CREDIT STRUCTURE of Five Year Integrated BCA and MCA (Data Science) Programme

SEMESTER-I

S. No.	Course Code	Course Title	L	T	P	Credit	Int.	Ext.
		THEORY						
1.		Foundation Course - 1				3	40	60
2.		Skill Based Elective - 1				3	40	60
3.	IDS001	Mathematics – 1	2	1	0	3	40	60
4.	IDS002	Database Management System	2	1	0	3	40	60
5.	IDS003	Python Programming	2	1	0	3	40	60
6.	IDS051	Python Programming Lab	0	0	8	4	40	60
7.	IDS052	DBMS Lab	0	0	6	3	40	60
		TOTAL				**22**		

SEMESTER-II

S. No.	Course Code	Course Title	L	T	P	Credit	Int.	Ext.
		THEORY						
1.		Foundation Course – 2				3	40	60
2.		Skill Based Elective – 2				3	40	60
3.	IDS004	'C' Programming with Data Structures	2	1	0	3	40	60
4.	IDS005	Operating System	2	1	0	3	40	60
5.	IDS006	Foundations of Data Science	2	1	0	3	40	60
6.	IDS053	Data Structure Lab	0	0	14	7	40	60
		TOTAL				**22**		

SEMESTER-III

S. No.	Course Code	Course Title	L	T	P	Credit	Int.	Ext.
		THEORY						
1.	IDS007	Probability Theory for Data Science	2	1	0	3	40	60
2.	IDS008	Computer Organization and Architecture	2	1	0	3	40	60
3.	IDS009	Artificial Intelligence	2	1	0	3	40	60
4.	IDS010	Advanced Data Structures	2	1	0	3	40	60
5.	IDS011	Object Oriented Programming using Java	2	1	0	3	40	60
6.	IDS054	Object Oriented Programming Lab	0	0	8	4	40	60
7.	IDS055	Computer Organization Lab	0	0	6	3	40	60
		TOTAL				**22**		

SEMESTER-IV

S. No.	Course Code	Course Title	L	T	P	Credit	Int.	Ext.
		THEORY						
1.	IDS012	Applied Algebra	2	1	0	3	40	60
2.	IDS013	Fundamentals of Statistics	2	1	0	3	40	60
3.	IDS014	Advanced Algorithm and Analysis	2	1	0	3	40	60
4.	IDS015	Data Engineering	2	1	0	3	40	60
5.	IDS016	Entrepreneurship and Management	2	1	0	3	40	60
6.	IDS056	Algorithm Analysis Lab	0	0	8	4	40	60
7.	IDS057	Data Engineering Lab	0	0	6	3	40	60
		TOTAL				**22**		

SEMESTER-V

S. No.	Course Code	Course Title	L	T	P	Credit	Int.	Ext.
		THEORY						
1.	IDS017	Fundamental of Computer Networks	2	1	0	3	40	60
2.	IDS018	Computational Intelligence	2	1	0	3	40	60
3.	IDS019	Machine Learning	2	1	0	3	40	60
4.	IDS020	Statistical Analysis using 'R'	2	1	0	3	40	60
5.	IDS021/IDS022	Elective 1	2	1	0	3	40	60
6.	IDS058	Machine Learning Lab	0	0	6	3	40	60
7.	IDS059	Statistical Analysis Lab	0	0	6	3	40	60
8.	IDS060	Field Visit / Educational Tour				1	40	60
		TOTAL				**22**		

Electives (Any one of the following)

    (i).   IDS021   Big Data Systems
    (ii).   IDS022   Business Analytics

SEMESTER-VI

S. No.	Course Code	Course Title	L	T	P	Credit	Int.	Ext.
		THEORY						
1.	IDS023	Statistical Pattern Recognition	2	1	0	3	40	60
2.	IDS024	Data Mining and Warehousing	2	1	0	3	40	60
3.	IDS025	Data Visualization and Dashboards	2	1	0	3	40	60
4.	IDS026	Artificial Neural Network and Deep Learning	2	1	0	3	40	60
5.	IDS027/IDS028	Elective 2	2	1	0	3	40	60
6.	IDS061	Data Mining Lab	0	0	8	4	40	60
7.	IDS062	Deep Learning Lab	0	0	6	3	40	60

		TOTAL				22		

Elective(Any One of the Following)

      (i).   IDS027   Ethics in Information Technology

      (ii).   IDS028   Work place communication skills

SEMESTER-VII

S. No.	Course Code	Course Title	L	T	P	Credit	Int.	Ext.
		THEORY						
1.	IDS029	Research Methodology	2	0	0	2	40	60
2.	IDS030/IDS031	Elective – 3	2	1	0	3	40	60
3.	IDS032/IDS033	Elective – 4	2	1	0	3	40	60
4.	IDS034/IDS035	Elective – 5	2	1	0	3	40	60
5.	IDS063	Colloquium				2	40	60
6.	IDS064	Educational Tour / Field Visit				2	40	60
7.	IDS065	Elective Lab	0	0	14	7	40	60
		TOTAL				22		

Elective – 3 (Any one of the following)

      (i).   IDS030   Discrete Mathematical Structures

      (ii).   IDS031   Mathematical Modelling and Simulations

Elective – 4 (Any one of the following)

      (i).   IDS032   Transforms and Their Applications

      (ii).   IDS033   Formal Languages & Automata Theory

Elective – 5 (Any one of the following)

      (i).   IDS034   Bio-inspired Data Engineering

      (ii).   IDS035   Fuzzy Logic and its Applications

SEMESTER-VIII

S. No.	Course Code	Course Title	L	T	P	Credit	Int.	Ext.
		THEORY						
1.	IDS066	Dissertation / Project	0	0	44	22	40	60
		TOTAL				22		

SEMESTER-IX

S. No.	Course Code	Course Title	L	T	P	Credit	Int.	Ext.
		THEORY						
1.	IDS036	§ Language Processing and Information Retrieval	2	1	0	3	40	60
2.	IDS037	Applied Predictive Analytics	2	1	0	3	40	60

S. No.	Course Code	Course Title	L	T	P	Credit	Int.	Ext.
3.	IDS038	Multivariate & Time Series Analysis	2	1	0	3	40	60
4.	IDS039	§ Blockchain Technology	2	1	0	3	40	60
5.	IDS –EL06– A/B/C	Elective-6	2	1	0	3	40	60
6.	IDS067	Lab	0	0	8	4	40	60
7.	IDS068	Project Phase - One	0	0	6	3	40	60
		TOTAL				22		

§ - There is option for earning the credit for this course from MOOCS (SWAYAM or NPTEL).

SEMESTER-X

S. No.	Course Code	Course Title	L	T	P	Credit	Int.	Ext.
		THEORY						
1.	IDS040	Domain Engineering	2	1	0	3	40	60
2.	IDS041	§ Complex Network Analysis	2	1	0	3	40	60
3.	IDS-EL07- A/B/C	Elective-7	2	1	0	3	40	60
4.	IDS-EL08- A/B/C	Elective-8	2	1	0	3	40	60
5.	IDS069	Project Phase - Two	0	0	20	10	40	60
		TOTAL				22		

§ - There is option for earning the credit for this course from MOOCS (SWAYAM or NPTEL).

List of Electives:

Electives	Bucket A	Bucket B	Bucket C
Elective I	Image and Video Analysis	Cloud computing	Cryptography
Elective II	Text Analytics	Security in Cloud	Introduction to Cyber forensics
Elective III	Computer Vision	Parallel and distributed computing	Data and Information security

SEMESTER-I

Paper-3: Mathematics-I (IDS001)

Unit 1: Basic Algebra: Notation of numbers, fundamental operations, fundamental theorem of arithmetic, rational density theorem, irrational density theorem, permutations and combinations, Binomial theorem, quadratic equations.

Unit 2: Matrix Algebra: Notations, order, sum and difference, scalar multiplication, multiplication of two matrices, general properties of determinants, singularity of matrices, inverse of a matrix, Cramer's Rule, solution of simultaneous linear equations, rank.

Unit 3: Set Theory: Relations, Relation matrix, Transitive closures, Partitions and equivalence relations, Characteristic functions of a set, Principle of inclusion and exclusion, applications.

Unit 4: Trigonometry and Vectors: Trigonometric ratios, trigonometric ratios of complementary and supplementary angles, basic identities, compound and multiple angles, trigonometric equations and their applications, Scalar and Vector quantity, vector notation, sum and difference, cross and dot products, simple applications

Unit 5: Calculus: Real valued functions, domain and range, limit continuity and differentiability, derivative of different types of functions and their applications. Integration, methods of Integration, Definite Integral and their simple applications.

References:
1. Calculus with Maple Labs, B. Rai and W. Krawcewicz, Narosa Publications.
2. Higher algebra, Hall and Knight, Arihant Publications.
3. Differential and Integral Calculus, Gorakh Prasad, Pothishala.
4. Vector Analysis, M. Ambar ,Shail Publishers

Paper 4: Database Management System (IDS002)

Unit 1: Introduction: Data, information and knowledge, Characteristics of database approach, Data independence, Architecture of database system, Data dictionary, Types of database language, database system life cycle, Overview of hierarchical, network and relational model. Relations and Codd's rules, Concepts of keys.

Unit 2: Relation Algebra: Select, Project, Joins, Set operations, Update operations – tuple relational calculus, Relational Calculus vs. relational algebra. Data definition, data manipulation, view definition, nested queries, updation, Embedded SQL, Handling of nulls and cursors.

Unit 3: Data Models: Conceptual, Logical and Physical design, ER models, ER diagrams, Strong and weak entity sets, Generalization, Specialization and Aggregation, Conversion of ER model into relational schemas

Unit 4: Normalization: Normalization concepts, Functional dependencies and dependency preservations, Normal forms – 1NF, 2NF, 3NF, BCNF, 4NF, 5NF, DKNF, Indexing, File organization, De-normalization, Clustering of tables and indexes.

Unit 5: Transaction Handling: Transaction recovery, System recovery, two phase commit, concurrency problems, locking, deadlocks, security, discretionary and mandatory access control, data encryption.

References:
1 Date C J, "An Introduction To Database System", Addision Wesley
2 Korth, Silbertz, Sudarshan, "Database Concepts", McGraw Hill
3 Elmasri, Navathe, "Fundamentals Of Database Systems", Addision Wesley
4 Paul Beynon Davies, "Database Systems", Palgrave Macmillan

Paper 5: Python Programming (IDS003)

Unit 1: Introduction to Python Language: Introduction to Python: Python variables, Python basic Operators, Understanding python blocks, Python Data Types, Declaring and using Numeric data types: int, float etc.

Unit 2: Control Structures: Python Program Flow Control Conditional blocks: if, else and else if, Simple for loops in python, For loop using ranges. String, list and dictionaries. Use of while loops in python, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks.

Unit 3: Strings, Lists, Tuples and Dictionaries,: Python Complex data types: Using string data type and string operations, Defining list and list slicing, Use of Tuple data type, String, List and Dictionary, Manipulations Building blocks of python programs, string manipulation methods, List manipulation. Dictionary manipulation, Programming using string, list and dictionary in-built functions, Python Function, Organizing python codes using functions.

Unit 4: Functions & Modules: Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables, Importing module, Math module, Packages and their composition.

Unit 5: File Handling: Python File Operations: Reading files, Writing files in python, Understanding read functions, read(), readline(), readlines(). Understanding Write functions, write() and writelines() Manipulating file pointer using seek Programming, using file operations.

References:

1. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372

2. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", 1st Edition, O'Reilly Media, 2016. ISBN-13: 978-1491912058

3. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365

6.	**IDS051**	Python Programming Lab
7.	**IDS052**	DBMS Lab

SEMESTER-II

Paper-3: 'C' Programming with Data Structures (IDS004)

Unit 1 : Introduction to computers and Problem Solving: Components of a computer, Operating system, compilers, Program Development Environments, steps to solve problems, Algorithm, Flowchart / Pseudocode with examples. Introduction to C: Introduction, structure of C program, keywords, identifiers, Variables, constants, I/O statements, operators, precedence, and associativity. Introduction to decision control statements: Selective, looping, and nested statements.

Unit 2: Introduction to arrays (Introduction, declaration of arrays, accessing and storage of array elements, 1-dimensional array, 2-D arrays, matrix operations. Strings: Introduction, strings representation, string operations), **structures** (Structure definition, initialization and accessing the members of a structure, nested structures, structures and functions, self-referential structures, unions, and enumerated data types.), **pointers** (Understanding computer's memory, introduction to pointers, declaration pointer variables, pointer arithmetic, pointers and strings, array of pointers, dynamic memory allocation, advantages, and drawbacks of pointers) and union.

Unit 3 : Linked list: Representation and Implementation of Singly Linked Lists, Two-way Header List, Traversing and Searching of Linked List, Insertion and deletion to/from Linked Lists, Insertion and deletion Algorithms, Doubly linked list, Linked List in Array, Polynomial representation and addition, Generalized linked list, Garbage Collection and Compaction. Functions: Function definition, declaration, passing parameters to functions, recursion.

Unit 4 : Array Representation and Implementation of Stack, Operations on Stacks: Push & Pop, Empty, Full, Linked representation of Stack, Application of stack: Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack. **Queues**: Array and linked representation and implementation of queues, Operations on Queue: Create, Add, Delete, Full and Empty. Circular queue, D-queue, and Priority Queue.

Unit 5: Trees: Basic terminology, Binary Trees, Binary tree representation, algebraic Expressions, Complete Binary Tree.

Reference Books:
1. The C Programming Language, B.W. Kernighan and D.M. Ritchie (PHI)
2. Programming using the C language, R.C. Hutchinson and S.B. Just (McGraw Hill)
3. Data Structures and Program Design- Robert Kruse.
4. Data Structures- Horowitz and Sahni
5. Data Structures through C- A. Tennenbaum

Paper 4: Operating System (IDS005)

Unit 1: Introduction: Definition and types of operating systems, Batch Systems, multi programming, time–sharing parallel, distributed and real-time systems, Operating system structure, Operating system components and services, System calls, system programs, Virtual machines.

Unit 2: Process Management: Process concept, Process scheduling, Cooperating processes, Threads, Inter-process communication, CPU scheduling criteria; Long term, Short Term & Medium Term scheduling; Scheduling algorithms, Multiple-processor scheduling, Real-time scheduling and Algorithm evaluation.

Unit 3: Process Synchronization and Deadlocks: The Critical-Section problem, Synchronization hardware, Semaphores, Classical problems of synchronization, Critical regions, Monitors; Deadlocks-System model, Characterization, Deadlock prevention, Avoidance and Detection, Recovery from deadlock, Combined approach to deadlock handling.

Unit 4: Storage management: Memory Management-Logical and Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation with paging, Virtual Memory, Demand paging and its performance, Page replacement algorithms, Allocation of frames, Thrashing, Demand segmentation.

Unit 5: File systems: Secondary Storage Structure, access methods, directory implementation, Efficiency and performance, recovery, Disk structure, Disk scheduling methods, Disk management, Recovery, Swap-Space management, Disk reliability. Security & Case Study: Protection and Security-Goals of protection, Domain of protection, Access matrix, Implementation of access Matrix, Revocation of Access Rights, language based protection, The Security problem, Authentication, One Time passwords, Program threats, System threats, Threat Monitoring.

References:
1. Introduction to Operating Systems: Deitel
2. Operating System Concepts: Peterson and Silbershatz
3. Modern Operating Systems: Andrew S Tanenbaum

Paper-5: Foundations of Data Science (IDS006)

Unit 1: Introduction to Python Language, Variables, Expressions and Statements, Functions, Conditionals and Recursion, Functions, Iteration, Strings, Lists, Dictionaries, Tuples.

Unit 2: Introduction to Data Science, Need for Data Science, Data Science Life Cycle. Python in Data Science-Introduction to Numpy, Pandas, SciPy, Matplotlib.

Unit 3: NumPy Basics: Arrays and Vectorized Computation, Getting Started with Pandas, Data Loading, Storage, and File Formats.

Unit 4: Data Cleaning and Preparation, Data Wrangling: Join, Combine, and Reshape, Making Sense of Data through Advanced Visualization, Data Aggregation and Group Operations

Unit 5: Exploratory Data Analysis, Case studies on Classification and Regression.

Reference Books:
1. Introducing Data Science Big Data, Machine Learning, And More, Using Python Tools, Davy Cielen, Arno D. B. Meysman, Mohamed Ali.
2. Data Science from Scratch, Joel Grus
3. Data Wrangling with Pandas, NumPy, and Python
4. Python-for-Data-Analysis-2nd-EditionWes McKinney

6.	**IDS053**	Data Structure Lab