CURRICULUM AND SYLLABI

for

Minor Programme

(Applicable to 2022 admission onwards)

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राष्ट्रीय प्रौद्योगिकी संस्थान गोवा

NATIONAL INSTITUTE OF TECHNOLOGY GOA

कोट्टामल प्लाटू, कुंकोलिम, सालसेट, दक्षिण गोवा, गोवा - ४०३७०३, इंडिया

Kottamoll Plateau, Cuncolim, Salcete, South Goa, Goa- 403703, India

Minor Specialization

in

Computer Science and Engineering

Offered by the

Department of Computer Science and Engineering

Scheme and Curriculum up to VI Semester

Semester Offered	Course Code	Course Name	Type	L-T-P	Credits
IV	CS250M	Fundamentals of Data Structures	MR	3-0-2	4
V	CS300M	Design and Analysis of Algorithm	MR	3-0-0	3
VI	CS350M	Database Management System	MR	3-0-2	4

Detailed Syllabi of courses

Course Code	Course Name	L	T	P	Credits
CS250M	Fundamentals of Data Structures	3	0	2	4

Course Objective

The objective of the course is to introduce the basic concepts of data structures and to develop skills to apply appropriate data structures for designing algorithms to solve problems.

Course Outcomes

At the completion of this course, the student shall acquire knowledge and ability

CO1. Select an appropriate data structure for a particular problem.

CO2. Implement linear and non-linear data structures.

CO3. Implement sorting and sching algorithms using relevant data structures.

CO4. Write programs that makes suitable use of queues, stacks, linked lists, trees, and graphs.

Relationship of Course Outcomes to Program Outcomes

H = High correlation; M = Medium correlation; L = Low correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M							
CO2	H	H	H	H	H							
CO3	H	H	H	H	H							
CO4	H	H	H	H	H							

Syllabus

Module 1: Introduction to data structures, asymptotic notation for complexity analysis, Time and space complexity analysis, Arrays: one dimensional, multi-dimensional, Structures, Union, Recursion, Searching and Sorting Algorithms.

Module 2: Queues: Simple Queue, Circular Queue, Elementary Operations, Applications of Queue.

Stacks: Elementary operations, Applications such as infix to postfix expression conversion, postfix expression evaluation, parenthesis matching.

Module 3: Linked lists: Linear, circular and doubly linked lists, Implementation of stack and queue using linked list.

Module 4: Trees: Basic terminologies, Binary tree, Binary search tree, Balanced trees. Graphs: Basic terminologies, Representation of graphs, Search Algorithms, Shortest path algorithms, Minimum spanning tree.

List of Experiments

1. Implementation of array operations, Structures & Unions
2. Stacks, Queues, Circular Queues, Priority Queues, Multiple stacks, and queues
3. Infix to postfix expression using stack.
4. Implementation of linked lists: stacks, queues
5. Implementation of doubly linked lists
6. Tree traversals
7. Searching and sorting

Reference Books/Material

1. Alfred V Aho, John E Hopcroft, Jeffrey D. Ullman, “Data structures & algorithms”, Pearson, 2013.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, “Introduction to algorithms”, Third Edition, MIT Press, 2009.
3. Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, “Data Structures using C”, Third Edition, Pearson, 2009.
4. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson, 2006.

Course Code	Course Name	L	T	P	Credits
CS300M	Design and Analysis of Algorithms	3	0	0	3

Course Objective

The aim of this course is to provide engineers and scientists with a strong foundation in Design and Analysis of Algorithms. The first part of this course is intended to make students familiar with Asymptotic Notations to analyze algorithms and Divide and Conquer. The second part of this course will provide a detailed introduction to Dynamic Programming. The third part of this course is looking at designing algorithms using Greedy Method. The last part of this course will deal with computationally hard problems and tackling them using approximation algorithms.

Course Outcomes

At the completion of this course, the student shall acquire knowledge and ability to

CO1. Analyze time and space complexities of algorithms

CO2. Identify algorithm design methodology to solve problems.

CO3. Distinguish between P and NP classes of problems.

CO4. Design and analyze approximation algorithms for NP-hard problems

Relationship of Course Outcomes to Program Outcomes

H = High correlation; M = Medium correlation; L = Low correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	H	M		L	L	L	L	H
CO2	H	H	H	M	H	M		L	L	L	L	H
CO3	H	H	H	M	H	M		L	L	L	L	H
CO4	H	H	H	H	H	M		L	L	L	M	H

Syllabus

Module 1: Introduction to Algorithm Analysis, Asymptotic Notations, Divide and Conquer – Master Theorem, Maximum Element in an Unimodal Array, Maximum Subarray Sum Problem, Expected Running Time of Randomized Quick Sort, Strassen's Matrix Multiplication Algorithm, Karatsuba's Large Integer Multiplication, Selection in Worst Case Linear Time

Module 2: Dynamic Programming - Matrix Chain Multiplication Problem, Optimal Binary Search Tree, Rod-Cutting Problem, 0-1 Knapsack Problem, Travelling Salesman Problem, All-Pairs Shortest Paths Problem, Optimal Vertex Cover of a Tree.

Module 3: Greedy Method - Activity Selection Problem, Fractional Knapsack Problem, Correctness and Running Time Analysis of Prim's and Kruskal's Algorithms for Finding Minimum Spanning Tree, Backtracing, Branch and Bound.

Module 4: Complexity Classes - P, NP, NP-hard, NP-complete, Example NP-complete Problems – Clique, Independent Set, Vertex Cover, Approximation Algorithms - Vertex Cover Problem

Reference Books/Material

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI, 2009.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Second Edition, Universities Press, 2011.
3. Michael R. Garey and David S. Johnson, "Computers and Intractability: A Guide the theory of NP-Incompleteness", W.H. Freeman & Co., 1979.
4. Herbert S. Wilf, "Algorithms and Complexity", AK Peters Ltd., 2003.
5. https://www.algorist.com/

Course Code	Course Name	L	T	P	Credits
CS350M	Database Management Systems	3	0	2	4

Course Objective

This course covers the relational database systems RDBS - the predominant system for business, scientific and engineering applications at present. The course includes relational model, entity-relation model, relational algebra, normalization and data access queries as well as an introduction to SQL.

Course Outcomes

At the completion of this course, the student shall acquire knowledge and ability to

CO1. Model Entity-Relationship diagrams for enterprise level databases

CO2. Formulate Queries using SQL and Relational Formal Query Languages

CO3. Apply different normal forms to design the Database and formal design techniques to produce a database schema

CO4. Summarize concurrency control protocols and recovery algorithms

CO5. Hands on with SQL and PL/SQL

Relationship of Course Outcomes to Program Outcomes

H = High correlation; M = Medium correlation; L = Low correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	M	L	L	H	M	M	M
CO2	H	H	H	H	H	M	L	L	H	M	H	M
CO3	H	H	H	M	M	M	L	L	M	M	M	M
CO4	H	H	H	M	M	M	L	L	M	M	M	M
CO5	H	H	M	M	H	M	L	L	M	L	M	M

Syllabus

Module 1 : Introduction: An overview of database management system, database system vs file system, database system concept and architecture, data model schema and instances, data independence and database language and interfaces, (DDL,DML,DCL), overall database structure, database users. Data modelling using the Entity Relationship model: ER model concepts, notation for ER diagram, mapping constraints, keys, specialization, generalization, aggregation, reduction of an ER diagrams to tables, extended ER model, relationship of higher degree.

Module 2 : Relational data Model and Language: Relational data model concepts, integrity constraints, entity integrity, referential integrity, key constraints, domain constraints, relational algebra, Introduction on SQL: Characteristics of SQL, SQL data type and literals, types of SQL commands, SQL operators and their procedure, tables, views, queries and sub queries, aggregate functions, insert, update and delete operations, joins, unions, intersection, minus, cursors, triggers, procedures in SQL/PL SQL.

Module 3 : Data Base Design & Normalization: Functional dependencies, primary key, foreign key, candidate key, super key, normal forms, first, second, third normal forms, BCNF, 4th Normal form,5th normal form, loss less join decompositions, canonical cover, redundant cover, MVD, and JDs, inclusion dependence, transaction processing concept, transaction system, testing of serializability, serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures, log based recovery, deadlock handling.

Module 4 : Concurrency Control Techniques: Concurrency control, locking techniques for concurrency control, 2PL, time stamping protocols for concurrency control, validation based protocol, multiple granularity, multi version schemes and recovery with concurrent transaction. Storage: Introduction, secondary storage devices, tertiary storage, buffering of blocks, structure of files, file organization, indexing and hashing, types of single level ordered indexes, multilevel indexes, dynamics multilevel indexes using B-trees and B+- Trees, database security.

List of Experiments:

1. Defining schemas for applications.
2. Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), Data insertion into a table.
3. Grouping data, aggregate functions, Oracle functions (mathematical, character functions).
4. Sub-queries, Set operations, Joins.
5. Creation of databases, writing SQL and PL/SQL queries to retrieve information from the databases.
6. Procedures, Functions, Cursors, Triggers, Packages, Views and Assertions.
7. Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management;

Reference Books/Material

1. Korth, Silberschatz, "Database System Concepts", 4th ed., TMH, 2003.
2. Elmsari and Navathe, "Fundamentals of Database Systems", 4th ed., A. Wesley, 2004
3. Raghu Ramakrishnan , Johannes Gehrke, " Database Management Systems", 3rd Edition, McGraw- Hill, 2003.
4. J D Ullman, "Principles of database systems", Computer Science Press, 2001.