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 DBase 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) Lal	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