DEPARTMENT OF COMPUTER SCIENCE
UNIVERSITY OF LUCKNOW
M.Sc. Computer Science (PG 2 Year) Programme

YEAR 1- SEMESTER I

CORE COURSE 1 Course code: MSCTCC101 Course title: Programming Concepts & Data Structure with Python	
Credit: 4	
Course Objectives: ✓ To understand fundamental programming concepts such as variables, data types, operators, and control flow. ✓ To learn, write clean, efficient, and well-documented Python code. ✓ To master object-oriented programming principles including classes, objects, inheritance, and polymorphism. ✓ To explore and implement various data structures such as arrays, linked lists, stacks, queues, trees, and graphs.	
UNIT	TOPICS
Unit I	Introduction to Python, Features of Python - interactive, object oriented, interpreted, platform independent. Python building blocks- identifiers, keywords, indentation, variables, comments. Python data types- Numbers, String, Tuples, Lists, Dictionary. Basic operators: arithmetic, comparison/ relational, assignment, logical, bitwise, membership, identity operators, Python operator precedence. Control flow i.e. conditional statements (if, if else, nested if), looping in python (while loop, for loop, nested loops) loop manipulation using continue, pass, break, else.
Unit II	Functions, Use of Python built- in functions (eg. type/ data conversion functions, mathematical functions etc.) User defined functions: Function definition, function calling, function arguments and parameter passing, return statement, scope of variables: global variable and local variable. Python Modules and Packages Modules- writing modules, importing modules, importing objects from modules, Python built- in modules (e.g. numeric and mathematical module, functional programming module). Python packages, writing Python packages. Using standard Numpy, methods in Numpy, creating and initializing arrays, reading arrays from files, special initializing functions, slicing and indexing, reshaping arrays, combining arrays
Unit III	Data Structures- definition and applications, Linear Data Structure, Non-linear data structures, Arrays- overview, types of arrays, operations on arrays, arrays vs list, Introduction to stack, stack applications - expression evaluation, backtracking, traversal- infix, prefix and postfix concepts, Stack implementation using Python, Linked Lists – singly linked list, doubly linked list, circular linked lists, implementation using Python packages for link list., arrays - Searching -linear search and binary search, Queues, queue applications- breadth first search, depth first search.

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Unit IV	Sorting, Comparison Based Sorting - Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Merge Sort, Non-Comparison Based Sorting- Counting Sort, Radix Sort, Bucket Sort, Non-Linear Data Structure. Trees - tree Terminology, Implementation and applications, binary tree implementation, tree traversals, binary search trees Applications of trees - spanning tree, BST, tree traversal - inorder, preorder and postorder concepts.

REFERENCE BOOKS:

1	"Automate the Boring Stuff with Python", Al Swelgart, William Pollock, 2015
2	"Think Python: How to Think Like a Computer Scientist", Allen B. Downey, Green Tea Press, 2015
3	"Introduction to Computer Science Using Python", Charles Dierbach, Wiley India Pvt Ltd. 2015
4	"Python for Everybody: Exploring Data Using Python 3", Charles R. Severance, Shroff Publishers, 2017

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YEAR 1- SEMESTER I

CORE COURSE 2

Course code: MSCTCC102

Course Title: Design and Analysis of Algorithm

Credit: 4

Course Objectives:

- ✓ To understand fundamental algorithmic concepts
- ✓ To develop problem-solving skills
- ✓ To master essential data structures
- ✓ To understand the limitations of algorithms and the importance of computational complexity theory.

UNIT	TOPICS
Unit I	Algorithm, pseudo code for expressing algorithms, performance analysis-space complexity, time complexity, asymptotic notation- big (O) notation, omega notation, theta notation and little (o) notation, recurrences, probabilistic analysis, disjoint set operations, union and find algorithms.
Unit II	Fundamental Algorithmic Strategies, Brute-Force, Linear search, selection sort, Greedy: Huffman coding, Fractional knapasack problem, Activity selection Problem, Dynamic Programming: matrix chain multiplication, longest common subsequence, Travelling Salesman Problem, Branch- and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains.
Unit III	Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.
Unit IV	Backtracking: General method, Applications- n-queen problem, Sum of subsets problem, Graph colouring and Hamiltonian cycles. Branch and Bound: General method, applications - travelling salesman problem, 0/1 knapsack problem- LC branch and bound solution, FIFO branch and bound solution.

REFERENCE BOOKS:

1.	"Algorithm Design", J. Kleinberg and E. Tardos, Pearson Education India 2013.
2.	"Algorithms", Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, Tata McGraw Hill, 2017
3.	"Introduction to Algorithms", T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, Prentice-Hall of India Learning Pvt. Ltd., 2010
4	"Combinatorial Optimization: Theory and Algorithms (Algorithms and Combinatorics)", Bernhard Korte and Jens Vygen, Springer, 2018

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YEAR 1- SEMESTER I

CORE COURSE 3 Course code: MSCTCC103 Course Title: RDBMS with SQL	
Credit: 4	
Course Objectives: ✓ The objective of this course is to impart sound knowledge of Database theory and hands-on practical skills to work on various DBMS and RDBMS. ✓ The students are taught to manage data effectively and access efficiently.	
UNIT	TOPICS
Unit I	Database Definition, Purpose of Database, DBMS Versus RDBMS, F. Codd's twelve rules, Database Modelling for a Database, Entities and attributes, Entity-relationship model, Three levels of data abstraction, Characteristics of Database. Data Models, Instances and Schemas, Data Independence. Structure of DBMS. Advantages and Disadvantages of DBMS, Data Dictionary, Database components, Data definition language, Data Manipulation language, Keys: primary keys, candidate keys, composite keys,
Unit II	Generalization and aggregation, Relational Data Model, Network Data Model, Hierarchical Model, Normalization, Transaction Processing and Concurrency Control, Database Recovery concepts, Definition of Transaction and ACID properties, Normalization through Synthesis, Functional dependencies and semantics, Synthesis approach, Synthesis Algorithm, Multivalued Dependencies
Unit III	Study of various Concurrency Control Techniques, Deadlocks, Database security and Authorization, Database Security issues, Views, Clustering, Joins Parallel Databases I/O Parallelism, Inter and Intra Query Parallelism Inter and Intra operation Parallelism, De-normalization for performance, ACID properties
Unit IV	Distributed Database system, Implementation of DDL and DML with Oracle software, Insertion and retrieving records from oracle database, database connection with web application, Relational Database Design, Features of Good Relational Designs, Decomposition using Functional Dependencies, Boyce-Codd normal form, BCNF and Dependency Preservation
REFERENCE BOOKS:	
1.	"Fundamentals of Database Systems", Elmasri, Navathe, Somayajulu and Gupta, , Pearson Education/Addison Wesley, 2006.
2.	"Database System Concepts", Henry F Korth, Abraham Silberschatz, S. Sudharshan, McGraw Hill, 2013.
3.	"An Introduction to Database Systems", Bipin C. Desai, Galgotia Publication, 2017.
4.	"Oracle Database 12c SQL", Jason Price, first Edition, McGraw Hill, 2017.

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YEAR 1- SEMESTER I

CORE COURSE 4 Course code: MSCTCC104 Course Title: Cloud Computing	
Credit: 4	
Course Objectives: ✓ To provide an in-depth and comprehensive knowledge of the Cloud Computing fundamental issues, technologies, applications and implementations. ✓ To expose the students to the frontier areas of Cloud Computing ✓ To motivate students to do programming and experiment with the various cloud computing environments ✓ To shed light on the Security issues in Cloud Computing ✓ To introduce about the Cloud Standards	
UNIT	TOPICS
Unit I	History of Centralized and Distributed Computing - Overview of Distributed Computing, Cluster computing, Grid computing. Technologies for Network based systems- System models for Distributed and cloud computing- Software environments for distributed systems and clouds.
Unit II	Introduction to Cloud Computing- Cloud issues and challenges - Properties - Characteristics- Service models, Deployment models. Cloud resources: Network and API - Virtual and Physical computational resources - Data-storage. Virtualization concepts, Types of Virtualizations, Introduction to Various Hypervisors, High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs.
Unit III	Service models- Infrastructure as a Service (IaaS)- Resource Virtualization: Server, Storage, Network- Case studies. Platform as a Service (PaaS)- Cloud platform & Management: Computation, Storage- Case studies. Software as a Service (SaaS)- Web services- Web 2.0- Web OS- Case studies – Anything as a service (XaaS).
Unit IV	Cloud Access: authentication, authorization and accounting- Cloud Provenance and meta-data- Cloud Reliability and fault-tolerance- Cloud Security, privacy, policy and compliance- Cloud federation, interoperability and standards.
REFERENCE BOOKS:	
1.	"Distributed and cloud computing from Parallel Processing to the Internet of Things", Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, Morgan Kaufmann, Elsevier, 2012
2.	"Cloud Computing Bible" Barrie Sosinsky, John Wiley & Sons, 2010
3.	"Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", Tim Mather, Subra Kumaraswamy, and Shahed Latif, O'Reilly 2009

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YEAR 1- SEMESTER I

CORE COURSE 5
Course code: MSCTCC105
Course Title: RDBMS with SQL(Practical)

Credit: 2

Course Objectives:

- ✓ To train the students to design and implement relational databases, including defining schemas.
- ✓ To understand retrieval and manipulation of data from relational databases using SQL queries, including various join operations.
- ✓ To train students to understand and implement advanced database concepts.
- ✓ To train students to connect and interact with databases from web applications, demonstrating an understanding of database connectivity principles.

Practical Paper

List of exercise based on database (Oracle)

1. Creating Database.
2. Creating database with schema.
3. Implementation of DML and DDL Commands.
4. Implementation of Primary key.
5. Implementation of foreign key.
6. Implementation of Candidate key.
7. Implementation of composite key.
8. Submitting and retrieval of records through firing queries from/to database.
9. Implementation of inner joins.
10. Implementation of left outer joins.
11. Implementation of right outer joins.
12. Implementation of right outer joins. (This appears to be a duplicate)
13. Implementation of full outer joins.
14. Implementation of creating, updating and dropping Views.
15. Implementation of Clustering.
16. Database Connection with web application.
17. Implementation of Database recovery.
18. Implementation of Database extraction and authentication.

REFERENCE BOOKS:

1.	"Fundamentals of Database Systems", Elmasri, Navathe, Somayajulu and Gupta, Pearson Education/Addison Wesley, 2006
2.	"Database System Concepts", Henry F Korth, Abraham Silberschatz, S. Sudharshan, McGraw Hill, 2013.
3.	"An Introduction to Database Systems", Bipin C. Desai, Galgotia Publication, 2017.
4.	"Oracle Database 12c SQL", Jason Price, McGraw Hill, 2017.

YEAR 1- SEMESTER I

VALUE ADDED COURSE (INTRADEPARTMENTAL) Course code: MSCTVA106 Course Title: Mathematical Foundation of Computer Science	
Credit: 2	
Course Objectives: ✓ To study the fundamental concepts of logic, abstract algebra, linear algebra, probability and statistics, graph theory etc.	
UNIT	TOPICS
Unit I	Functional Logic: Propositional Logic, Applications of Propositional Logic, Propositional Equivalence, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Resolution Proof system, Predicate logic Sets, Functions, Sequences & Summations, Cardinality of Sets and Matrices, Matrices Relations and Their Properties and Linear Transformations, Eigen values, Orthogonality, n-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Partial Orderings
Unit II	Probability, Probability Theory, Discrete random variable, Continuous random variable, Bayes' Theorem, Expected Value and Variance, Moment generating function, Markov's inequality, Chebyshev's inequality, The geometric and binomial distributions, The tail of the binomial distribution. Advanced Counting Techniques: Recurrence Relations, Solving Linear Recurrence Relations, Divide-and-Conquer Algorithms and Recurrence Relations, Generating Functions, Inclusion-Exclusion, Applications of Inclusion-Exclusion
Unit III	Graphs, Euler tours, planar graphs, Hamiltonian graphs, Euler's formula, applications of Kuratowski's theorem, graph colouring, chromatic polynomials, trees, weighted trees, the max-flow min-cut theorem.
Unit IV	Turing Machines, Recursive and Recursively Enumerable languages. Cantor's Diagonalization theorem. Complexity classes- NP-Hard and NP-complete Problems- Cook's theorem NP completeness reductions. Approximation algorithms.
REFERENCE BOOKS:	
1.	"Discrete mathematics in Computer Science", Donald F. Stanat and David F. McAllister, Pearson Education, 1977
2.	"Elementary number theory with Applications", Thomas Koshy, Elsevier, 2001
3.	"Introduction to Graph Theory", Douglas B. West, Prentice Hall of India, 2000
4.	"Linear Algebra", Kenneth Hoffman, Ray Kunze, PHI Learning, 2009.