretical Distributions, Difference between Theoretical & Observed Frequency Distributions, Binomial Distribution, Properties and Constants of Binomial Distribution.	15	CO4

Suggested Readings

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

Online Resources

1. https://archive.nptel.ac.in/courses/111/105/111105077/
2. https://onlinecourses.nptel.ac.in/noc22_cs120/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	1	1	1			1	2	1	1	1
CO2	2	2	2	2	1									
CO3	3	2	2	3	1									
CO4	2	2	2	2	1	1	1			1	1		1	1

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**	I		
Course Name	Programming in 'C' Lab				
Code	BCADSN11151				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To provide the fundamental knowledge about various concepts of 'C' Programming using various constructs like if, if-else, switch case, for loop, do while, etc. and apply code reusability using functions and pointers.				
Course Outcomes					
CO1	Understand various constructs of the C Language along with proper syntax.				
CO2	Develop programs using functions, pointers, structure, union on various topics.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Implementation of Fundamental Data Types. 2. Implementation of Fundamental Operators. 3. Implementation of Conditional Program such as if, switch etc. 4. Implementation of Basic Control Constructs such as For Loop, While Loop, Do While Loop. 5. Implementation of Functions. 6. Implementation of Functions using call by value and call by reference. 7. Implementation of This pointer.	15	CO1
2	1. Implementation of Structures, Union, and Enumeration etc. 2. Implementation of Pointers. 3. Implementation of Pointers as Function Arguments. 4. Implementation of Pointer of Pointer. 5. Implementation of Nested Structure.	15	CO2

Suggested Readings

1. E. Balagurusamy, "Programming in ANSIC", TMH Publications.
2. Reema Thareja, "Programming in C", OXFORD University Press.
3. Peter Norton's, "Introduction to Computers", TMH Publications
4. Kernighan, Ritchie, "The C Programming Language", PHI Publications
5. Yashwant Kanitakar, "Let us C", BPB Publications.

Online Resources

1. https://nptel.ac.in/courses/106104128
2. https://cse02-iiith.vlabs.ac.in/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	3	2	2	3		1	2	2	1	2	3
CO2			2	3	3								2	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**	I		
Course Name	Database Management System Lab				
Code	BCADSN11152				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	The main objective is students gain knowledge about databases for storing the data and to share the data among different kinds of users for their business operations				
Course Outcomes					
CO1	Develop database modelling for a problem.				
CO2	Design a database using normalization.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Creating and Managing Tables a. Creating and Managing Tables b. Including Constraints 2. Manipulating Data a. Using INSERT statement. b. Using DELETE statement. c. Using UPDATE statement. 3. SQL Statements – 1 a. Writing Basic SQL SELECT Statements b. Restricting and Sorting Data c. Single-Row Functions 4. SQL Statements – 2 a. Displaying Data from Multiple Tables b. Aggregating Data Using Group Functions c. Subqueries	15	CO1& CO2
2	1. Using SET operators, Date/Time Functions, GROUP BY clause (advanced features) and advanced subqueries a. Using SET Operators b. Datetime Functions c. Enhancements to the GROUP BY Clause d. Advanced Subqueries 2. Creating and Managing other database objects a. Creating Views b. Other Database Objects c. Controlling User Access 3. Using DCL commands a. creating users b. Authenticating users c. Roll back command	15	CO1 & CO2

Suggested Readings

1. Ivan Bayross, “SQL, PL/SQL: The Programming Language of Oracle”, BPP Publication.
2. Connolly & Begg, “Database Systems: A Practical Approach to Design, Implementation and Management”, Pearson Education.
3. R. S. Despandey, “SQL/PL SQL for Oracle”, Dreamtech.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105175/
2. https://nptel.ac.in/courses/106104135

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2			1	2	1	1		2		1	1	1	
CO2	1	1	1	1	2	2	2		3		1	2	1	1

SECOND SEMESTER

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**	II		
Course Name	Cloud Application Development				
Code	BCADSN12101				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To learn different cloud computing techniques and concepts for the development of the virtualization and hypervisor.				
Course Outcomes					
CO1	Understand and apply statistical methods for Data visualization and gain knowledge of Watson Studio, R and Python.				
CO2	Identify appropriate data visualization techniques given requirements imposed by the data, Acquire and Apply data visualization tools on various data sets.				
CO3	Understand and apply REST API and JSON				
CO4	Understand and apply data services and IBM Cloud				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to cloud computing:** 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 Deep Down into IBM Cloud- 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	CO1
2	**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	CO2
3	**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	CO3
4	**Introduction to data services on IBM Cloud**: Describe different services and database 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	CO4

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.

Online Resources

1. https://www.youtube.com/watch?v=EN4fEbcFZ_E
2. https://www.youtube.com/watch?v=1PAy6d16ADQ
3. https://cognitiveclass.ai/courses/data-visualization-python

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	2		1	1	1			1	1		1
CO2	2	1	2	1	2	2	2	1		1			1	2
CO3	1	2	1	3		2	2			2	1	2	1	3
CO4	1	2	3	2	2	2	1			3		2	2	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**	II		
Course Name	Data Visualization				
Code	BCADSN12102				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		2	0	0	2
Course Objectives	To learn different statistical methods for Data visualization with the help of Watson Studio R and Python, packages Numpy, pandas and matplotlib and learn functionalities and usages of Seaborn.				
Course Outcomes					
CO1	Understand and apply statistical methods for Data visualization and gain knowledge of Watson Studio, R and Python.				
CO2	Identify appropriate data visualization techniques given particular requirements imposed by the data, Acquire and Apply data visualization tools on various data sets.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction of Statistics:** 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	CO1
2	**Data Visualization with Watson Studio and Python:** 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	CO2

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

Online Resources

1. https://bcourses.berkeley.edu/courses/1267848/files/52083638/download?wrap=1
2. https://www.youtube.com/watch?v=3Ua6lT7Ye0A
3. https://cognitiveclass.ai/courses/data-visualization-python

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1		1	2	3	2		2	1	1	2		2	3
CO2	2	2	2	1	1	3		1	2	1	2		2	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**		II	
Course Name	Operating Systems				
Code	BCADSN12103				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To provide a good understanding of the underlying concepts of operating systems.				
Course Outcomes					
CO1	Understand the principles and techniques used to implement processes and threads as well as the different algorithms for process scheduling.				
CO2	Understand the mechanisms used for process synchronization & handling deadlock.				
CO3	Understand the concept of memory management and virtual memory.				
CO4	Understand the file system structure and storage management.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction and Process Management:** 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	CO1
2	**Process Synchronization and Deadlocks**: 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	CO1 & CO2
3	**Memory Management**: 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; 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.	15	CO2 & CO4
4	**Storage Management:** 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; Secondary Storage Structure: Disk Structure**,** Disk Scheduling Algorithms**,** Disk Management.	15	CO3 & CO4

Suggested Readings

1. Abraham Silberschatz and Peter Baer Galvin, “Operating System Concepts”, Addison-Wesley.
2. Andrew S. Tanenbaum, “Modern Operating Systems”, Prentice Hall.
3. Milan Milankovic, “Operating Systems, Concepts and Design”, TMH.
4. William Stallings, “Operating Systems: Internal and Design Principles”, PHI.
5. D M Dhamdhere, “Operating System- a Concept based Approach”, McGraw Hill Education.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105214/
2. https://onlinecourses.nptel.ac.in

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3					2	2			1	1	3	2	
CO2	3	3		3	2	2	3			2	1	3	2	
CO3	2	2		2		1				2	2	3	2	
CO4	2	1		2	1	2	1			1	1	2	2	

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	Semester		II	
Course Name	Data Structure Using C				
Code	BCADSN12104				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	To impart the basic concepts of data structures and algorithms and stacks, queues, list, trees, and graph.				
Course Outcomes					
CO1	Apply advanced C programming techniques such as pointers, dynamic memory allocation, structures to developing solutions for problems.				
CO2	Design and implement abstract data types such as stack and queue by using C as the programming language using static implementations.				
CO3	Design and implement abstract data types such as tree by using C as the programming language using static and dynamic implementations.				
CO4	Design and implement C programs that apply abstract data types.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Data Structures:** Basic Terminology, Definition of Data Structure, Application of Data Structure, Classification of Data Structure, Operations on Data Structure, Algorithm, Efficiency of an algorithm, Abstract Data Type (ADT); Arrays: Definition, Single and Multidimensional Arrays, Address Calculation, Representation of Arrays, Advantages and Disadvantages of Array, Application of Arrays, Limitations of Array, Sparse Matrices and their representations, Dynamic Memory Allocation.	15	CO1
2	**Continuous Implementation (Stack and Queue)**:Introduction to Stack, Array Representation; Operations on Stacks: Push & Pop, Applications of stack, Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack; Recursion: Principles of Recursion, Tail Recursion, Tower of Hanoi Problem, Recursion Vs. Iteration; Queue: Introduction to Queue, Array representation and implementation of Queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Dequeue and Priority Queue. Operations on Queue: Create, Add, Delete, Full and Empty Queue, Circular Queue, Dequeue and Priority Queue.	15	CO1 & CO2
3	**Non Continuous Implementation:** Linked Lists: Linear List concept, List v/s Array, 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: Create List Insert node (empty list, beginning, middle, end), Delete node (first, general case), Traversing node, Searching node, Print list, Count Nodes, Sort Lists.	15	CO2 & CO3
4	**Trees:** Introduction to Tree & its Terminology, Binary trees, Types of Binary trees, Representation of Binary Tree, Traversals (Inorder, Preorder, Postorder), Tree Expression, Binary Search Tree, Insertion and Deletion in BST; Sorting & Searching Techniques: Bubble Sort, Selection Sort, Insertion Sort, Shell Sort, Quick Sort, Merge Sort; Sequential Search,	15	CO3 & CO4

	Binary Search.		

Suggested Readings

1. Y. Langsam, M. Augenstin and A. Tannenbaum, “Data Structures using C and C++”, Pearson Education Asia, 2nd Edition, 2002.
2. Ellis Horowitz, S. Sahni, D. Mehta, “Fundamentals of Data Structures in C++”, Galgotia Book Source, New Delhi.
3. S. Lipschutz, “Data structures”, Mc-Graw-Hill International Editions, 1986.
4. Jean-Paul Tremblay, Paul. G. Soresan, “An Introduction to Data Structures with Applications”, Tata Mc-Graw-Hill International Editions, 2nd edition 1984.
5. A. Michael Berman, “Data Structures via C++”, Oxford University Press, 2002.
6. M. Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson Education, 2nd Edition, 2002.

Online Resources

1. https://www.tutorialspoint.com/dsa_using_c/index.htm
2. https://www.youtube.com/watch?v=Db9ZYbJONHc
3. https://www.mygreatlearning.com/blog/data-structures-using-c/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	2	2	3	1		1	2	1	3	3	3
CO2	3	2	2	3	2	3	1		1	2	1	3	3	3
CO3	3	2	2	3	2	3	1		1	2	1	3	3	3
CO4	3	2	2	3	2	3	1		1	2	1	3	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**		II	
Course Name	Foundation of Machine Learning				
Code	BCADSN12111				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To acquire the fundamental knowledge of Machine Learning.				
Course Outcomes					
CO1	Understand the basics of machine learning concepts.				
CO2	Learn various algorithms of machine learning.				
CO3	Learn and apply extended concepts of machine learning.				
CO4	Learn and solve the Neural Network concepts and problems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Definition of Machine Learning, Key elements of Machine Learning, The origins of Machine Learning, Machine learning in practice, Design of a Learning System, Types of Machine Learning: Supervised Learning, Semi Supervised Learning, Unsupervised Learning, Reinforcement Learning and Artificial Neural Network, Applications of Machine Learning; **Data Pre-Processing:** Overview and Need of Data Pre-processing, Data Quality, Factors Affecting Data Quality; **Major Task in Data Pre-processing:** Cleaning, Integration, Reduction, Transformation, and discretization; **Scaling:** Types of Scaling, Normalization and Standardization.	15	CO1
2	**Supervised Learning:** Classification and Regression, Generalization, Overfitting, and Underfitting, Supervised Machine Learning Algorithms, K-Nearest Neighbors (KNN), Support Vector Machine (SVM): Working of SVM, Implementation; Decision Tree: Working and Implementation; Naïve Bayes Classifier: Introduction to Naïve Bayes Algorithm, building a model Using Naïve Bayes;	15	CO2 & CO3
3	**Unsupervised Learning:** Types of Unsupervised Learning, Introduction to Clustering, K-means Clustering Algorithm, Working and Implementation of K-means Clustering, Introduction to Hierarchical Clustering, Agglomerative Hierarchical Clustering, Density-Based Method. **Reinforcement Learning:** Overview of Reinforcement Learning, The Learning Task, Markov Decision process, Q learning, The Q function, Algorithm for Learning Q.	15	CO2 & CO3
4	**Artificial Neural Network:** Motivation, Neural Network Representation, Perceptron, Training Rule, Activation Functions and types of Activation Functions, Introduction to Gradient Descent and Delta Rule. Feed Forward Neural Network, Back Propagation Network: Overview, Back Propagation Algorithm.	15	CO3 & CO4

Suggested Readings

1. Tom M. Mitchell, "Machine Learning", First Edition by Tata McGraw-Hill Education, 2013.
2. Jiawei Han, Micheline Kamber, Jian Pie, “Data Ming Concept and Techniques”, Morgan Kaufmann, 3rd Addition, 2011.
3. Fengxiang He and Dacheng Tau, “Machine Learning Foundation, Methodologies and Application”, Springer 2023.

4. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, O'Reilly, 2017.

Online Resources

1. https://www.youtube.com/playlist?list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77
2. https://bloomberg.github.io/foml/#home

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	1	1	1	1		1	2	1	1	2	1
CO2	2	2		2	1	2	2	1	3	3		2	3	3
CO3	2	2		2	2	3	3	1	2	3	1	3	2	2
CO4	1	2		2	3	2	3	1	2	2		3	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**	II		
Course Name	Fundamentals of Data Science				
Code	BCADSN12112				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To understand the overview of data Science with its importance and crucial role in current business world.				
Course Outcomes					
CO1	Understand the basic concepts of data Science.				
CO2	Understand the Algorithm and Process.				
CO3	Understand to classify the data.				
CO4	Learned the concepts of the clustering techniques.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction**: Definition and description of Data Science, history and development of Data Science, terminologies related with Data Science, Basic Framework and Architecture, Primary components of Data Science, users of Data Science and its hierarchy, Overview of different Data Science techniques, challenges and opportunities in business analytics, different industrial application of Data Science techniques. **Role of Mathematics in Data Science**: Importance of Probability and Statistics in Data Science, important types of statistical measures in Data Science, Introduction to statistical Inference and its usage in Data Science, Application of Statistical techniques in Data Science, Overview of linear algebra: matrix and vector theory, Role of linear Algebra in Data Science, Exploratory data Analysis and Visualization Techniques.	15	CO1
2	**Data Mining:** Data Mining and its features, Use of Data mining, area of applications of data mining, technologies and techniques used for data mining. Major Issues in Data Mining, Data Pre-processing: An Overview, Data Pre-processing: Data Cleaning, Data Pre-processing: Data Integration, Data Pre-processing: Data Reduction, Data Transformation, Data Discretization, **Pattern Analysis:** Introduction to pattern analysis, Mining Frequent Patterns, Frequent Itemset Mining Methods. Patterns used for data mining, numerical on Apriori algorithm, Pattern Evaluation Methods, Advanced Pattern Mining, Pattern Mining: A Road Map, Pattern Mining in Multilevel, Multidimensional Space, Constraint-Based Frequent Pattern Mining, Mining High-Dimensional Data.	15	CO2 & CO3
3	**Classification:** Introduction to Classification, Decision Tree Induction, Bayes Classification methods, Rule-Based classification, Model evaluation and classification, Techniques to Improve Classification Accuracy, Support Vector Machines, Lazy Learners (or learning from neighbors).	15	CO3
4	**Clustering:** Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Evaluation of Clustering, Clustering High-Dimensional Data, Clustering Graph and Network Data.	15	CO4

Suggested Readings

1. Vijay Kotu and Bala Desh pandey, "Data Science Concept and Practice", Morgan Kaufmann, 2nd Edition, 2019.
2. Jiawei Han, Micheline Kamber, Jian Pie, "Data Ming Concept and Techniques", Morgan Kaufmann, 3rd Addition, 2011.
3. Avrim Blum, John Hopcroft, and Ravindran Kannan, "Foundations of Data Science", Cornell University, 2018.

Online Resources

1. https://www.youtube.com/playlist?list=PL15FRvx6P0OWTlNBS_93NHG2hIn9cynVT
2. https://www.youtube.com/watch?v=7Dv8Ke5FJOM&list=PLmNPvQr9Tf-b_SuBdoRsuNhTmaHJ0eKab

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	1	1	1	1		1		1	1	1	2
CO2	1	2		2	2	1		1		2		2	2	3
CO3	2	3		2	3	3			1	2		3	2	3
CO4	2	3		1	3	2	1		1	3	1	3	2	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	I	**Semester**	II		
Course Name	Data Structure Using C Lab				
Code	BCADSN12151				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To understand the various concepts of Data Structures, their usage and implement them using 'C' programming language.				
Course Outcomes					
CO1	Understand and implement 'C' program with data types, control loop, array, functions, structures, stack, string, queue, circular queue, linked list.				
CO2	Understand and implement 'C' program for implementing Linear Search, binary search, bubble sort, selection sort, insertion sort, merge sort, quick sort, binary tree				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Implementation of Arrays (Single & Double Dimension). 2. Implementation of String. 3. Implementation of Recursive Procedures. 4. Array implementation of Stack. 5. Array implementation of Queue. 6. Array implementation of Circular Queue. 7. Array implementation of Linked List. 8. Adding a node into linked list. 9. Deleting a node from linked list. 10. Insertion of a node in middle of linked list. 11. Insertion of a node at the end of linked list	15	CO1
2	1. Implementation of Binary tree. 2. Implementation of Linear Search. 3. Implementation of Binary Search. 4. Implementation of Bubble sort. 5. Implementation of Merge sort. 6. Implementation of Insertion sort 7. Implementation of Selection sort. 8. Implementation of Quick sort.	15	CO2

Suggested Readings

1. Y. Langsam, M. Augenstin and A. Tannenbaum, "Data Structures using C and C++", Pearson Education Asia, 2nd Edition, 2002.
2. Ellis Horowitz, S. Sahni, D. Mehta, "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi.
3. S. Lipschutz, "Data structures", Mc-Graw-Hill International Editions, 1986.

Online Resources

1. https://www.youtube.com/watch?v=Db9ZYbJONHc
2. https://www.mygreatlearning.com/blog/data-structures-using-c/
3. http://cse01-iiith.vlabs.ac.in/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	2	2	2	3	3		1	2		3	3	3
CO2	2	1	2	2	2	3	1		1	2		3	3	3

Third Semester

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**	III		
Course Name	Descriptive Analytics				
Code	BCADSN13201				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Understand how analytics provided a solution to industries using real case studies. To learn the importance of analytics and how it's transforming the world today. Describe a reporting application, its interface, and the different report types and prompts. Learn the implementation of conditional formatting and different layout to work on.				
Course Outcomes					
CO1	To understand and implement the concept of configuring and using IBM Cognitive Analytics Tool.				
CO2	Understand how a business analysis software works, and its architecture				
CO3	Create different types of advanced reports.				
CO4	Learn to create gauge, pie charts and RAVE visualizations.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Changing business with data insight Overview:** 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	CO1
2	**IBM Cognos Analytics for Consumers:** 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 crosstab report, Add measures to crosstab reports, Data sources for crosstabs.	15	CO2
3	**Accessing the data warehouse and present data graphically:** 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	15	CO3

	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.		
4	**Wrap up and planning considerations and customize reports:** 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 relate 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	CO4

Suggested Readings

1. Holden Karau, “Learning Spark: Lightning-Fast Big Data Analysis”, Shroff/O'Reilly
2. Dr. Charles Russell,”Python for Everybody: Exploring Data in Python 3”, Severance Managing Your Business.
3. IBM Courseware

Online Resources

1. https://onlinecourses.nptel.ac.in/noc24_cs65/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2		2		2	1	2	2	2	2
CO2	2	2	2	3	2	1	2		2	1	1	2	2	2
CO3	2	1	3	2	2		2		2	1		2	2	2
CO4	2		2		2	2	1		1		1	2	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**	III		
Course Name	NO SQL and Dbaas 101				
Code	BCADSN13202				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	2
Course Objectives	Students will understand fundamental concepts of a number of different NOSQL products. Students will also learn various CRUD operations and the querying mechanisms in NOSQL. Students will also comprehend with advanced topics. Use the MongoDB tools to develop and deploy your applications. Implement Java/ Python / PHP web application for a real world problem with MongoDB.				
Course Outcomes					
CO1	Define, compare and use the four types of NoSQL Databases (Document-oriented, Key Value Pairs, Column-oriented and Graph).				
CO2	Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.				
CO3	Explain the detailed architecture, define objects, load data, query data and performance tune Document-oriented NoSQL databases.				
CO4	Demonstrate an understanding of the detailed architecture; define objects, load data, query data and performance tune Key-Value Pair NoSQL databases.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	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.	7	CO1
2	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.	8	CO2
3	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.	7	CO3
4	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.	8	CO4

Suggested Readings:

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

Online Resources:

1. https://archive.nptel.ac.in/noc/courses/noc17/SEM2/noc17-cs33/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2		2		2	1	2	2	2	2
CO2	2	2	2	3	2	1	2		2	1	1	2	2	2
CO3	2	1	3	2	2		2		2	1		2	2	2
CO4	2		2		2	2	1		1		1	2	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**		III	
Course Name	Linux and Shell Programming				
Code	BCADSN13203				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To present the fundamental concepts of LINUX. To get an understanding of Multiuser, Multitasking and Timesharing System. To introduce the significance of Open Source Software. Introduction of GUI of LINUX. Introduction of Shell programming for solving various problems.				
Course Outcomes:					
CO1	Develop the understanding of LINUX Operating System.				
CO2	Get the understanding of Redirection, Filters and LINUX Utilities.				
CO3	Ability to understand the functioning of vi editor.				
CO4	Ability to write Shell Scripts using Linux commands.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to LINUX:** Difference between UNIX & LINUX, Features of LINUX, LINUX system organization (the kernel and the shell), Files and directories, Hierarchical File Structure, Basic LINUX Commands: PATH, man, echo, passwd, uname, who, date, stty, pwd, cd,mkdir, rmdir, ls, cp, mv, rm, cat, more, wc.; Introduction to LINUX file system: Boot block, super block, Inode table, data blocks; Library Functions versus System Calls	15	CO1
2	**Input Output Redirection & LINUX Utilities:** Input Output Redirection, File handling utilities; Security by file permissions: chmod, umask, sticky bit; disk utilities-du, df; find & ulimit; Process utilities; Filters: Filters and Pipes, Concatenating files, Display Beginning and End of files, Cut and Paste, Sorting, Translating Characters, Files with Duplicate Lines, Count Characters, Words or Lines, Comparing Files.	15	CO2
3	**vi editor:** Types of editors, Basic features, modes of execution in vi editor, commands for Creating & saving a file and quitting from vi, Cursor movement, Text insertion, changing and replacing text, deleting text, searching the text, Pattern Matching of text, various options to :set command, Writing, Compiling and Running a C program on Linux.	15	CO3
4	**Shell Programming:** Types of shells, Shell Meta characters, Shell keywords, Shell variables, Scripting Basics , Creating Shell scripts, Shell commands, the environment, Environmental Variables, Integer arithmetic and string manipulation, Special command line characters; Decision making and loop control; File Tests, String Tests, continue and break; Using positional parameters, changing Positional Parameters, Generating Output, Handling Input, Exit Status of a Command, eval Command; Argument Validation, Debugging Scripts, Script Examples, Arrays; String Functions, Mathematical Functions, User – Defined Functions, Applications	15	CO4

Suggested Readings:

1. Sumitabha Das, “Unix Concepts and Applications”, TMH.
2. Yashwant Kanetkar, “Unix Shell Programming”, BPB.
3. Parata, “Advanced Unix–A Programmer’s Guide”, BPB.
4. Behrouz A. Forouzan, Richard F. Gilberg, “Unix and shell Programming”, Thomson Asia
5. M.G. Venkateshmurthy, “Unix & Shell Programming”, Pearson Education

Online Resources:

1. http://www.nptel.com/computerscience/Linuxprogramming
2. http://manuals.bioinformatics.ucr.edu/home/linux-basics

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2	1	1	2	1		1			2	1	1
CO2	2		2	1	2	2	1		1			2	2	1
CO3	2		2	1	2	2	1		2			2	1	2
CO4	2		3	2	1	2	1		1			3	1	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**	III		
Course Name	Computer Network				
Code	BCADSN13204				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To introduce basic elements of communication system. To understand channels, techniques and devices used to transmit data between distant locations through different devices. To introduce the functions of different layers of reference model. Understand different protocols and network components.				
Course Outcomes					
CO1	To describe and analyze the hardware, software, and various components of a communication network.				
CO2	Able to explain networking protocols models and devices with their hierarchical relationship. Compare protocol models and select appropriate protocols for a particular design.				
CO3	Able to classify networks, transferring of data, address of data packets, analyzing performance, and understanding concepts of data connection and transfer.				
CO4	Able to Identify infrastructure components and their roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Data Communications:** Basic Data Communication System: Data, Signaling and Transmission System; Synchronous and Asynchronous Transmission; Transmission modes and media. **Introduction to Computer Network:** Definition; Goals and Application of Computer Network; Types of Networks: Point to point, Multipoint, Types of Topologies (PAN, LAN, MAN, WAN), Centralized, Distributed and Collaborative; Type of Data Communication System: Wired and Wireless communication.	15	CO1
2	**Introduction to Network Connections:** Introduction to Internet, Intranet, Extranet, VPNS. Bandwidth, Band and Channel Capacity: Nyquist Capacity and Shannon Capacity Formula. **Network Architecture:** Monolithic v/s Layered Approach; Design Issues of Layered approach; Services, Interfaces, Standards and Protocols; ISO- OSI Reference Model and TCP/IP Model; Multiplexing: SDM, FDM, TDM, WDM; Switching: Circuit, Message, Packet; PSTN & ISDN: Narrowband and Broadband. **Subnet Communication:** Concept of Subnet & Host-to-Host Communication; Intermediate Devices: Repeaters and Regenerators, Hub, Switch, Router, Gateway. **Physical Layer:** Design Issues, Services, Protocols.	15	CO2
3	**Data Link Layer:** Framing, Error Control-VRC,LRC,CRC, Checksum, Flow Control- Hamming Code; LLC and MAC Sub-layer; DLL Protocols: Stop-and-wait Protocol, Sliding Window Protocols, Go-Back-N protocol; Subnet	15	CO3

	Communication**:** LAN Protocols: IEEE protocol. **Network Layer:** Routing, Congestion Control, QoS, Internetworking; Routing Algorithms: Distance Vector Routing, Link State; IP Addressing: IPV4 & IPV6, Firewalls. **Transport Layer:** Connection Management, Multiplexing, Segmentation and Reassembly Host- to-Host Flow Control, Acknowledge and Error Control; Transport Protocol: Connection-oriented TCP and Connection-less UDP.		
4	**Session Layer** Logical Session Management, QoS, Token Management; Synchronization; Event Management; Exception Handling. **Presentation Layer:** Data Presentation, Compression and Encryption; Data Compression: Text, Image, Audio and Video; Cryptography; Symmetric and Asymmetric Encryption; Private Key and Public Key Encryption. **Application Layer:** HTTP, HTTPS, Internet Browser, FTP, Telnet, DNS, Email System.	15	CO4

Suggested Readings

1. W. Stallings, “Data and Computer Communication”, Pearson Education.
2. A. S. Tanenbaum, “Computer Network”, Pearson Education.
3. Behrouz A. Forouzan, “Data Communication and Networking”, Tata McGraw Hill.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105183/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1s	2		1		2	1	1	2	2	2
CO2	2	2	2	1	2	1	1		2	1	1	2	2	2
CO3	2	1	3	1	2		1		2	1		2	2	2
CO4	2		2		2	2	1		1		1	2	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**	III		
Course Name	Object Oriented Programming Using Java				
Code	BCADSN13205				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
Course Objectives	The main objective of this subject is to introduce the fundamental concepts of object-oriented Programming, 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 andperformance standard.				
Course Outcomes					
CO1	To understand the concept of object-oriented programming and implement it in Java.				
CO2	To understand building blocks of OOPs language, class, objects and method etc.				
CO3	Able to understand inheritance, package and interfaces concepts.				
CO4	To implement multithreading in object-oriented programs and designing GUI using AWT Control and event handling.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Java:** 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; **Array and String:** Single and Multidimensional Arrays, String Class, StringBuffer Class, Operations on String, CommandLine Argument, and Use of Wrapper Class.	12	CO1
2	**Classes, Objects & Methods:** 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.	12	CO2
3	**Inheritance and Polymorphism:** Inheritance in Java, Types of Inheritance, Member Access Rule, Use of this and Super Keyword, Abstract class, Dynamic Method Dispatch, Use of final Keyword; **Package & Interface:** Defining and Importing Packages, Defining and Implementing Interfaces, Extending Interfaces; **I/O STREAM:** Concept of Streams, Streams Classes: Byte and Character Stream, Reading Console input & Writing Console output.	12	CO3
4	**Exception Handling:** Exception Type, Usage of try, catch, throw, throws and finally Keywords, Creating Own Exception Classes; **Multi-Threading:** Concept of Thread, Thread Life Cycle, Creating Thread Using Thread Class and Runnable Interface, Thread Priority; **AWT Control:** 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; **Event Handling:** Events, Event Sources, Event Listeners, EDM, Handling Mouse and Keyboard Events.	12	CO4

Suggested Readings

1. Herbert Schild, “The Complete Reference, Java 2”, TMH.
2. R. Krishnamoorthy & S. Prabhu, “Internet and Java Programming”, New Age International Publishers.
3. E. Balaguruswamy, “Programming with Java A Primer”, TMH.
4. Udit Agrawal, “Internet and Java Programming”, Dhanpat Rai & Co.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105191/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	2	1	2	1	2		3	1	2	2	2	2
CO2	2	1	1	1	2	3	3		1			2	2	2
CO3	1	2	2	2	2	2	2		2	1	1	1	2	2
CO4	2	3	1	2	1	3	2		2		2	1	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**	III		
Course Name	Information & Data Security				
Code	BCADSN13211				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	In this course, student will systematically study the fundamental principles of computer system security, including access control, security policies, software vulnerabilities, web security and various authentication mechanisms.				
Course Outcomes					
CO1	To understand the basics of information security.				
CO2	To learn about how to maintain the information and data security i.e., confidentiality, integrity and availability.				
CO3	Understanding the basic concept of security policies.				
CO4	The student will be able to understand the basics of security, policies, cryptographic algorithms, and its issues along with its countermeasures				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Information Security:** Principles, CIA (Confidentiality, Integrity, Availability), Aspects of Information Security, Need for Security, Goals of Information Security, Features of a Good Security Policy, Security Attacks, Virus, DoS, Worms, Spyware, Ransomware, Security Services and Mechanisms, Security Standards.	15	CO1
2	**Principles of Security**: Steganography, Cryptographic Techniques: Plain Text and Cipher Text, Substitution Techniques, Types of Substitution Techniques, Transposition Techniques, Types of Transposition Techniques, Block Cipher Principles, Block Cipher Modes of Operation, Encryption and Decryption, Data Encryption Standard (DES) Algorithm, Strength of DES.	15	CO2
3	**Introduction to Security Policies:** Confidentiality, Integrity, Availability and Hybrid Policies, Academic Computer Security Policy: General University Policies, Information Risk Management, Risk Mitigation, Risk Handling Strategies and Risk Assessment, Information Classification – Guidelines, Types, Criteria for data Classification, Data Classification procedures, Classification Controls.	15	CO3
4	**Authentication:** Basics of Authentication, One Factor Authentication, Two Factor Authentication, Multi Factor Authentication, Passwords: Attacking a Password System, Countering Password Guessing, Biometrics: Fingerprints, Faces, Voices, Eyes and Combinations, Access Control, Types of Access Control.	15	CO4

Suggested Readings

1. Matt Bishop, “Introduction to Computer Security”, Addition Wesley.
2. William Stallings, “Computer Security: Principles and Practices”, Pearson Education.

3. Timothy Morey Andrew Burt, Thomas C. Redman, Christine Moorman “Customer Data and Privacy: The Insights You Need from Harvard Business”, Harward Business Press.

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106146/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	1		1	2		1			1		1
CO2	1	2	1	1	1	1	2		1			1	1	2
CO3		1	2	2		1	1		1	1	1	1		1
CO4	2	2	3	2	2	2	3		3	2	3	2	2	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	Semester	III		
Course Name	Essential Of Data Collection Ethics				
Code	BCADSN13212				
Course Type	GE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	To provide participants with the adequate knowledge of the techniques of data collection and ethics.				
Course Outcomes					
CO1	To understand the basic concept of data collection and their methods.				
CO2	To understand the principle of data collection ethics.				
CO3	To understand the essential of data collection ethics.				
CO4	To understand the case studies of data collection ethics.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of data collection:** Definition and concept Data collection, Data collection method, type of data collection method; **Primary data collection method**: Quantative method-Time series analysis, Smoothing technique, Barometric method, Qualitative method-survey, Interviews, Group, questionnaire; **Secondary data collection method:** Internal sources of data collection, External sources of data collection.	15	CO1
2	**Data collection ethics**: 5C's of data collection ethics, Consent, Clarity, Consistency, Control, Consequences; **Principle of data collection ethics**: Privacy, Consent, Transparency, Fairness, Accountability.	15	CO2
3	**Data collection ethics:** Introduction of data collection ethics, Ethical frameworks, Informed consent, Privacy and Confidentiality, Bias and Fairness, Responsible data handling, Ethics issue in specific context.	15	CO3
4	**Case Studies:** Facebook Emotional Contagion Study, Tuskegee Syphilis Study, Cambridge Analytical Data Scandal, Google Street WIFI Data Collection, Online Survey Consent.	15	CO4

Suggested Readings

1. Data Collection: Methods, Ethical Issues and Future Directions by Susan Elswick, Nova Science Pub Inc.
2. Data Science Ethics: Concepts Techniques and Cautionary Tales by David Martens, Oxford University Press.
3. Ethics of Data and Analytics Concepts and Cases by Kirsten Martin, Auerbach Publications (T&F).

Online Resources

1. https://www.simplilearn.com/what-is-data-collection-article
2. https://searchworks.stanford.edu/view/13045465

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2		2	1	1		1			2	1	1
CO2	2		2		2	2	1		1			2	1	1
CO3	2	2	2	2	3	2	2		2	2	2	2	2	2
CO4	2	2	3	2	2	2	2		3	2	2	2	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	Semester		III	
Course Name	Linux Lab				
Code	BCADSN13251				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		0	0	4	2
Course Objectives	To provide the fundamental knowledge about LINUX operating system, its diverse commands related to file handling, disk, process utilities, redirection etc. Also familiarize the students to do shell programming using vi editor.				
Course Outcomes					
CO1	To demonstrate the basic knowledge of Linux commands and file handling utilities by using Linux shell environment.				
CO2	To introduce shell scripting for various applications.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Use of Basic LINUX Commands: PATH, man, echo,who passwd, uname, date, stty, pwd, cd,mkdir, rmdir, cat,ls, cp, mv, rm, , more, wc 2. Commands related to Input Output Redirection 3. Commands related to File handling and Process utilities 4. Commands related to Security by file permissions: chmod, umask, stickybit 5. Commands related to disk utilities-du, df, find & ulimit 6. Implementation of Filters and Pipes 7. Using vi editor do the following things: a. Cursor movement b. Text insertion c. Changing and replacing text d. Deleting text e. Searching the text f. Pattern Matching of text g. Various options to :set command h. Compiling and Running a C program Note: Student will also perform all other exercises provided by course instructor.	30	CO1

2	1. Write interactive shell scripts based on following: a. Positional parameters b. Arithmetic and Logical Operators c. If-then-fi, if-then-else-fi, nested if-else, elif, case structure d. While, until and for loop e. Shell Meta characters 2. Write a Shell script that accepts a filename, starting and ending line numbers as arguments and displays all the lines between the given line numbers. 3. Write a Shell script that deletes all lines containing a specified word in one or more files supplied as arguments to it. 4. Write a Shell script that displays list of all the files in the current directory to which the user has Read, Write and Execute permissions. 5. Write a Shell script that receives any number of file names as arguments checks if every argument supplied is a file or a directory and reports accordingly. If the argument is a file, the number of lines on it is also reported. 6. Write a Shell script that accepts a list of file names as its arguments, counts and reports the occurrence of each word present in the first argument file on other argument files. 7. Write a shell program to accept user name and reports if user log has logged in. Note: Student will also perform all other exercises provided by course instructor.	30	CO2

Suggested Readings:

1. Sumitabha Das, “Unix Concepts and Applications”, TMH
2. Yashwant Kanetkar, “Unix Shell Programming”, BPB
3. Parata, “Advanced Unix–A Programmer’s Guide”, BPB
4. Behrouz A. Forouzan, Richard F. Gilberg, “Unix and shell Programming”, Thomson Asia
5. M.G. Venkateshmurthy, “Unix & Shell Programming”, Pearson Education

Online Resources:

1. http://www.nptel.com/computerscience/Linuxprogramming
2. http://manuals.bioinformatics.ucr.edu/home/linux-basics

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2	1	1	2	1		1			2	1	1
CO2	2		2	2	2	2	1		1			2	1	1

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**	III		
Course Name	Programming with java Lab				
Code	BCADSN13252				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To implement the basic concepts of object-oriented using classes and objects, inheritance, interface, packages, exception handling techniques and multithreading and to design streams and efficient user interface design techniques using GUI.				
Course Outcomes					
CO1	Able to use the syntax and semantics of java programming language and basic concepts of OOP using the concepts of inheritance, polymorphism, interfaces and packages.				
CO2	Able to apply the concepts of Multithreading and Exception handling to develop efficient and error free codes and to design event driven GUI and web related applications which mimic the real word scenarios.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Implementation of a simple Java Program, Interpreting & Compiling. 2. Implementation of control, such as Loops etc. 3. Implementation of Single and Multidimensional Array. 4. Implementation of String class and String Operations. 5. Implementation of Classes and Objects. 6. Implementation of Method in Java. 7. Implementation of Constructor overloading. 8. Implementation of Access Modifier. 9. Implementation of static and this keyword. Note: - Students will also perform all other exercises provided by course instructor.	30	CO1
2	1. Implementation of Inheritance in Java 2. Implementation of Super Keyword. 3. Implementation of Abstract class and final Keyword. 4. Defining and Importing Packages. 5. Defining and Implementing Interface. 6. Implementation of I/O Stream. 7. Implementation of Exception Handling 8. Handling of Multiple Threads. 9. Implementation of AWT Control. 10. Implementation of Event Handling. Note: - Students will also perform all other exercises provided by course instructor.	30	CO2

Suggested Readings

1. Herbert Schild, “The Complete Reference, Java 2”, TMH.
2. R Krishnamoorthy & S. Prabhu, “Internet and Java Programming”, New Age International Publishers.
3. E. Balaguruswamy, “Programming with Java A Primer”, TMH.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105191/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1			2	1	1					1	2	1
CO2	2	2	1	1	2	1	2		2	2	1	3	2	2

Fourth Semester

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**	IV		
Course Name	Big Data Fundamentals				
Code	BCADSN14201				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To provide an overview of an exciting growing field of big data analytics. To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability. To enable students to have skills that will help them to solve complex real-world problems in for decision support.				
Course Outcomes					
CO1	Develop an understanding of the complete open-source Hadoop ecosystem and its near term future direction				
CO2	Understand the functions and features of HDP				
CO3	Understand the Map Reduce model v1 and review java code				
CO4	Develop an understanding of the complete open-source Hadoop ecosystem and its near-term future directions				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Big Data:** 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	CO1
2	**Introduction to Hortonworks Data Platform (HDP):** 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	CO2
3	**Storing and querying data:** 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.	15	CO3

4	**Data processing with different Hadoop Tools:** 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.	15	CO4

Suggested Readings

1. IBM Courseware
2. Alex Holmes, "Hadoop in Practice", Dreamtech Press
3. Shankarmani, "Bigdata Analytics", Wiley

Online Resources

1. Big Data Computing - Course (nptel.ac.in)

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2		2		2	1	2	2	2	2
CO2	2	2	2	3	2	1	2		2	1	1	2	2	2
CO3	2	1	3	2	2		2		2	1		2	2	2
CO4	2		2		2	2	1		1		1	2	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**	IV		
Course Name	Data Science				
Code	BCADSN14202				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	2
Course Objectives	To acquire technical expertise using popular open source analytics frameworks for Data Science. To understand the scientific method for Data Science, use cases, and the Data science team Key roles. To define the Demonstrate knowledge of statistical data analysis techniques utilized in business decision making. To learn how to Use data mining software to solve real-world problems.				
Course Outcomes					
CO1	Understand the scientific method for analytics projects, and the data science team key roles				
CO2	Data Science lifecycle revolve around using some techniques and other Analytical methods to produce insights and predictions from data to achieve a business objective.				
CO3	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.				
CO4	Understand Data engineering and data modeling practices using machine learning and Building and create role-playing challenge-based scenarios to propose real-world solutions.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Data Science:** Data Science overview, Data Science domains with roles, Data Analytics in Practice with Methodologies, Data Science Method, Accessing IBM Cloud and Watson Studio.	7	CO1
2	**Implement Data Techniques on The Cloud:** Integrated Environments for Data Science Projects, Cloud based Data science lifecycle with capabilities, Understand Business needs, explore and prepare the data.	8	CO2
3	**Represent And Transform Data And Data Modeling** 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	8	CO3
4	**Various approaches to Machine Learning:** About Machine learning techniques like Regression to neural nets, Decision tree classifier, Machine learning Framework, Auto insurance Fraud Analyzed in Jupyter Notebooks.	7	CO4

Suggested Readings

1. IBM Courseware
2. Joseph K. Blitzstein and Jessica Hwang, “Introduction to Probability”
3. Wes McKinney “Introduction to Machine Learning with Python: A Guide for Data Scientists”

Online Resources

1. https://onlinecourses.nptel.ac.in/noc19_cs60/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2		2		2	1	2	2	2	2
CO2	2	2	2	3	2	1	2		2	1	1	2	2	2
CO3	2	1	3	2	2		2		2	1		2	2	2
CO4	2		2		2	2	1		1		1	2	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**	IV		
Course Name	Data Warehousing & Data Mining				
Code	BCADSN14203				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course provides an in-depth exploration of data mining and data warehousing techniques, methodologies, and applications. Students will learn how to extract valuable insights from large datasets, design and implement data warehouses, and apply data mining algorithms for knowledge discovery.				
Course Outcomes					
CO1	To understand the basic concept Data Warehousing and Data Mining.				
CO2	To understand the concept of preprocessing, OLAP and Frequent pattern Mining.				
CO3	To understand the concept of Classification.				
CO4	To understand the concept of Clustering.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Data Mining and Data Warehousing:** Overview of data mining and knowledge discovery process Role and importance of data warehouses, Key concepts and components of data mining and data warehousing; **Multi-Dimensional Data Model:** Introduction, Elements, steps in dimensional modeling, Multi-Dimensional Schema; **Data Warehouse Architecture:** The 3-Tier Data Warehouse Architecture, The Bus Architecture.	15	CO1
2	**Data Preprocessing:** Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Discretization; **Data Warehouse Modeling:** Data Cube, Typical OLAP Operations, Role of Concept Hierarchies, OLAP Server Architectures; **Mining Frequent Patterns:** Basic concepts Frequent Item set mining method: the Apriori Algorithm, Generating Association Rules from frequent item sets, FP Growth Algorithm.	15	CO2
3	**Classification:** General Approach to solving classification problems, Classification by decision Tree Induction: Attribute selection measure, Tree pruning, Bayesian Classification: Bayes' Theorem; Rule based classification, Model Evaluation and Selection.	15	CO3
4	**Cluster Analysis:** Cluster Analysis, Partitioning Methods: K-means clustering; Hierarchical Methods: BIRCH clustering; Density Based Methods: DBSCAN; Grid Based Methods: STING, Outlier Analysis; **Data Mining Ethics and Privacy:** Ethical considerations in data mining, Privacy-preserving data mining techniques.	15	CO4

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.
4. Arun K Pujari, “Data Mining Techniques”, University Press.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105174/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	1	1	2	2	1		1	1	1	2	3	1
CO2	2	2	1	1	2	2	1		1	3	1	2	3	1
CO3	3	3	2	3	3	3	1		1	3	1	3	3	3
CO4	3	3	2	3	3	3	1		2	3	1	3	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	Semester	IV		
Course Name	Basics of Design & Analysis of Algorithms				
Code	BCADSN14204				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	0	0	3
Course Objectives	To know the importance of studying the complexity of a given algorithm and various design techniques. Utilizing data structures and/or algorithmic design techniques in solving new problems. Understanding basic computability concepts and the complexity.				

Course Outcomes	
CO1	Able to Argue the correctness of algorithms using inductive proofs and analyze worst-case running times of algorithms using asymptotic analysis.
CO2	Able to explain important algorithmic design paradigms (divide-and-conquer, greedy method) and apply when an algorithmic design situation calls for it.
CO3	Able to explain important algorithmic design paradigms (dynamic-programming and Backtracking) and apply when an algorithmic design situation calls for it.
CO4	Able to Explain the major graph algorithms and Employ graphs to model engineering problems, when appropriate.

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Basic Concepts of Algorithms**: 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 Terms.	12	CO1
2	**Divide and conquer**: Binary Search, Maximum & Minimum, Merge Sort, Quick Sort, Strassen's matrix multiplication; **Greedy Method**: General method, Knapsack Problem, Travelling Salesman problem, Job Sequencing with deadline, Optimal Storage on tapes, Huffman Codes, An Activity Selection Problem.	12	CO2
3	**Dynamic Programming**: Assembly Line Scheduling, Matrix Chain Multiplications, Longest Common Subsequence; Backtracking: General method, N Queens Problem, Sum of subsets, Hamiltonian Circuit Problem.	12	CO3
4	**Branch & Bound**: Introduction, Live Node, Dead Node and Bounding Functions, Knapsack Problem, Assignment Problem; **Analysis of Graph Algorithms**: Elementary Graph Algorithms, Multistage Graphs, Minimum Spanning Trees: Kruskal's & Prim's Algorithm, Single Source Shortest Path: Dijkstra's & Bellman Ford.	12	CO4

Suggested Readings:

1. Thomas H. Coremen, "Introduction to Algorithms", MIT Press.
2. Horowitz & Sahani, "Fundamentals of Algorithms", Galgotia Publications.
3. Aho, Ullman, "Design & Analysis of Computer Algorithms", Pearson.
4. Johnsonbaugh, "Algorithms", Pearson.
5. Bressard, "Fundamentals of Algorithms", PHI.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/106/106106131/.
2. https://onlinecourses.nptel.ac.in/noc19_cs47/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	2		3	1		1	2	1	3	3	3
CO2	2	2	2	3		3	1		1	2	1	3	3	3
CO3	2	2	2	3		3	1		1	2	1	3	3	3
CO4	2	2	2	3		3	1		1	2	1	3	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**	IV		
Course Name	Foundation of Deep Learning				
Code	BCADSN14211				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course aims at teaching supervised, unsupervised and reinforcement deep learning methods which helps to develop state-of-the-art artificial intelligence applications.				
Course Outcomes					
CO1	To explain the fundamentals of deep learning, artificial neural network.				
CO2	To articulate different problem of model improvement, imbalance data problem, and CNN.				
CO3	To understand object detection and image segmentation.				
CO4	To understand generative learning, its application, and deep reinforcement learning.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction:** Deep Learning & its applications, Machine Learning, features, weights, loss function, cost function; **Artificial Neural Network** (ANN): forward propagation, Backpropagation, Stochastic Gradient Descent, Batch gradient descent, mini batch gradient descent, Optimizers, Momentum, training-validation testing set, evaluation measures, accuracy, precision, f-measure.	15	CO1
2	**Model Improvement**: Overfitting vs underfitting, Bias vs Variance, Regularization: L1, L2 regularization, Dropout, Early stopping, Data normalization, Batch normalization, Hyper parameter Tuning; **Imbalance data problem**: Data augmentation in image, Cropping, Flipping, Rotation, Brightness, Contrast, Color augmentation, Saturation, Convolutional Neural Networks; CNN architectures; convolution, striding, padding, pooling.	15	CO2
3	**Object Detection**: setup problem and cost function, well known datasets, Evaluation measure, Average precision, Mean average precession, Two stage detector, single stage detector, RCNN, Fast RCNN; **Image Segmentation**: setup problem and cost function, various dataset, Semantic segmentation, Instance segmentation.	15	CO3
4	**Generative Learning (GL)**: Variational auto-encoders, Generative Adversarial Neural Networks, GL Applications, Image generation, font generation, video generation, anime face/celebrity face generation, **Deep Reinforcement Learning**; Markov decision Processing, Deep Q Learning, exploration vs exploitation, Value iteration vs policy iteration, RL Applications.	15	CO4

Suggested Readings:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, and Yoshua Bengio, “Deep learning”, Cambridge, MIT press.
2. Aston Zhang, Zack C. Lipton, Mu Li, and Alex J. Smola, “Dive into Deep Learning”, Corwin.
3. Nithin Bu duma, Nikhil Bu duma, Joe Papa "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", Shroff/O'Reilly.
4. S Lovelyn Rose, L Ashok Kumar, D Karthika Renuka, "Deep Learning Using Python", Wiley.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/106/106106184
2. https://nptel.ac.in/courses/106106184

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	1	1	1	1			1	1	1	2	1
CO2	2	2	2	2	1	2	1		1	1	1	2	2	2
CO3	2	2	2	1	2	2				2	2	1	2	2
CO4	2	2	2	1	1	2	1			2	1	1	1	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**	IV		
Course Name	Big Data Analytics				
Code	BCADSN14212				
CourseType	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The objective of this syllabus is to provide students with a comprehensive understanding of big data analytics, including concepts, techniques, and tools used for processing and analyzing large volumes of data to extract valuable insights and make data-driven decisions.				
Course Outcomes					
CO1	To understand the concepts of Big Data Analytics.				
CO2	To understand the concepts of hadoop and hadoop ecosystem.				
CO3	To understand and apply analytics algorithms.				
CO4	To understand and apply data visualization techniques.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Big Data:** Introduction, Evolution; Analytics: Descriptive analytics, Diagnostic analytics, Predictive analytics and Prescriptive analytics; characteristics of Big Data, Domain specific examples of Big Data, Analytics flow for Big Data, Big Data stack; Analytics Architecture Components & Design Styles: Load leveling with queues, Load Balancing, Leader Election, sharding, consistency, availability & partition tolerance, bloom filter, materialized views, lambda architecture, scheduler-agent-supervisor, pipes & filters, web service and consensus distributed systems.	15	CO1
2	**MapReduce Patterns:** Numerical Summarization, Top-N, Filter, Distinct, Binning, Inverted Inex, Sorting, Joins; Big Data Analytics Implementations: Data acquisition, Big Data collection systems: flume, Sqoop, Hive, Hbase; Messaging Queues, Custom Connectors; **Big Data Storage:** HDFS architecture, Hadoop and MapReduce, Yarn, Hadoop schedulers.	15	CO2
3	**Analytics Algorithms & Frameworks:** Spark MLlib, H2O, Clustering: K-Means, Classification & Regression: Performance Evaluation Metrics, Naive Bayes, Generalized Linear Model, Decision Trees, Random Forest, Gradient Boosting Machine and Support Vector Machine.	15	CO3
4	**Data Visualization:** Line Chart, Scatter Plot, Bar Chart, Box Plot, Pie Chart, Dot Chart, Map Chart, Gauge Chart, Radar Chart, Matrix Chart, Force-directed Graph, Spatial Graph, Distribution Plot, Kernel Density Estimate (KDE) Plot, Regression Plot, Residual Plot, Interaction Plot, Violin Plot, Strip Plot, Point Plot, Count Plot, Heatmap, Clustered Heatmap, Joint Plot, Pair Grid, Facet Grid.	15	CO4

Suggested Readings

1. S Chandramouli, Asha A George, CR Rene Robin, D Doreen Hephzibah Miriam, J Jasmine Christina Magdalene, “Big Data Analytics”, Universities Press.

2. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer.
3. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press.
4. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R
5. Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media, Oracle press.

Online Resources

1. https://archive.nptel.ac.in/courses/106/104/106104189/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	1	1	2	3	1	2	1	2	2	2	3	2
CO2	3	3	1	3	3	3	2	3	2	3	2	3	3	2
CO3	3	3	2	3	3	3	2	3	2	3	3	3	3	3
CO4	3	3	2	3	3	3	3	3	3	3	3	3	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	Semester		IV	
Course Name	Cloud Computing				
Code	BCADSN14221				
Course Type	DSE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	To learn basic concepts, types and characteristics of cloud computing. To learn Cloud Computing Architecture and service models. To learn Virtualization and its types in cloud computing. To learn fundamental concepts and architecture of cloud computing security.				
Course Outcomes					
CO1	Able to understand basic concepts, principles and paradigm of Cloud Computing.				
CO2	Able to interpret various Cloud computing models and services.				
CO3	Able to identify the significance of implementing virtualization techniques.				
CO4	Able to understand the need of security in Cloud computing.				

Module	Course Contents	Contact Hrs.	MappedCO
1	**Cloud Computing Basics –** History of Cloud Computing, Need for Cloud computing, Advantages and Possible Disadvantages of cloud computing; **Cloud Characteristics -**On-demand service, pay as per usage pricing, elasticity, resource pooling, scalability Grid vs. Parallel Computing, Challenges of Cloud Computing, Impact of cloud computing: Business perspective.	15	CO1
2	**Cloud Deployment Models:** Public, Private, Hybrid, Community, Other deployment Models; **Cloud Architecture** -Layered, NIST Cloud Computing Reference architecture; **Cloud Services:** Types of Cloud services: Software as a Service- Platform as a Service – Infrastructure as a Service, Hypervisor, Type 1 and Type 2.	15	CO2
3	**Virtualization for Cloud:** Need for Virtualization – Pros and cons of Virtualization, Software Virtualization, Memory Virtualization, Storage Virtualization, Server Virtualization and Network Virtualization; **Types of Hardware Virtualization:** Full, Partial and Para, Virtualization. **Cloud Service Providers:** Google Cloud, Microsoft Azure, and Amazon Web Services (AWS).	15	CO3
4	**Overview of Cloud Security:** Introduction to Cloud Security, Cloud Security Fundamentals: Confidentiality, Integrity, Authenticity, Availability, Threat, Vulnerability, Risk, Cloud Security Threats. Security Governance, Security Standards, Introduction to Green Cloud; **Securing Data:** Encryption, Hashing, Digital Signature, Identity and Access Control.	15	CO4

Suggested Readings:

1. Barrie Sosinsky, “Cloud Computing Bible”, Wiley India.
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, “Cloud Computing: Principles and Paradigms”,Wiley.
3. Nikos Antonopoulos, Lee Gillam, “Cloud Computing: Principles, Systems and Applications”, Springer.
4. Ronald L. Krutz, Russel lDeanVines ,“Cloud Security: A Comprehensive Guide to Secure Cloud Computing”,Wiley-India.

Online Resources:

1. https://nptel.ac.in/courses/106105167
2. https://onlinecourses.nptel.ac.in/noc22_cs20/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1				1				1	1		1
CO2	2	1	2	1	2		1			1			1	2
CO3	1	2	1	1		1	1			2	1	2	1	3
CO4	1	2	3	1	2	1	1			3	2	2	2	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	Semester		IV	
Course Name	IOT & Technology				
Code	BCADSN14222				
Course Type	DSE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	To study fundamental concepts of IoT, To understand roles of sensors and hardware in IoT, To learn different Wireless Technologies and protocols for IoT, Understand the role of IoT in various domains of Industry.				
Course Outcomes					
CO1	Understand the various concepts, terminologies and architecture of IoT systems.				
CO2	Understand the use of sensors, actuators and IoT supported hardware for design of IoT system.				
CO3	Understand and apply various wireless technology and protocols for design of IoT systems.				
CO4	Understand the various security aspects for IoT system.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of IoT:** Concepts and Definition of IoT, Characteristics, Conceptual Framework, Architectural view, technology behind IoT, M2M Communication; **Design Principles for Connected Devices:** IoT/M2M systems layers and design standardization, Application of IoT.	15	CO1
2	**Hardware for IoT:** Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology; **Embedded Platforms for IoT:** Embedded computing basics, Overview of IoT supported Hardware platforms such as Arduino, Net Arduino, and Raspberry pi.	15	CO2
3	**Wireless Technologies for IoT:** IEEE 802.15.4, Bluetooth, Wi-Fi, Zigbee, RFID, HART, LoRaWAN, NFCZ-Wave, Z-Wave; **IP Based Protocols for IoT:** IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT.	15	CO3
4	**Overview of IoT Security:** Introduction Securing the Internet of Things, Architecture, Requirements, Security Protocols for IoT Access Networks, Attack, Defense, and Network Robustness of Internet of Things; **Case Studies/Industrial Applications:** Home Automation, Smart Cities, Smart Parking, Agriculture and Health Sector, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.	15	CO4

Suggested Readings:

1. SudipMisra , Anandarup Mukherjee , Arijit Roy “Introduction to IoT” Cambridge University Press.
2. ArsheepBahga , Vijay Madisetti,” INTERNET OF THINGS - A HANDS-ON APPROACH”, Orient Blackswan Private Limited - New Delhi.
3. Raj Kamal, “INTERNET OF THINGS (IOT): Architecture and Design Principles”, McGraw Hill; Standard Edition.
4. VibhaSoni,“IoT for Beginners: Explore IoT Architecture, Working Principles, IoT Devices, and Various Real IoT Projects”, BPB Publications.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105166/
2. https://kp.kiit.ac.in/pdf_files/06/SM_6th-Sem__Cse_Internet-of-Things.pdf

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	1	1	1	-	-	2	1	1	1	1	1
CO2	2	1	3	1	1	2	1	-	1	3	1	2	2	1
CO3	1	3	3	2	3	2	-	-	1	2	1	2	3	1
CO4	3	3	1	3	1	1	1	3	3	1	3	2	1	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	**Semester**		IV	
Course Name	Soft Computing				
Code	BCADSN14223				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The main objective of the soft computing techniques to improve data analysis solution is to strengthen the dialogue between the statistics and soft computing research communities in order to cross pollinate both fields and generate mutual improvement activities.				
Course Outcomes					
CO1	To understand how soft computing and ANN approach influences various modern developments.				
CO2	To understand learning rule and activation function.				
CO3	To understand different types of Fuzzy System used in real world.				
CO4	To understand type II fuzzy set and genetic algorithms.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction:** Soft Computing, Differences between Soft Computing and Hard Computing, Requirements of Soft Computing, Applications of Soft Computing; Introduction to Artificial Intelligence, Models of Artificial Neural Network, Feed forward artificial neural networks, Perceptron and Multilayer Perceptron neural networks, Radial basis function artificial neural networks, Recurrent neural networks, Modular neural networks.	15	CO1
2	**Learning Rules and Various Activation Functions**, Hebbian Learning Rule, Perception Learning Rule, Delta Learning Rule, Widrow, Hoff Learning Rule, Correlation Learning Rule, Winner take All Learning Rule, Associative Memories**.**	15	CO2
3	**Introduction to Fuzzy System:** Fuzzy System, Fuzzy Logic, Fuzzy Sets and Crisp Sets, Evolution of Fuzzy System, Fuzzy Set Operations, Fuzzy to Crisp Conversion, Inference in Fuzzy Logic, Fuzzy Rule Base, Fuzzy Knowledge Base, Fuzzyfication and Defuzzyfication**.**	15	CO3
4	**Type II Fuzzy Set:** Need of Type II Fuzzy Set, Type II Fuzzy Set, Generalized Type II Fuzzy Set, Interval Type II Fuzzy Set, Fuzzy System; Genetic Algorithm, Basic Concept, Working Principle of Genetic Algorithm, Flow Chart of Genetic Algorithm, Genetic Representation (Encoding), Initialization and Selection.	15	CO4

Suggested Readings

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, “Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications” Prentice Hall of India
2. N.P.Padhy,”Artificial Intelligence and Intelligent Systems” Oxford University Press
3. Siman Haykin,”Neural Netowrks”, Prentice Hall of India.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105173/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	1		1	1		1	2	1	2	2	2
CO2	2	1	2	1		2	1		1	3	1	2	2	1
CO3	2	2	2	2		2	1		2	2	2	2	2	2
CO4	2	2	3	2	2	2	1		2	2	2	2	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	II	Semester		IV	
Course Name	Data Warehousing & Data Mining Lab				
Code	BCADSN14251				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		0	0	4	2
Course Objectives	The objective of this lab syllabus is to provide students with hands-on experience in designing, implementing, and analyzing Data Warehousing and Data Mining solutions. The lab exercises will cover various aspects of data warehousing, including data modeling, ETL processes, OLAP cube design, and Data Mining techniques.				
Course Outcomes					
CO1	To design and implement Data Warehouse.				
CO2	To implement Data Mining techniques.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Overview of Data Warehousing tools and platforms. 2. Setting up the Data Warehousing Environment. 3. Design and Implements Dimensional Model of Data Warehouse. 4. Implement ETL Process. i. Extract ii. Transform iii. Load 5. Building OLAP Cube. 6. Querying OLAP Cube. Note: Student will also perform all other exercises provided by course instructor.	30	CO1
2	1. Implementation of Apriori and Implementation of FP-Growth Algorithm. 2. Implementation of Decision Tree. 3. Implementation of Bayesian Classification. 4. Implementation of K-Means Clustering. 5. Implementation of Birch Clustering. 6. Implementation of DBSCAN, Sting Clustering. Note: Student will also perform all other exercises provided by course instructor.	30	CO2

Suggested Readings

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques” 3rd Edition Elsevier.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, PHI
3. Max Bramer, “Principles of Data Mining”, Springer.
4. Data Mining Techniques, Arun K Pujari, University Press.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105174/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3		3	3	3			3	3	2	3	2	2
CO2	3	3		3	3	3			1	3	2	3	2	2

Fifth Semester

Program	Bachelor of Computer Applications (DS & AI)				
Year	III	**Semester**	V		
Course Name	Predictive Analytics				
Code	BCADSN15301				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To provide an overview of an exciting field of Predictive Analytics. To introduce the tools required For the Predictive Analytics. Review and explore data to look at data distributions and to identify data problems, including missing values. To enable students to have skills that will help them to solve complex real-world problems for decision support.				
Course Outcomes					
CO1	Understand and critically apply the concepts and methods of Business analytics				
CO2	To understand and apply IBM SPSS Modeler in Data Mining, what kinds of data can be mined, what kinds of patterns can be mined.				
CO3	Applying and analyzing how to use functions, deal with missing values, use advanced field operations, handle sequence data and improve efficiency.				
CO4	To evaluate the Model on the basis of different Predictive Methods.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Analytics Overview:** 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	CO1
2	**IBM Spss Modeler & Data Mining:** What is a Data Mining application, 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	CO2
3	**Unit of Analysis:** Concepts of Unit of analysis (Distinct, Aggregate, SetToFlag), Integrate data, CLEM Expression, Role of Relationship between two fields, Identifying the modeling objective.	15	CO3
4	**Advanced Data Preperation With IBM Spss Modeler:** Functions to enrich data, Method to transform data, Cross record functions, Sampling, Partitioning and sampling data, Improving Efficiency. **PROJECT** Predicting using IBM SPSS Modeler & IBM Watson with real Case studies.	15	CO4

Suggested Readings

1. IBM Courseware
2. ERIC SIEGEL, “Predictive Analytics Mesmerizing & fascinating”,

Online Resources

1. https://nptel.ac.in/courses/110104086

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2		2		2	1	2	2	2	2
CO2	2	2	2	3	2	1	2		2	1	1	2	2	2
CO3	2	1	3	2	2		2		2	1		2	2	2
CO4	2		2		2	2	1		1		1	2	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	III	Semester	V		
Course Name	Mobile Application Development				
Code	BCADSN15302				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	The capabilities and limitations of mobile platforms that affect application development and deployment. The technology and business trends impacting mobile application development. The characterization and architecture of mobile applications. The techniques for deploying and testing mobile applications, and for enhancing their performance and scalability.				
Course Outcomes					
CO1	To understand the basic concepts of Mobile application development				
CO2	Able to design and develop user interfaces for the Android platforms.				
CO3	Able to design and develop mobile applications using Components.				
CO4	Able to design and develop mobile applications using a chosen application development framework.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Introduction to android, history and versions of android, android API, Various mobile platforms, android architecture, android runtime, Dalvik virtual machine, features of android, introduction and installation of eclipse and ADT plugin and/or introduction and installation of android studio, requirements and installation of android SDK, SDK manager, emulator, AVD, android virtual device manager, Google play account, installing android app from google play, APK file.	15	CO1
2	**Development Environment**: Setting up Development Environment, Installing Packages using SDK Manager, Android Project Structure, Creating Hello Android App, deploy it on USB-connected Android device, setting up an Emulator, Android Tool Repository, Manifest File, Installing and Running Android - Hello App, Activity Life Cycle and its methods, Logcat, Components of an Android App: Activity, Service, Broadcast Receiver, Content Provider.	15	CO2
3	**Layout**: Linear Layout, Relative Layout, Scroll View: Vertical, Horizontal Layout, Table Layout, Frame Layout, **Views**: Text view, Edit Text, Button, Check Box, Radio Button, Image View, Grid View, Web View, Video View, Toast, Rating Bar, Seek Bar, Date Picker.	15	CO3
4	**Intent:** Types of Intents**; Fragments**: Lifecycle, Methods; **Service**: Features of Service, Android platform service, Defining new service, Service Lifecycle, Permissions, example of service. **Android Menu:** Option, context, popup Menu; Data persistency using SQLite.	15	CO4

Suggested Readings

1. Michael Burton, Donn Felker, "Android Application Development for Dummies", Dummies
2. Pradeep Kothari, "Android Application Development (with Kitkat Support)", Kogent Learning Solutions Inc.
3. W. Frank Ableson, Robi Sen, Et. Al., " Android in Action", Manning
4. Charlie Collins, Michael Galpin, Et. Al., " Android in Practice", Manning

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106156/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2		2	1	2		1			2	1	1
CO2	2		2		2	2	2		1			2	1	1
CO3	2	2	2	2	3	2	3		2	2	2	2	2	2
CO4	2	2	3	2	2	2	3		3	2	2	2	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	III	Semester	V		
Course Name	Server Side Scripting				
Code	BCADSN15303				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	The main objective of this subject is to understand about server side scripting languages, applying PHP programming principles and techniques for effective web development, developing form handling, validation and creating databases using MySQL.				
Course Outcomes					
CO1	To use different data types to design programs involving control flow and looping statements.				
CO2	To understand the concept of Strings and arrays in PHP.				
CO3	Able to create functions in HTML forms and handling HTML forms using PHP.				
CO4	Able to understand MYSQL database and perform insert, update and delete operations and implementing and debugging programs in PHP and MYSQL for a specific application.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Server Side Scripting:** Role of web server software, server side scripting languages; **Introduction to PHP**: Structure, Syntax, Comments, Data Types, Variables, Operators, Assignments, Multiple Line Commands, Constants, Predefined Constants, echo& print statements; Built- in Functions; Expressions, Literals and Variables; **Operators:** Operator Precedence, Associativity; Conditional Statements; Looping Statements; Break, Continue; Implicit and Explicit Casting, Dynamic Linking.	15	CO1
2	**Strings:** Creating Strings, Concatenating Strings, Handling Newlines, HTML and PHP, Encoding and Decoding Strings, Finding Substrings, Replacing Parts of a String; **Arrays:** Creation, Adding Items, Accessing Array Elements, Multidimensional Arrays, Sorting Arrays, Transforming Between Strings and Arrays; **Graphics:** Creating Images, Images with text, Scaling Images, Creating pdf document.	15	CO2
3	**Functions:** Creating Functions, Functions with Arguments, Setting Default Argument Values, Returning values from functions, Variable Scope; **Creating forms using PHP:** Simple Form, different Form Method, Receiving Form Data, Displaying Errors, Error Reporting; **Cookies:** Use of cookies, Attributes of Cookies, Modify and Delete Cookies.	15	CO3
4	**Creating Web Applications using Server Side Scripting:** Templates, Constants, Working with Date and Time; **Database Handling:** Introduction to SQL, Connecting MySQL, Creating and Selecting Database, Creating Table, Inserting, Retrieving, Deleting and Updating Data in Database.	15	CO4

Suggested Readings:

1. Robin Nixon," Learning PHP, MySQL & JavaScript_ with jQuery, CSS & HTML5", O' Reilly Media.
2. Larry Ullman, "Php for the Web Visual Quickstart Guide", Peachpit Press.
3. Vikram Vaswani, "PHP: A Beginner's Guide", McGraw-Hill.
4. Larry Ullman, "PHP 5 Advanced: Visual Quickpro Guide", Peachpit Press.

Online Resources:

1. https://spoken-tutorial.org/tutorial-earch/?search_foss=PHP+and+MySQL&search_language=English

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	2	2	3		3	3	3	2	2	3
CO2	2	2	2	1	2	2	2		3	2	3	2	2	2
CO3	2	3	2	1	2	3	2		3	2	3	2	3	2
CO4	3	3	2	2	2	3	2		3	2	3	2	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	III	**Semester**		V	
Course Name	Machine Learning				
Code	BCADSN15321				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To acquire the fundamental knowledge of Machine Learning.				
Course Outcomes					
CO1	To understand the basics of machine learning concepts.				
CO2	To learn various algorithms of machine learning.				
CO3	To learn and apply extended concepts of machine learning.				
CO4	To learn and solve the Neural Network concepts and problems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Definition of Machine Learning, Key elements of Machine Learning, The origins of Machine Learning, Machine learning in practice, Design of a Learning System, Types of Machine Learning: Supervised Learning, Semi Supervised Learning, Unsupervised Learning, Reinforcement Learning and Artificial Neural Network, Applications of Machine Learning; **Data Pre-Processing:** Overview and Need of Data Pre-processing, Data Quality, Factors Affecting Data Quality; **Major Task in Data Pre-processing:** Cleaning, Integration,Reduction, Transformation, and discretization; **Scaling:** Types of Scaling, Normalization and Standardization.	15	CO1
2	**Supervised Learning:** Classification and Regression, Generalization, Overfitting, and Underfitting, Supervised Machine Learning Algorithms, K-Nearest Neighbors (KNN), Support Vector Machine (SVM): Working of SVM, Implementation; Decision Tree: Working and Implementation; Naïve Bayes Classifier: Introduction to Naïve Bayes Algorithm, building a model Using Naïve Bayes;	15	CO2 & CO3
3	**Unsupervised Learning:** Types of Unsupervised Learning, Introduction to Clustering, K-means Clustering Algorithm, Working and Implementation of K-means Clustering, Introduction to Hierarchical Clustering, Agglomerative Hierarchical Clustering, Density-Based Method. **Reinforcement Learning:** Overview of Reinforcement Learning, The Learning Task, Markov Decision process, Qlearning, The Q function, Algorithm for Learning Q.	15	CO2 & CO3
4	**Artificial Neural Network:** Motivation, Neural Network Representation, Perceptron, Training Rule, Activation Functions and types of Activation Functions, Introduction to Gradient Descent and Delta Rule. Feed Forward Neural Network, Back Propagation Network: Overview, Back Propagation Algorithm.	15	CO3 & CO4

Suggested Readings

1. Tom M. Mitchell, "Machine Learning",Tata McGraw-Hill Education.
2. Jiawei Han, Micheline Kamber, Jian Pie, “Data Ming Concept and Techniques”, Morgan Kaufmann.
3. Fengxiang He and Dacheng Tau, “Machine Learning Foundation, Methodologies and Application”, Springer
4. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, O'Reilly.

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106/106/139/
2. https://archive.nptel.ac.in/courses/205/206/207/208/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	1	1	1	1		1	2	1	1	2	1
CO2	2	2		2	1	2	2		3	3		2	3	3
CO3	2	2		2	2	3	3		2	3	1	3	2	2
CO4	1	2		2	3	2	3		2	2		3	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	III	**Semester**		V	
Course Name	Pattern Recognition				
Code	BCADSN15322				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Understand basic, as well as advanced techniques of pattern classification Statistical, nonparametric and neural network techniques for pattern recognition have been discussed. Finding and understanding patterns is crucial to mathematical thinking and problem solving				
Course Outcomes					
CO1	To understand and compare a variety of pattern classification, mathematical analysis, and pattern formation discussed.				
CO2	To apply pattern recognition techniques to real-world problems such as document analysis and recognition. The different approaches of pattern recognition are discussed.				
CO3	To understand about the dimensionality reduction and discriminant function in pattern recognition.				
CO4	To understand and learn about the ANN, and Decision Tree				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction**: Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches; Probability**:** independence of events, conditional and joint probability, Bayes theorem; Linear Algebra, Inner product, outer product, inverses, Eigen values, Eigen vectors, singular values, singular vectors; **Bayes Decision Theory**: Minimum error rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, Discrete features.	15	CO1
2	**Parameter Estimation Methods**: Maximum Likelihood Estimation, Gaussian case, Maximum a posteriori estimation; Bayesian estimation: Unsupervised learning and clustering; Criterion functions for clustering; **Algorithms for Clustering**: K-Means, Hierarchical and other methods, Cluster validation, Gaussian mixture models, Expectation Maximization method for parameter estimation, Maximum entropy estimation, Sequential Pattern Recognition, Hidden Markov Models (HMM); Nonparametric techniques for density estimation, Parzen window method, K-Nearest neighbor method.	15	CO2
3	**Dimensionality reduction**: Principal component analysis, Fisher discriminant analysis, Eigen vectors/Singular vectors as dictionaries, Factor Analysis, Dictionary learning method, Total variability space, non-negative matrix factorization; **Linear Discriminant Functions**: Gradient descent procedures, Perceptron, Support vector machines.	15	CO3
4	A**rtificial Neural Networks**: Multilayer Perceptron, Feed Forward neural network, A brief introduction to deep neural networks, Convolution neural networks, recurrent neural networks; **non-metric methods for pattern classification**: Non numeric data or nominal data, Decision trees, Classification and Regression Trees (CART).	15	CO4

Suggested Readings

1. Richard O. Duda, Peter E. Hart and David G. Stork, “Pattern Classification”, John Wiley.
2. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2009.
3. S. Theodoridis and K. Koutroumbas, “Pattern Recognition”, Academic Press.
4. Earl Gose, Richard Johnsonbaugh, Steve, "Pattern Recognition and Image Analysis", Pearson.

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106046/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2		1	2	1			1	3	1	2	1	1
CO2	1	2	1	1	3	1	1		1	3	1	2	1	1
CO3		2	2		3	1	1		1	2	1	2	1	
CO4	2	2	3		2	1			1	2	2	2		1

Program	Bachelor of Computer Applications (DS & AI)				
Year	III	**Semester**		V	
Course Name	Neural Network				
Code	BCADSN15323				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Introduce the fundamental concepts of Neural Network. Equip students with the learning process of ANN, RNN and CNN. Students will get the basic understanding of neural network fundamentals.				
Course Outcomes					
CO1	To understand how human brain works and how ANN mimics that.				
CO2	To understand ANN architecture and perceptron.				
CO3	To understand RNN, RNN types, architecture and LSTM.				
CO4	To understand CNN, CNN architecture, its layers and learning.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Biological Neural Network**: Structure and working, Artificial Neural Networks applications, Fundamentals, Characteristics, History of neural networks, characteristics of neural networks terminology; Topology of neural network architecture, Multilayer Neural Networks.	15	CO1
2	**Artificial Neural Networks (ANN)**: Artificial Neuron and its models, McCulloch-Pitts model, Perceptron, Adaline model; Neural Network Architectures, Single Layer Feedforward Network, Multilayer Feedforward Network, Recurrent Networks, Various Activation Functions; Characteristics of Neural Network; Perceptron, Single Layer Perceptron, Multi-Layer Perceptron.	15	CO2
3	**Recurrent Neural Network (RNN):** Introduction to RNN, RNN vs Feedforward Neural Network, Types Of RNN, Recurrent Neural Network Architecture, Applications of RNN in real world; Introduction to Long Short Term Memory (LSTM) LSTM Architecture, Forget gate, input gate, output gate, LSTM vs RNN.	15	CO3
4	**Convolution Neural Network (CNN)**: Introduction to CNN, CNN architecture, Working of Convolutional Layers, Layers of CNN, Merits of CNN, Demerits of CNN, Applications; Concept of Learning, Types of Learning, Learning Rules; Hebbian Learning Rule	15	CO4

Suggested Readings

1. B.Yegnanarayana, “Artificial Neural Networks”, Prentice Hall of India.
2. S. Rajsekaran & G.A. Vijayalakshmi Pai, “Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications”, Prentice Hall of India.
3. Siman Haykin,”Neural Netowrks”, Prentice Hall of India.

Online Resources

1. https://archive.nptel.ac.in/courses/117/105/117105084/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2		2	1	1		1			2	1	1
CO2	2				2	2			1				1	1
CO3	2	2		2	1	2	1			2	2		2	2
CO4	2	2	3	2	2	2				2	2		1	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	III	**Semester**	V		
Course Name	Deep Learning				
Code	BCADSN15324				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite	Machine Learning	3	1	0	4
Course Objectives	The subject provides the fundamental concepts of Deep Learning and its applications in various fields as well as the training procedures for neural networks and their applications.				
Course Outcomes					
CO1	Able to understand concepts of deep learning models.				
CO2	Able to understand the architecture of convolutional neural networks.				
CO3	Able to understand the concept of Recurrent Neural Network and their application.				
CO4	Able to understand the encoder/decoder and attention network.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Deep Learning**: Basic concept of deep learning and its applications, Introduction to scaler, vectors, matrices, and tensors, Special types of matrices, matrix operations, linear Dependence, Span, Norms, Eigen Decomposition, Singular value Decomposition, Determinant, Principal Component Analysis; Concepts of Neural Network: Perceptron, Multi-Layer Perceptron, Activation function, Feedforward process, Error function, Optimization algorithms, Back propagation.	15	CO1
2	**Convolutional Neural Network:** Convolution and its type, Layers of CNN and its working (Convolution layer, Pooling layer, Fully Connected Layer), Advance CNN architecture: LeNet, Alexnet, VGGNet, GoogleNet, ResNet, Train network for image classification, Semantic Segmentation, Hyperparameter optimization, Transfer learning, Difference between CNN and Feed Forward Neural Network; **Application of CNN:** Case Study- Segmentation of Brain Tumour from MRI using CNN or any other similar case Study.	15	CO2
3	**Recurrent Neural Network:** Introduction, Architecture, Deep RNNs, Bi-RNN; **Algorithm to train the RNN:** Backpropagation through time, Truncated Backpropagation Through Time, Challenges in training the RNN, Vanishing gradient Types of RNN: LSTM, Gated RNN; Application of RNN; **Case Study:** Sequence classification or any other similar case study.	15	CO3
4	**Encoder/Decoder:** Introduction, Architecture, Application: A case study on image captioning or sentiment analysis, or translation; **Attention Network:** Introduction, Attention mechanism, Types of Attention, Architecture, Application: A case study on the addition of attention layer in Encoder/Decoder.	15	CO4

Suggested Readings:

1. Goodfellow, Benjio Corivilli, “Deep Learning”, Mit Press.
2. Bishop, “Pattern Recognition and Machine Learning”, Springer.
3. Chollet, “Deep Learning with Python”, Manning Publications.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs54/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2		2	1			1			2	1	1
CO2	2		2		2	2			1			2	1	1
CO3	2	2	2	2	3	2	1		2	2	1	2	2	2
CO4	2	2	3	2	2	2	1		3	2	1	2	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	III	Semester	V		
Course Name	Introduction to Hadoop				
Code	BCADSN15325				
Course Type	DSE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	The objective of this syllabus is to provide a comprehensive understanding of Hadoop, a distributed storage and processing framework, along with its ecosystem components, to enable students to effectively store, process, and analyze big data.				
Course Outcomes					
CO1	To understand the basics of Big Data and Hadoop.				
CO2	To understand the concept of Hadoop Distributed File System.				
CO3	To understand the basics of MapReduce.				
CO4	To understand the concept of YARN, Hadoop Operations and Hadoop security overview.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Big Data and Hadoop:** Understanding Big Data concepts, Evolution of Hadoop, Hadoop ecosystem overview, Data Storage and analysis, comparisons with other systems.	15	CO1
2	**The Hadoop Distributed Filesystem:** The design of HDFS; HDFS concepts: blocks, namenodes, datanodes, block caching and HDFS Federation; HDFS High Availability: Failover and fencing; Basic Filesystem operations, Hadoop java Interface; Hadoop I/O: Data integrity, compression, serialization and File-Based Data Structures.	15	CO2
3	**MapReduce:** Introduction, analyzing data with Hadoop, Scaling out, Hadoop streaming; Anatomy of a MapReduce Job Run, Failures, Shuffle and sort, Task Execution; MapReduce types and Format: MapReduce Types, Input Formats, Output Formats; MapReduce Features: Counters, Sorting, Joins, Side Data distribution.	15	CO3
4	**YARN:** Anatomy of YARN application run, Scheduling in YARN. **Hadoop Operations:** Hadoop cluster: Specification, cluster setup and configuration; Hadoop Security Overview: Need and challenges, Key security consideration, Hadoop default security model without Kerberos, Hadoop Kerberos security implementation.	15	CO4

Suggested Readings

2. Tom White, “Hadoop: The Definitive Guide”, O'Reilly Media, Inc.
3. Chuck Lam, “Hadoop in Action”, Dreamtech Press.
4. Eric Sammer, “Hadoop Operations”, O'Reilly Media.
5. Garry Turkington and Gabriele Modena, “Learning Hadoop 2”, Packt Publishing.

Online Resources

1. Hadoop Documentation: https://hadoop.apache.org/docs/
2. https://archive.nptel.ac.in/courses/106/104/106104189/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	1	1	2	1		2	1	1	3	3	2
CO2	2	2	1	3	3	3	3		2	3	3	3	3	3
CO3	2	3	1	3	3	3	3		2	3	3	3	3	3
CO4	2	3	2	3	3	3	3		2	3	3	3	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	III	**Semester**	V		
Course Name	Blockchain Technology				
Code	BCADSN15326				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To Gain a comprehensive understanding of Blockchain and Distributed Ledger Technologies, covering fundamental concepts and functionalities. Delve into Alternative Blockchains to grasp the workings of Distributed Ledger Technology beyond conventional paradigms.				
Course Outcomes					
CO1	Students will learn fundamental concepts of Blockchain and Distributed Ledger Technologies				
CO2	To acquire the insights into Blockchain functionality.				
CO3	To explore Blockchain implementation through Bitcoin and Merkle Root etc.				
CO4	To get knowledge about Distributed Ledger Technology in Alternative Blockchains.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Blockchain and Distributed Ledger Fundamentals**: Blockchain, Growth of Blockchain technology Cryptographic basics for cryptocurrency: signature schemes, encryption schemes; Categories of Blockchain: Public Blockchain, Private Blockchain, Permissioned Ledger, Tokenized Blockchain, Tokenless Blockchain.	15	CO1
2	**Blockchain Functionality:** Distributed identity and Digital identification: Public and private keys, Decentralized network, Permissioned distributed Ledger, Digital identification and wallets; Blockchain data structure and security: Double spending, Network consensus, Sybil attacks, Block rewards and miners, Forks and consensus chain, Sharding based consensus algorithms to prevent attack, Finality, Limitation of proof-of-work, Alternatives to Proof of Work.	15	CO2
3	**Blockchain Implementation:** Bitcoin and Merkle Root; Eventual Consistency and Bitcoin; Byzantine Fault Tolerance and Bitcoin; Bitcoin block-size; Bitcoin Mining; Blockchain Collaborative Implementations: Hyperledger, Corda; Ethereum's ERC 20 and token explosion; Blockchain and full ecosystem decentralization: Smart contract, Decentralized autonomous organization (DAO), Decentralized applications.	15	CO3
4	**Distributed Ledger Technology in Alternative Blockchain:** Blockchain Governance Challenges: Bitcoin Blocksize Debate, The Ethereum DAO Fork, Ethereum's Move to PoS and Scaling Challenges; Blockchain Technical Challenges: Denial-of-Service Attacks, Security in Smart Contracts, Ripple, Stellar; Decentralized Network manager: Tezos.	15	CO4

Suggested Readings

1. Iyer, Kedar, et al., “Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions”, McGraw-Hill Education.
2. Wattenhofer, R., “Distributed Ledger Technology: The Science of the Blockchain, Create Space Independent Publishing Platform.
3. Mark Gates, “Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money, CreateSpace Independent Publishing Platform,
4. Bahga, Vijay Madisetti, “Block chain Applications: A Hands-On Approach”, Arshdeep Bahga.

Online Resources

1. https://nptel.ac.in/courses/106105184/.

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	1	2	1	1			1		1	2	
CO2	2	2	2	1	2	1	1			1	1	1	2	1
CO3	2	1	2	1	2	2	1		1	1	1	1	1	1
CO4	2	2	2	1	1	2	1		1	1	1	1	2	1

Program	Bachelor of Computer Applications (DS & AI)				
Year	III	**Semester**	V		
Course Name	Server Side Scripting Lab				
Code	BCADSN15351				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	The course demonstrates an in depth understanding of the tools and server-side scripting language using PHP which is necessary for design and development of web applications, developing form handling, validation and creating databases using MySQL.				
Course Outcomes					
CO1	To apply the concept of loops, Conditional statements, functions, Arrays, Strings using PHP to develop interactive web pages.				
CO2	Able to understand the concept of HTML forms in designing web pages including form validation, error correction, and connecting the forms to database using MySQL.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Develop a Program in PHP to implement different built-in functions. 2. Develop a Program in PHP to implement if and nested if Statements. 3. Develop a Program in PHP to implement while loop. 4. Develop a Program in PHP to implement do-while loop. 5. Develop a Program in PHP to show use of break and Continue statement. 6. Develop a Program in PHP to implement switch case. 7. Develop Programs in PHP to implement for & nested For Loop. 8. Develop a Program in PHP to implement strings functions. 9. Create a program in PHP to implement array. 10. Design a program in PHP to implement array using function. Note: - Students will also perform all other exercises provided by course instructor.	30	CO1
2	1. Design a program in PHP to implement Error handling. 2. Design a program in PHP to show how to define your own functions. 3. Design a program in PHP to show how to return values from functions: these can be variables, arrays, etc. 4. Design a program in PHP to show how to named constants. 5. Design a program in PHP to show how to use math Functions. 6. Design a program in PHP to show how to use “printf” function for formatted output. 7. Design a personal information form, Submit & Retrieve the Form Data Using $_GET(), $_POST() and _REQUEST() variables. 8. Design A Login Form and Validate that Form using PHP Programming. 9. create a PHP Code to make database connection, Create	30	CO2

	DataBase, Create Table in Mysql. 10. Design a PHP code to Insert, Delete, Update, Select the Data from Database. Note: - Students will also perform all other exercises provided by course instructor.		

Suggested Readings

1. Robin Nixon," Learning PHP, MySQL & JavaScript_ with jQuery, CSS & HTML5", O' Reilly Media.
2. Larry Ullman, "Php for the Web Visual Quickstart Guide", Peachpit Press.
3. Vikram Vaswani, "PHP: A Beginner's Guide", McGraw-Hill.
4. Larry Ullman, "PHP 5 Advanced: Visual Quickpro Guide", Peachpit Press.

Online Resources

5. https://spoken-tutorial.org/tutorial search/?search_foss=PHP+and+MySQL&search _language=English

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	2	2	3		3	3	3	2	2	3
CO2	2	2	2	1	2	2	2		3	2	3	2	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	III	**Semester**	V		
Course Name	Mobile Application Development Lab				
Code	BCADSN15352				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	The capabilities and limitations of mobile platforms that affect application development and deployment. The technology and business trends impacting mobile application development. The characterization and architecture of mobile applications. The techniques for deploying and testing mobile applications, and for enhancing their performance and scalability.				
Course Outcomes					
CO1	To understand the basic concepts of Mobile application development Design and develop user interfaces for the Android platforms.				
CO2	Able to designing and develop mobile applications using a chosen application development framework.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Creating “Hello world” Application. 2. Creating an application that displays message based on the screen orientation. 3. Create an application to develop Login window using UI controls. 4. Create an application to implement new activity using explicit intent, implicit intent and content provider. 5. Create an application that displays custom designed Opening Screen. 6. Create an UI with all views. 7. Create Calculator in Application 8. Read/ write the Local data. Note: Students will also perform all other exercises provided by course instructor	30	CO1
2	1. Create an UI with all Layouts. 2. Develop an application that makes use of Notification Manager 3. Display Map based on the Current/given location. 4. Create a sample application with login module (check user name and password) On successful login change Text view “Login Successful”. On login fail alert using Toast “login fail” 5. Learn to deploy Android applications. 6. Create menu in Application 7. Develop a Mobile application for simple needs (Mini Project) Note: Students will also perform all other exercises provided by course instructor	30	CO2

Suggested Readings

1. Michael Burton, Donn Felker, "Android Application Development for Dummies", DummiesPradeep Kothari, " Android Application Development (with Kitkat Support)", Kogent Learning Solutions Inc.
2. W. Frank Ableson, Robi Sen, Et. Al., " Android in Action", Manning
3. Charlie Collins, Michael Galpin, Et. Al., " Android in Practice", Manning

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106156/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2		2	1	2		1			2	1	1
CO2	2		2		2	2	2		1			2	1	1

Sixth Semester

Program	Bachelor of Computer Applications (DS & AI)				
Year	III	**Semester**		VI	
Course Name	Advance Computer Technologies (Online)				
Code	BCADSN16301				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre -Requisite		3	1	0	4
Course Objectives	To present fundamentals of advanced technologies and cover computing processes for managing vast data. To gain an overview of NLP, its applications, and challenges. To learn text processing techniques like tokenization, stemming, lemmatization, and stop word removal.				
Course Outcomes					
CO1	To Develop the understanding of Data Science and its stream uses.				
CO2	To Develop the understanding of data compilation.				
CO3	To explore the applications of block chain in various fields such as e-governance, smart cities, smart industries, and anomaly detection.				
CO4	To develop an understanding of processing of natural language.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction of Data Science**: Definition, History of Data Science , Era of Data Science, Business Intelligence vs Data Science, Life cycle of Data Science, Tools of Data Science Data Extraction, Wrangling & Exploration, Data Analysis Pipeline; Types of Data: Raw and Processed Data, Data Wrangling, Exploratory Data Analysis; **Visualization of Data**: Introduction to Visualization, Human Perception and Information Processing; Data types: Graphical perception or information display, Color management system; **Charts and standard views**: relevance and appropriateness, Advanced and innovative tools for data visualization and advanced quantitative analysis.	15	CO1
2	**Introduction of Big Data Analytics:** Introduction, Evolution of Big data, Big data characteristics, Big Data Modelling- Hadoop Eco system; An Overview of Clustering- K-means clustering, Use Cases - Determining the Number of Clusters; Classification- Decision Trees- Decision Tree Algorithms, Evaluating a Decision Tree- Decision Trees in R, Bayes Theorem- Naive Bayes Classifier.	15	CO2
3	**Introduction of Block chain Technology:** Introduction: History, Architecture, Types of block chain; **Base technologies**: dockers, docker compose, data structures, hashes, micro-services; **Blockchain hyper ledger:** Fabric architecture, implementation, networking, fabric transactions, demonstration, smart contract; **Applications of block chain**: e governance, smart cities, smart industries, anomaly detections, use case.	15	CO3

4	**Introduction to NLP:** Overview of NLP, Applications of NLP, Challenges in NLP; **Text Processing:** Overview of Tokenization, Stemming and Lemmatization, Stop Word Removal; **Part-of-Speech Tagging:** Understanding POS tags (Rule-based, Stochastic, and Machine Learning approaches), **Named Entity Recognition**: Introduction to different approaches of NE.	15	CO4

Suggested Readings:

1. Blum, A., Hopcroft, J., & Kannan, R. "Foundations of Data Science". Cambridge University Press.
2. White, T. "Hadoop: The Definitive Guide" O'Reily Publication.
3. MC Education Services."Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data". Wiley publishers.

Online Resources:

1. https://archive.nptel.ac.in/noc/courses/noc17/ SEM2/noc17-mg24/
2. https://archive.nptel.ac.in/courses/ 106/105/106105158/

Course Articulation Matrix														
PO -PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	1	1	1	1		1	2		1	2	2
CO2	2	2	2	1	2	1	1		2	1	1	1	2	2
CO3	2	1	2	1	2	1	2		1	1	1	1	1	1
CO4	2	2	1	1	1	1	1		1	1		1	1	1

Seventh Semester

Program	Bachelor of Computer Applications (DS & AI)				
Year	IV	**Semester**	VII		
Course Name	Statistical & Optimization Techniques				
Code	BCADSN17401				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The course provides a holistic understanding of statistical analysis, optimization, logistics, and project management. Students will learn to interpret data, solve optimization problems, manage logistics efficiently, and plan projects effectively, preparing them for analytical roles in diverse industries.				
Course Outcomes					
CO1	Gain proficiency in basic statistical analysis and interpretation.				
CO2	To understand Master problem-solving techniques for linear programming and optimization.				
CO3	Develop skills to solve transportation and assignment problems efficiently.				
CO4	Apply inventory management and job sequencing principles effectively in real-World scenarios.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Statistics:** Introduction, Review of Basic Statistics; Different **Frequency Chart:** Histogram, Frequency Curve, Pi-Chart etc.; **Measurement of Central Tendency:** Mean, Median, Mode; **Measures of dispersion:** Absolute Measure of Dispersion, Range, Inter Quartile Range; **Relative Measure of Dispersion:** Mean Deviation, Standard Deviation.	15	CO1
2	**Linear Programming Problem**: Introduction to LPP, Components of LPP, Formulation of LPP, Graphical Solution of LPP, Slack and Surplus Variable, Basic Feasible Solution, Unbounded Solution, Optimal Solution, Simplex Method, Artificial Variables, Two-Phase Method, Big-M Method, Duality, Dual Simplex Method, Revised Simplex Method, Problem of Degeneracy.	15	CO2
3	**Transportation Problem:** Introduction, Basic Feasible Solution of TP, North-West Corner Method, Matrix Minima Method, Row Minima Method, Column Minima Method, Vogal's Approximation Method, Degeneracy in TP, Loops in TP, Optimal Solution, Unbalanced TP. **Assignment Problem:** Introduction and Application of AP, Hungarian Algorithm for AP, Unbalanced AP.	15	CO3
4	**Inventory Management:** Introduction, Types of Inventories, Costs Involved in Inventory Decisions, Economic Order Quantity (EOQ), Determination of EOQ, EOQ Model without Shortage and with Shortage, Inventory Model with Price-Break, Replacement Problem; **Job Sequencing:** Introduction, N-Jobs Two Machines, N-Jobs Three Machines, N-Jobs M Machines; **CPM and PERT:** Introduction, Application of CPM/PERT, Network Diagram, Floats, Critical Path, Project Evaluation and Review Technique (PERT).	15	CO4

Suggested Readings

1. Gillet B.E., "Introduction to Operation Research, Computer Oriented Algorithmic approach", Tata McGraw Hill Publising Co. Ltd. New Delhi.
2. P.K. Gupta & D.S. Hira, "Operations Research", S.Chand & Co.
3. J.K. Sharma, "Operations Research: Theory and Applications", Mac Millan.
4. S.D. Sharma, "Operations Research", Kedar Nath Ram Nath, Meerut (UP).

Online Resources

1. http://www.digimat.in/nptel/courses/video/111105039/L21.html
2. https://www.digimat.in/nptel/courses/video/111105077/L25.html

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	2	2	1			1	1		2	1	1
CO2	1	2	1	2	2	1			1	1		2	1	1
CO3	1	2	2	2	1	1	1		1	2		2	1	
CO4	2	2	2	3	2	1	1		1	2		2	1	1

Program	Bachelor of Computer Applications (DS & AI)				
Year	IV	**Semester**	VII		
Course Name	Research Methodology				
Code	BCADSN17402				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The course aims to develop research aptitude skills among the learners and to enable them to prepare a research report. To identify the relevance and role of research and differentiating between different kinds of research available, data models, data handling and analysis.				
Course Outcomes					
CO1	To Understand the basic concepts of research and Outlining the significance of research and research methodology.				
CO2	To Formulate research process for solving the business related problems. To develop ability to determine qualitative and quantitative methods of collection of data and sampling				
CO3	Able to examining the concept of measurement, sampling and hypothesis testing. Reconcile various types of charts, diagrams and statistical techniques used to analyze data.				
CO4	Able to prepare and present an effective research report.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Research Methodology:** Scope, Purpose, Need, Functions and Application of research; Types of research, Criteria of research. **Process of Research:** Steps of research process, Unit of Analysis: Individual, and organizational, Group and data series; Concept, Construct, Attributes, Variable and Hypotheses. **Research Design:** Various Methods of Research Design, Review of literature; Planning research: Preparing the Research Proposal, Elements of Research Proposal, Evaluating Research Proposal; Problem identification and formulation; Research design; Applications of Research.	15	CO1
2	**Data Collection:** Primary and Secondary source of data; Qualitative Vs Quantitative data; Methods of Data Collection; **Sampling theory with applications:** types of sampling, steps in sampling, sampling and non-sampling error: sample size, advantage and limitations of sampling; Precautions in Preparation of Questionnaire, Collection of Data, Significance and Reliability of Questionnaire.	15	CO2
3	**Research Modelling:** Field study, laboratory study, survey method, observational method, existing data based research; Scaling techniques. **Data Handling and Analysis:** Coding, Editing and Tabulation of Data, Measurement Scales. Various Kinds of Charts and Diagrams Used in Data Analysis: Line, Bar and Pie, Histogram Graphs and their Significance; Basics of Hypothesis and hypothesis testing.	15	CO3

4	**Report/ Thesis Writing:** Pre writing consideration; Formulation of research projects/ proposals; Format of Report; Presentation of Research report; Review articles, bibliography norm & plagiarism.	15	CO4

Suggested Readings

1. C. R. Kothari, "Research Methodology Methods &Techniques", New Age International Publishers.
2. Cooper, "Donald R and Schindler" Business Research Methods, Tata McGraw Hill.
3. Naresh Malhotra, "Market Research", Pearson Education.
4. Kumar, Ranjit, "Methodology: A Step by Step guide for Beginners", Pearson Education

Online References:

1. https://onlinecourses.nptel.ac.in/noc23_ge36/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	1	2	1	2	2	-	1	2	1	2	-	1
CO2	1	1	1	1	1	2	2	-	1	2	1	1	-	3
CO3	1	1	1	1	1	2	1	-	1	2	1	1	-	3
CO4	2	3	3	2	2	2	2	-	3	3	1	2	1	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	IV	**Semester**	VII		
Course Name	Distributed System				
Code	BCADSN17421				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To explain fundamental principles and models underlying the Distributed Systems and to understand the various practical-system like problems e.g. Global State and Time, Mutual Exclusion, Deadlock Detection, Failure Recovery, Authentication etc.				
Course Outcomes					
CO1	Identify various design and operational issues of Distributed Systems like Concept of Distributed Object, Indirect Inter-process Communication in Distributed System; Logical Clocks.				
CO2	Understand the working of various Algorithms required in modeling various functional aspects and designing the distributed systems.				
CO3	To know about distributed resource management and Shared Memory Techniques.				
CO4	Have knowledge of Fault Tolerance, Synchronization and Deadlock.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Characterization of Distributed Systems**: Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models; **Theoretical Foundation for Distributed System**: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's & vectors logical clocks. Concepts in Message Passing Systems: causal order, total order, total causal order, Techniques for Message Ordering, Causal ordering of messages, global state, and termination detection.	15	CO1
2	**Distributed Mutual Exclusion**: Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non-token-based algorithms, performance metric for distributed mutual exclusion algorithms; **Distributed Deadlock Detection**: system model, resource Vs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms.	15	CO2
3	**Agreement Protocols**: Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem, Atomic Commit in Distributed Database system; **Distributed Resource Management**: Issues in distributed File Systems, Mechanism for building distributed file systems, Design issues in Distributed Shared Memory, Algorithm for Implementation of Distributed Shared Memory.	15	CO3

4	**Failure Recovery in Distributed Systems**: Concepts in Backward and Forward recovery, Recovery in Concurrent systems, Obtaining consistent Checkpoints, Recovery in Distributed Database Systems. Fault Tolerance: Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols; **Transactions and Concurrency Control**: Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, comparison of methods for concurrency control; **Distributed Transactions**: Flat and nested distributed transactions, Atomic commit protocols, concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery.	15	CO4

Suggested Readings:

1. Singhal & Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill.
2. Ramakrishna, Gehrke," Database Management Systems", McGraw Hill.
3. Vijay K. Garg, "Elements of Distributed Computing", Wiley Publications.
4. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Education.
5. Tenanuanbaum, Steen, "Distributed Systems", PHI Publication.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs87/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	3	2	2	3	1		2	2	1	2	2	3
CO2	1	1	3	2	2	3	1		2	2	1	2	2	3
CO3	1	1	3	2	2	3	1		2	2	1	2	2	2
CO4	1	1	3	2	2	3	1		2	2	1	2	2	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	IV	**Semester**		VII	
Course Name	Ethics for Data Science				
Code	BCADSN17422				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course examines ethical considerations in the practice of data science, focusing on the responsible collection, use, and dissemination of data. Students will explore ethical frameworks, case studies, and real-world applications to develop a deeper understanding of the ethical challenges and responsibilities faced by data scientists.				
Course Outcomes					
CO1	To understand key ethical principles and frameworks relevant to data science.				
CO2	To Identify ethical issues related to data collection, storage, analysis and dissemination.				
CO3	To apply ethical reasoning to evaluate data science practices and decision-making.				
CO4	To develop strategies for addressing ethical dilemmas in data science.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Ethics and Data Science;** Overview of ethical principles and theories, Ethical considerations in data science, Ethical frameworks, utilitarianism, deontology; virtue ethics, and consequentialism, Applying ethical frameworks to data science.	15	CO1
2	**Data Collection and Privacy**: Informed consent and data privacy laws, Data anonymization and de-identification, Bias and Fairness. Types of bias in data collection and analysis, Mitigating bias in algorithms and decision-making, Transparency and Accountability.	15	CO2
3	**Explainability and interpretability in Machine Learning**: Ethical responsibilities of data scientists, Social Impacts of Data Science, Surveillance, discrimination, and social justice, Data ethics, Data ethics in healthcare, finance, and other industries.	15	CO3
4	**Case Studies**: Ethical dilemmas in data science, Analyzing and discussing real-world cases, Responsible Data Science, Best practices for ethical data science. Developing an ethical data science framework.	15	CO4

Suggested Readings

1. Davis, Kord, “Ethics of Big Data”, O'reilly.
2. Cathy O'Neil, “Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy”, Crown Publishing Group.
3. David Martens, "Data Science Ethics: Concepts, Techniques, and Cautionary Tales", Oxford University Press

Online Resources

2. https://onlinecourses.nptel.ac.in/noc21_hs55/preview
3. https://archive.nptel.ac.in/noc/courses/noc17/SEM1/noc17-hs05/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	2		2	1	2		1			2	1	1
CO2	1	1			2		1		1			2	1	1
CO3		2	2	2	1				2	2	2	2	2	2
CO4	1	2	3	2	2	2	3		3	2	2	2	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	IV	Semester		VII	
Course Name	Data Privacy and Laws				
Code	BCADSN17423				
Course Type	DSE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	This course will examine fundamentals of data privacy include data confidentiality, data security, limitation in data collection and use, transparency in data usage, and compliance with the appropriate data privacy laws.				
Course Outcomes					
CO1	To understand the basic concept of digital age privacy concepts and theories.				
CO2	To understand the basic concept of privacy implications of modern digital technology.				
CO3	To understand the basic rules and frameworks for data privacy in the age of technology.				
CO4	To understand the basic concept of various data privacy acts and IT Acts.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction Data Privacy**: Fundamental Concepts, Definitions, Data Privacy Attacks, Types of Attacks, Phishing, Ransomware, SQL Injection, DoS, DDoS, Password Attack, Malicious Insiders, Access Control Models: Role Based Access Control, Rule Based Access Control. Privacy Policies: Introduction, General Data Protection Regulation (GDPR), California Privacy Right Act (CPRA), Personal Information Protection and Electronic Documents Act (PIPEDA) Privacy in Different Domains-Medical, Financial, etc.	15	CO1
2	**Concepts of Security:** Basic Components of Security, Principles of Security, Encryption and Decryption, Authentication: Introduction, 1FA Authentication, 2FA Authentication, MFA Authentication, Security Standards, Types of Security Standards, Security Services, Importance of Security Services, Security Mechanism, Encipherment, Digital Signatures, Authentication Exchange, Notarization.	15	CO2
3	**Introduction to Cryptography:** Definition, Symmetric and Asymmetric Cryptography, Steganography, Types of Steganography, Plain Text and Cipher Text, Conventional Encryption Techniques: Substitution Techniques, Types of Substitution Techniques, Transposition Techniques, Types of Transposition Techniques, Modern Technique, Block Ciphers Block Cipher Principles, Block Cipher Modes of Operation Data Encryption Standard (DES), Triple DES, Strength of DES, Advance Encryption Standard.	15	CO3
4	**Data Privacy Law:** Cyber-crime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Cyber-crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and social media, Cyber Laws of other countries, Case Studies.	15	CO4

Suggested Readings:

1. Matt Bishop, “Introduction to Computer Security”, Addition Wesley.
2. William Stallings, “Computer Security: Principles and Practices”, Pearson.
3. Timothy Morey Andrew Burt, Thomas C. Redman, Christine Moorman “Customer Data and Privacy: The Insights You Need” Harvard Business Press.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc24_cs121/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2		2	1	2		1			2	1	1
CO2	2		2		2	2	2		1			2	1	1
CO3	2	2	2	2	3	2	3		2	2	2	2	2	2
CO4	2	2	3	2	2	2	3		3	2	2	2	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	IV	**Semester**		VII	
Course Name	Computer Vision				
Code	BCADSN17424				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course introduces students to the fundamental concepts, techniques, and applications of computer vision. Students will learn how computers can be programmed to interpret and understand visual information from digital images and videos. Topics covered include image formation, image processing, feature extraction, object recognition, and deep learning approaches to computer vision.				
Course Outcomes					
CO1	Understand the basic principles and challenges of computer vision.				
CO2	Apply image processing techniques for image enhancement, filtering, and segmentation.				
CO3	Extract meaningful features from images for pattern recognition and object detection.				
CO4	Implement algorithms for image classification, object recognition, and scene understanding. Analyze and evaluate the performance of computer vision systems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Computer Vision**, Definition and scope of computer vision, Applications of computer vision in real-world scenarios, Challenges and limitations in computer vision Image processing and low-level vision, Image sampling, interpolation, transformations Linear filters and edges, Feature extraction, Optical flow and feature tracking.	15	CO1
2	**Image**: Image Formation and Representation, Digital image fundamentals, Image formation process, Color models and color spaces, Image Processing Techniques, Image enhancement, Image filtering and convolution, Image segmentation and thresholding Grouping and fitting, Least squares fitting, robust fitting, RANSAC, Alignment, image stitching.	15	CO2
3	**Geometric vision:** Image geometric vision and formation, Camera models, Light, shading and color, Camera calibration, Epipolar geometry, Two-view and multi-view stereo, Structure from motion, Morphological operations, Point and edge detection.	15	CO3
4	**Image classification:** Recognition and beyond, Statistical learning framework, Deep learning, Object detection, Segmentation; **Deep Learning** for Computer Vision, Introduction to deep learning and neural networks.	15	CO4

Suggested Readings:

1. Richard Szeliski ,"Computer Vision: Algorithms and Applications", Springer.
2. David A. Forsyth and Jean Ponce , "Computer Vision: A Modern Approach", Pearson.
3. Rajalingappaa Shanmugamani , "Deep Learning for Computer Vision", Packt publisher

Online Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105216/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2					1			1		1	2	2	1
CO2	1	2	2	1	2	2	1		2	2	2	2	2	2
CO3	1	1	2	1	1	2	2		2	2	2	2	2	3
CO4	2	2	1	2		1	1		1	1		2	1	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	IV	**Semester**		VII	
Course Name	Natural Language Processing				
Code	BCADSN17425				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite	Artificial Intelligence and Automata	3	1	0	4
Course Objectives	To understand the algorithms available for the processing of linguistic information and computational properties of natural languages. To conceive basic knowledge on various morphological, syntactic and semantic NLP tasks.				
Course Outcomes					
CO1	Introduce the basic concepts of NLP, its applications, syntax, semantics, discourse & pragmatics of natural language.				
CO2	Demonstrate the understanding of Language Modeling and Neural Networks Basics.				
CO3	Discover the linguistic and statistical features relevance to the basic NLP task in context to parts-of-speech tagging.				
CO4	Understanding of parsing and semantic analysis.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to NLP**: NLP – introduction and applications, NLP phases, Difficulty of NLP including ambiguity; Spelling error and Noisy Channel Model; Concepts of Parts-of-speech and Formal Grammar of English.	15	CO1
2	**Language Modeling:** N-gram and Neural Language Models Language Modeling with N-gram, Simple N-gram models, Smoothing (basic techniques), Evaluating language models; Neural Network basics, Training; Neural Language Model, application of neural language model in NLP system development.	15	CO2
3	**Parts-of-speech Tagging:** Basic concepts; Tagset; Early approaches: Rule based and TBL; POS tagging using HMM, Introduction to POS Tagging using Neural Model.	15	CO3
4	**Parsing**: Basic concepts: top down and bottom up parsing, tree bank; Syntactic parsing: CKY parsing; Statistical Parsing basics: Probabilistic Context Free Grammar (PCFG); Probabilistic CKY Parsing of PCFGs; **Semantics**: Vector Semantics; Words and Vector; Measuring Similarity; Semantics with dense vectors; SVD and Latent Semantic Analysis; Embeddings from prediction: Skip-gram and CBOW; Concept of Word Sense; Introduction to WordNet.	15	CO4

Suggested Readings:

1. Jurafsky D. and Martin J. H., “Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Upper Saddle River, NJ: Prentice-Hall
2. Yoav G., “A Primer on Neural Network Models for Natural Language Processing”, AI Access Foundation.
3. Vajjala S., Gupta A. and Surana H., “Practical Natural Language Processing”, O’Reilly.

Online Resources:

1. https://elearn.nptel.ac.in/shop/nptel/applied-natural-language-processing/?v=c86ee0d9d7ed
2. https://www.coursera.org/learn/machine-learning-and-nlp-basics

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2	1	2	1			1			2	1	1
CO2	2		2	1	2	2			1			2	1	1
CO3	2	2	2	1	3	2			2	2	1	2	2	2
CO4	2	2	3	2	2	2	1		3	2	1	2	3	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	IV	**Semester**		VII	
Course Name	Human Computer Interaction				
Code	BCADSN17426				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Understand the fundamentals of Human computer interaction. Develop user empathy and preferences through user research, design principles of interactive systems that are usable, efficient, and satisfying for users. The skills to design user interfaces, interaction patterns, and visual design. Explore emerging trends and technologies in Human computer interaction, student to think constructively and analytically about how to design and evaluate interactive technologies.				
Course Outcomes					
CO1	To understand and analyze the common methods in the user cantered design process and the appropriateness of individual methods for a given problem.				
CO2	To apply, adapt and extend classic design standards, guidelines, and patterns.				
CO3	To employ selected design methods and evaluation methods at a basic level of competence. Build prototypes at varying levels of fidelity, from paper prototypes to functional, interactive prototypes.				
CO4	To demonstrate sufficient theory of human computer interaction, experimental methodology and inferential statistics to engage with the contemporary research literature in interface technology and design.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction:** Importance of user Interface definition, importance of good design. Benefits of good design, A brief history of Screen design. The graphical user interface popularity of graphics; **Concept of direct manipulation**: graphical system, Characteristics, Web user, Interface popularity, Principles of user interface.	15	CO1
2	**Design process:** Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions; **Screen Designing:** Design goals, Screen planning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow.	15	CO2
3	**Visually pleasing composition**: amount of information, focus and emphasis, presentation information simply and meaningfully, information retrieval on web, statistical graphics, Technological consideration in interface design; **Windows:** New and Navigation schemes selection of window, selection of devices based and screen based controls. Components, text and messages, Icons and increases multimedia, colors, uses problems, choosing colors.	15	CO3
4	**HCI in the software process**: The software life cycle, Usability engineering, Iterative design, and prototyping Design; Focus prototyping in practice design rationale; Design rules; principles to support usability standards; Golden rules; **heuristics HCI patterns Evaluation techniques**: Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Universal design, Universal design principles Multi modal interaction.	15	CO4

Suggested Readings:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, Prentice Hall.
2. Jonathan Lazar Jinjuan, Heidi Feng, Harry Hochheiser, “Research Methods in Human Computer Interaction”, Wiley.
3. Ben Shneiderman, and Catherine Plaisant, “Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Addison-Wesley Publishing Co.
4. Samit Bhattacharya, “Human-Computer Interaction: User-Centric Computing for Design”, McGraw Hill

Online Resources

1. https://archive.nptel.ac.in/courses/106/103/106103115/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	2		1	1	1				1	1	2	1
CO2		2	2		1	2	1		1		1	1	2	1
CO3	1	2	2	1	1	2				2	1	1	2	2
CO4		2	2	1	1	2	1			2	1	1	1	2

Program	Bachelor of Computer Applications (DS & AI)				
Year	IV	Semester		VII	
CourseName	Statistical Package for Social Sciences (SPSS) Lab				
Code	BCADSN17451				
CourseType	DSC	L	T	P	Credit
Pre-Requisite	MS-EXCEL	0	0	4	2
Course Objectives	To familiarize students with data analysis using a statistical software package like SPSS or any other equivalent. To provide skills for research analysis and increase employability.				
Course Outcomes					
CO1	Students' familiarity with the tool box of SPSS, Data transformation and Descriptive Statistics.				
CO2	A strong theoretical and empirical foundation in statistical analysis.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**1. Familiarization with SPSS Environment** a) Overview of SPSS interface, data editor, output viewer, syntax editor, Data view window, SPSS Syntax b) Data creation and Importing data c) Defining variables d) Creating a Codebook in SPSS. **2. Data cleaning and transformation** a) Recoding (Transforming) Variables:-Recoding Categorical String Variables using Automatic Recode, Rank Cases b) Computing Variables c) Sorting Data d) Grouping or Splitting Data. **3. Descriptive Statistics** a) Frequency distribution b) Measures of central tendency and dispersion Note: Student will also perform all other exercises provided by course instructor	30	CO1
2	**1. Correlation and Regression** a) Correlation Coefficient b) Univariate Regression c) Multivariate regression **2. Inferential Statistics** a) Sampling for a problem domain and analysis using a Case Study b) Hypothesis testing, t - distribution, chi- square distribution, f- distribution, normal distribution c) ANOVA test d) Central charts and Graphs e) Time series f) One-tailed and Two-tailed tests Note: Student will also perform all other exercises provided by course instructor	30	CO2

Suggested Readings:

1. Brian C. Cronk, "HOW TO USE SPSS ® A Step-By-Step Guide to Analysis and Interpretation", 10th edition, Routledge.
2. Field A., "Discovering Statistics Using IBM SPSS Statistics", SAGE Publications, Inc.
3. McCormick K. & Salcedo J., "SPSS for Dummies", 3rd Edition, John Wiley & Sons.
4. Pandya K., Bulsari S., Sinha S., "SPSS in Simple Steps", KoGENT Learning.

Online Resources:

1. https://www.ibm.com/docs/en/spss-statistics

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	1	2	1	2		2	1	1	1	1	1
CO2	2	2	2	2	2	2	2		2	2	1	2	1	1

Eighth Semester

Program	Bachelor of Computer Applications (DS & AI)				
Year	IV	**Semester**		VIII	
Course Name	R Programming				
Code	BCADSN18401				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The objective is to provide fundamental understanding of R Programming/RStudio. Also able to understand needs and usages of graphical tools and statistical functions, correlations, and other R Programming related aspects				
Course Outcomes					
CO1	Able to understand R Programming/RStudio, commands, conditional and Iterative statements.				
CO2	Able to identify and manage data Structures, Utilizing inbuilt functions and custom functions using R Programming				
CO3	Able to identify and manage and implementation of Data management and data frames, reading and writing data in files.				
CO4	Able to understand the implementation of statistical functions, handling data with graphical tools.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Fundamentals of R Programming:** Basic fundamentals of R Programming, installation and use of Base-R/RStudio software, data editing, and use of R as a calculator, Writing R scripts in an editor, Vector and scalar, missing data and logical operators, Conditional executions and iterative statements /loops.	15	CO1
2	**Data Structures and Functions:** Data management with sequences. Data management with repeats, sorting, ordering, and lists, Vector indexing, factors, Data management with strings, display and formatting, inbuilt function support, creating custom functions.	15	CO2
3	**Matrices and Data Frames:** Creating matrices and Data frames, Matrices and dataframe functions, slicing data frame, combining slicing with functions, data management with display paste, split, find and replacement, manipulations with alphabets, evaluation of strings, data frames. Advanced Data frames manipulations, import of external data in various file formats.	15	CO3
4	**Plots and Statistical function:** Graphics and plots, Colors, plotting arguments, Scatterplot, Histogram, Barplot, pirateplot, Low level plotting functions, Saving plot to pdf, jpg, png file formats, statistical functions (linear and nonlinear modeling, classical statistical tests, time-series analysis, classification, clustering) for central tendency, variation, skewness and kurtosis, handling of bivarite data through graphics, correlations, Data persistency, Hypothesis test (T Test, Correlations Test, Chi Square Test).	15	CO4

Suggested Readings:

1. Christian Heumann, Michael Schomaker and Shalabh “Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R” Springer.
2. Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Liquet “The R Software-Fundamentals of Programming and Statistical Analysis” Springer.
3. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters “A Beginner's Guide to R (Use R)” Springer.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_ma33/preview
2. https://home.iitk.ac.in/~shalab/sprs.htm

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2					1								
CO2	2	1				1				1				
CO3	2	2		1	1	2				1		1		
CO4	2	2		1	1	2				1		1	1	

Program	Bachelor of Computer Applications (DS &AI)				
Year	IV	**Semester**		VIII	
Course Name	Intellectual Property Right				
Code	BCADSN18402				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course introduces the student to the basics of Intellectual Property Rights, Copy Right Laws, Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations.				
Course Outcomes					
CO1	To understand the need of intellectual property rights.				
CO2	To understand the concepts Patent and Copyrights.				
CO3	To understand the concept of Trade Mark and Design.				
CO4	To understand the Geographical indications and Plant Variety Protection.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction and the need for intellectual property right (IPR):** Meaning, nature and basic concepts of intellectual property, Types of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design; IPR in India: Genesis and development, IPR in abroad, Introduction to TRIPS and WTO, Introduction to IT Act.	15	CO1
2	**PATENT:** Objectives, Rights, Patent Acts 1970 and its amendments. Procedure of obtaining patents, working of patent, Industrial Application: Non-Patentable Subject Matter, Registration Procedure, Rights and duties of Patentees, Infringement, Restoration of lapsed Patents, Surrender and Revocation of Patents; **Copyright:** Definition &Types of Copyright, Registration procedure, Assignment & license, Terms of Copyright, Piracy, Infringement, Remedies, Copyrights with special reference to software.	15	CO2
3	**Trademarks:** Concept of Trademarks, Types of trademarks: brand names, logos, signatures, symbols, well-known marks, certification marks and service marks, Non-Registrable Trademarks, Registration of Trademarks, Rights of holder, assignment and licensing of marks Trademark Infringement, Remedies & Penalties - Trademarks registry and appellate board; **Design:** meaning and concept of novel and original, Procedure for registration, effect of registration and term of protection.	15	CO3
4	**Geographical indication:** Concept of GI, Procedure for registration, effect of registration and term of protection; **Plant Variety Protection**: Concept of Plant variety protection, Procedure for registration, effect of registration and term of protection. India`s New National IP Policy, Govt. of India step towards Promoting IPR, Govt. Schemes in IPR – Career Opportunities in IPR.	15	CO4

Suggested Readings:

1. Neeraj, P., & Khusdeep, D. , “Intellectual Property Rights. India”, IN: PHI learning Private Limited.
2. B.L. Wadera, Patents, trademarks, copyright, Designs and Geographical Judications.
3. Nityananda, K.V. , Intellectual Property Rights: Protection and Management. India, In: Cengage Learning India Private Limited.

Online Resources:

1. https://www.uspto.gov/
2. http://cipam.gov.in/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1		1			1	1			2	1	2	1	1
CO2	1	2	1	1	2	1	2		2	3	1	2	2	2
CO3	1	2	3	1	2	1	2		2	3	1	2	2	2
CO4	1	2	2	1	2	1	1	2	1	2	2	2	2	3

Program	Bachelor of Computer Applications (DS & AI)				
Year	IV	**Semester**	VIII		
Course Name	R Programming Lab				
Code	BCADSN18451				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	The objective of this course is to provide students with a practical understanding of R Programming/RStudio. It will dive deep in managing the concept and significance of Data Management and Data Frames, and to understand need and usages of graphical tools and relevant statistical functions, correlations.				
Course Outcomes					
CO1	Able to work on RStudio and learn basics of R Programming, control & iterative, matrix, list, vector manipulations, inbuilt and custom Functions				
CO2	Able to Use data management through excel file, CSV File, Graphical tools and statistical functions.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Introduction to R and RStudio, Working with commands and variables 2. Implementation of various Data Structures in R (Vectors, Matrices, lists, data frames) 3. Implementation of various Control Structure (If-else statements, loops) 4. Implementations and usage of various inbuilt functions, writing custom functions and apply family functions in R Programming 5. Performing data manipulation with dplyr and tidyr packages 6. Performing Data visualization with ggplot2 for creating plots, scatter plots, histogram, box plots, customizing plots with themes, colors and labels 7. Introduction to Statistical Analysis in R Programming, Implementation of basic regression analysis. 8. Implementations of various inferential statistics (T-tests, ANOVA, Correlation) 9. Implementation of importing and exporting data to and from sources (CSV, Excel, database etc) 10. Introductions and demonstrate the use of readr and readxl packages. Note: Students will also perform all other exercises provided by course Instructor.	30	CO1
	1. Creating and managing R Packages 2. Introduction to Probability and its implementation in R Programming 3. Simulation and Implementation of the Normal Curve using R Programming 4. Simulating and implementation of Measures of Central Tendency and Dispersion 5. Simulating and implementation Standard Deviations,	30	CO2

2	Standard Scores and the Normal Distribution 6. Simulating and implementation Hypothesis Testing: Testing the Significance of the Difference Between Two Means 7. Simulating and implementation Hypothesis testing: One and Two-tailed Tests 8. Simulating and implementation Bivariate Statistics for Nominal Data 9. Simulating and implementation Bivariate Statistics for Ordinal Data 10. Simulating and implementation Bivariate Statistics for Interval / Ratio Data Note: Students will also perform all other exercises provided by course Instructor.		

Suggested Readings:

1. Christian Heumann, Michael Schomaker and Shalabh "Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R" Springer.
2. Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Liquet "The R Software-Fundamentals of Programming and Statistical Analysis" Springer.
3. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters "A Beginner's Guide to R (Use R)" Springer.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_ma33/preview
2. https://home.iitk.ac.in/~shalab/sprs.htm

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2					1								
CO2	2	1				1				1				